SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur-603203.

Approved by AICTE, Affiliated to Anna University

CURRICULA AND SYLLABI

B.Tech. AGRICULTURAL ENGINEERING

(Regulations 2023)

B.Tech. AGRICULTURAL ENGINEERING

REGULATIONS – 2023

VISION OF THE INSTITUTE

“Educate to excel in Social Transformation”

To accomplish and maintain international eminence and become a model institution for higher learning through dedicated development of minds, advancement of knowledge and professional application of skills to meet the global demands.

MISSION OF THE INSTITUTE

To contribute to the development of human resources in the form of professional engineers and managers of international excellence and competence with high motivation and dynamism, who besides serving as ideal citizen of our country will contribute substantially to the economic development and advancement in their chosen areas of specialization.

To build the institution with international repute in education in several areas at several levels with specific emphasis to promote higher education and research through strong institute industry interaction and consultancy.

VISION OF THE DEPARTMENT

To produce world class professionals who are equipped to meet the demands of global outfit, have analytical abilities and entrepreneurship for making career of self-employment and as contributors to Livelihood and Food / Nutritional Security.

MISSION OF THE DEPARTMENT

M1: To ensure effective teaching learning process to provide in-depth knowledge of principles and its application pertaining to Agricultural Engineering.

M2: To import practical knowledge to students about the conventional and technology based agricultural systems.

M3: To provide engineering and technology expertise in the field of agriculture for the state and nation.

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To train and educate students with general knowledge and skills in agricultural water management, agricultural production process, farm machinery and farm management.
2. To provide a sound theoretical knowledge in engineering principles applied to agriculture.
3. To prepare students for a successful agricultural engineering career integrating all aspects of engineering in agriculture.
4. To develop innovative capacity of students for increasing agricultural production with scarce water resources available.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Agriculture Engineering Graduates will exhibit ability to:

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering Problems.

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of Mathematics, natural sciences, and engineering sciences.

Design / Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

1. Establish an Agricultural Engineering career in industry, government or academic field and achieve professional expertise as appropriate.
2. Execute innovation and excellence in Agricultural engineering problem solving and design in global and societal contexts.
3. Commit to lifelong learning and professional development in the agriculture engineering field to stay updated in technology, research topics and contemporary issues.
4. Understand the fundamentals of Agriculture engineering in commercial contexts and in expediting irrigation projects.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1.	3	1	1	1	3	3	3	3	3	3	1	3	3	3	2	3
2.	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
3.	1			3	3	3	1	1	3		3	1	3	3	3	2
4.	3			1	3	3	3		3	3	3	3	3	3	3	3

Contribution: **1.Reasonable** **2.Significant** **3. Strong**

		Courses	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO4
Year I	Semester I	Professional English - I	2.2	2.6	2	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
		Matrices and Calculus	3.0	2.0	2.0	1.0	-	-	-	-	-	-	-	1.0	-	-	-	-
		Engineering Physics	2.8	1.4	1.4	1.0	1.0	1.0	1.0	-	-	-	-	1.0	-	-	-	-
		Engineering Chemistry	2.8	1.8	2.2	1.2	1.0	1.0	2.0	-	-	-	-	2.0	1.0	-	-	-
		Basic Electrical and Electronics Engineering	2.8	2.8	1.8	1.7	3.0	2.0	2.0	2.0	-	-	-	-	1.8	1.5	2.5	2.0
		தமிழர் மரபு / Heritage of Tamils																
		Physics and Chemistry Laboratory	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-
		Engineering Practices Laboratory	2.0	1.0	0.8	1.0	1.2	-	1.0	-	-	-	-	1.0	2.0	-	-	-
		English Language Learning Laboratory	3.0	2.0	2.3	2.0	2.3	1.0	-	-	1.0	-	1.0	1.0	-	-	-	-
		Professional English - II	2.0	2.0	1.4	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
		Statistics and Numerical Methods	3.0	3.0	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-
		Physics for Agricultural Engineering	2.6	1.4	1.7	1.6	1	1	1	-	-	-	-	1	-	-	-	-
		Chemistry for Agricultural Engineering	2.4	1.8	2.2	1.6	1.4	1.2	1.6	-	-	-	-	1.2	-	0.8	1	-

Year I	**Semester II**	Problem solving and Python Programming	2.2	2.4	3.0	2.7	1.8	-	-	-	-	-	1.5	2.0	2.0	-	2.0	1.0
		தமிழரும் தொழில்நுட்பமும் / Tamils and Technology																
		Engineering Graphics and Design	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-
		Problem Solving and Python Programming Laboratory	2.0	1.4	1.0	1.0	1.2	2.0	1.5	2.0	-	-	-	-	2.0	-	-	-
		Engineering Sciences	2.0	3.0	3.0	3.0	2.0	-	-	-	-	-	2.0	2.0	1.0	3.0	2.0	2.0
		Laboratory	2.0	-	3.0	-	1.0	-	-	-	1.0	3.0	-	2.0	2.0	1.0	1.0	1.0
		NSS / YRC / NSO / Club Activities#																
Year II	**Semester III**	Transforms and Partial Differential Equations	3.0	3.0	-	-	1.0	-	-	-	-	-	-	1.0	-	-	-	-
		Fluid Mechanics and Open Channel	1.8	2.5	2.3	1.7	-	1.0	1.7	2.0	-	-	1.7	2.6	2.6	1.6	2.4	2.6
		Hydrology and Water Resources Engineering	2.2	2	2.2	1.4	2	1	1	2	1	-	2	2	2	2	2	-
		Soil Science and Engineering	2.8	1.8	1.7	1.0	1.0	2.0	2.0	-	2.0	1.0	-	3.0	2.6	2.5	3.0	2.0
		Theory of Machines for Agricultural Engineering	1.0	2.0	3.0		1.0	-	2.0	1.3	-	-	-	1.5	1.0	2.0	3.0	-
		Surveying and Levelling	2.4	2.5	-	3	1.2	2	2	1.5	2.4	2.4	2	2.2	2.4	1.8	2.5	2.6

		Fluid Mechanics Laboratory	3.0	3.0	2.3	1.7	-	1.0	1.7	2.0	-	-	-	1.7	2.6	1.6	2.4	2.6
		Soil Science Laboratory	1.2	1.3	1.0	2.0	2.0	1.0	1.0	-	1.0	1.0	-	1.5	2.0	2.0	2.2	1.2
		Surveying and Levelling Laboratory	2.6	2.75	2	2	1.2	2	2	1.5	3	2.4	2	2.6	2.8	1.6	2.6	2.6
Year II	**Semester IV**	Applied Mathematics for Agricultural Engineering	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
		Tractors and Farm Engines	2.0	2.0	-	1.0	-	-	-	-	-	-	2.0		2.0	1.0	1.0	-
		Irrigation and Drainage Engineering	1.3	1.0	2.5	1.0	1.5	1.5	3.0	1.0	2.3	1.0	1.5	-	1.3	2.0	3.0	2.5
		Principles and Practices of Crop Production	1.8	1.8	2	2	1	2.4	2.2	1	1.2	-	2	2	2.4	2.2	2	2
		Strength of Materials for Agricultural Engineering	3	1.6	1.8	1	-	1	-	-	-	-	1	1	3	3	1	2
		Thermodynamics for Agricultural Engineering	2.0	2.0	1.0	-	-	-	-	-	-	-	-	1.0	1.0	-	1.0	-
		NCC Credit Course Level - I*																
		Crop Husbandry Laboratory	2.6	1.4	2	2.2	1.6	1	2.6	2	2	1.5	1.8	2.2	2.4	2	2.4	1.4
		Irrigation Field Laboratory	2.0	2.0	1.6	2.0	2.3	1.0	1.5	2.0	1.7	2.4	1.8	2.2	1.6	1.4	2.2	2.0
		Strength of Materials Laboratory	2.7	1.7	2.0	1.0	-	1.0	-	-	-	-	2.0	1.0	3.0	3.0	1.0	-
		Agricultural Structures	2.4	2.6	3	2.4	2	1.6	1.8	1.6	1.4	2.4	2	2	2	2	1	-
		Farm Machinery and Equipment	1.5	1.3	1.7	2.0	2.5	1.5	2.5	1.6	1.4	1.3	2.3	1.4	1.3	2.3	1.8	1.6
		Post-Harvest Technology	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5

Year III	**Semester V**	Unit Operations in Agricultural Processing	2.0	3.0	1.0	1.6	1.0	1.0	1.0	-	-	-	-	1.0	1.0	1.0	1.0	1.0
		Environmental Studies	2.8	1.8	1	1	-	-	-	-	-	-	-	1.8	-	-	-	-
		Design and Drawing of Farm and Irrigation Structures	2	1.5	1.8	1.4	-	-	-	-	-	-	1	1.3	1	-	1.5	2
		Tractors and Farm Machinery Laboratory	2	1.5	1.6	1.0	1.5	1.0	1.5	1.0	1.25	-	1.2	1	1.2	1.6	2.2	2
		Post-Harvest Engineering Laboratory	2.0	2.0	1.6	2.0	2.3	1.0	1.5	2.0	1.7	2.4	1.8	2.2	1.6	1.4	2.2	2.0
Year III	**Semester VI**	Design of Agricultural Machinery	2.0	2.0	3.0	-	-	-	-	1.0	-	-	-	2.0	3.0	3.0	-	-
		Bio - Energy Resource Technology	1.5	2.0	1.0	1.5	-	-	-	-	-	-	1.7	1.3	1.7	1.3	1.5	2.0
		Soil and Water Conservation Engineering	1.5	1.3	1.8	2.0	1.5	-	2.0	2.0	1.0	-	1.5	1.0	2.0	1.0	1.8	2.0
		Cad For Agricultural Machinery	1.5	2.0	2.7	1.0	2.0	1.6	1.8	1.0	1.5	1.5	1.0	2.4	1.6	1.2	2.8	1.8
		Mini Project	1.5	1.7	2.7	2.0	2.0	1.4	1.0	-	2.6	2.2	1.6	2.4	2.0	2.4	2.6	1.8
Year IV	**Semester VII**	Food and Dairy Engineering	1.8	1.0	1.6	2.2	1.6	1.0	1.0	-	-	-	1.3	-	2.0	2.0	2.0	2.0
		Remote Sensing and Geographical Information System	1.5	2.0	2.0	1.7	2.7	1.0	2.0	-	1.0	2.0	2.0	1.3	2.0	1.3	1.3	1.5
		Human Values and Ethics	-	-	1.0	2.0	-	-	1.0	-	-	-	-	-	-	-	-	-
		Food Process Engineering Laboratory	-	1.0	1.6	1.7	1.0	1.5	1.6	-	-	1.0	1.0	2.4	2.5	2.3	2.4	1.6
		Internship (2 Weeks)	2.8	1.8	1.8	1.4	-	-	-	-	2.3	1.5	1.3	2.0	2.2	1.2	1.4	1.8

Year IV	**Semester VIII**	Project Work	2.8	1.8	1.8	1.4	-	-	-	-	2.3	1.5	1.3	2.0	2.2	1.2	1.4	1.8
	Vertical I	Process Engineering of Fruits and Vegetables	2.0	2.5	-	2.0	3.0	2.5	2.4	2.5	-	2.0	-	2.3	2.3	2.7	2.0	2.7
		Food Process Equipment and Design	1.4	1.0	1.6	1.2	1.2	1.2	1.4	1.4	1.2	1.4	1.0	1.6	1.2	1.4	1.4	-
		Food Plant Design and Management	1.4	1.0	3.0	2.0	1.0	2.0	1.0	2.0	-	-	2.6	1.0	2.6	2.6	2.6	-
		Dairy Plant Management	1.6	1.6	1.6	2.2	1.8	1.2	1.0	-	-	-	1.3	-	1.8	1.8	1.8	2.0
		Refrigeration and Cold Storage	3.0	1.6	2.0	1.0	1.2	1.0	1.7	1.0	-	-	1.0	1.0	2.0	2.0	2.0	2.0
		Storage and Packaging Technology	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6
	Vertical II	Production Technology of Agricultural Machinery	2.0	1.6	2.0	1.0	1.2	2.0	1.7	1.0	-	-	1.0	1.0	2.0	1.0	2.0	2.0
		Mechanics of Tillage and Traction	2.3	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	2.0	2.3	2.7	2.0	2.7
		Testing and Evaluation of Farm Machinery and Equipment	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6
		Precision Farming Equipment	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6
		Special Farm Equipment	1.8	1.8	2.0	2.0	1.0	2.4	2.2	1.0	1.2	-	2.0	2.0	2.4	2.2	2.0	2.0
		Human Engineering and Safety In Farm Machinery	2.5	2.0	3.0	-	2.0	2.0	2.0	2.0	2.0	3.0	2.7	2.3	2.0	1.7	2.5	2.5

		Operations																
		Protected Cultivation	1.0	2.0	1.8	1.5	2.5	2.0	2.0	1.0	1.0	1.3	1.0	2.4	2.0	1.4	2.4	2.2
		Groundwater and Well Engineering	2.2	2.0	1.8	1.8	2.4	1.6	2.0	2.8	1.4	1.8	2.0	2.2	1.8	1.8	1.8	1.8
		Micro Irrigation	1.8	1.3	2.0	1.8	2.0	1.7	2.0	1.7	1.5	2.0	1.3	1.7	1.7	1.8	2.0	1.5
	Vertical III	Irrigation Water Quality and Waste Water Management	2.6	2.0	2.0	1.0	2.0	1.5	1.5	1.0	1.0	1.5	2.0	1.3	2.4	1.5	2.7	2.0
		Watershed Planning and Management	2.3	2.0	1.5	3.0	2.7	2.8	1.8	2.4	1.0	2.0	1.5	2.0	3.0	2.5	2.3	1.8
		Climate Change and Adaptation	2.0	2.0	1.0	2.0	2.0	1.8	1.8	-	-	-	-	1.8	1.8	1.5	1.6	1.5
		Principles of Agricultural Economics	1.0	1.4	-	-	1.8	1.0	-	-	-	2.4	3.0	3.0	2.0	1.0	1.4	1.8
		Agricultural Extension	1.4	-	1.0	2.0	2.2	-	-	-	1.5	1.7	1.3	1.3	1.8	1.0	1.0	1.5
	Vertical IV	Agricultural Business Management	2.0	2.3	2.5	1.8	2.0	2.0	2.2	1.3	1.0	2.0	2.0	2.0	1.8	1.8	1.8	-
		Systems Analysis In Agricultural Engineering	2.4	2.4	2.4	2.6	1.8	2.4	2.0	1.8	2.0	1.8	2.6	2.0	2.6	2.2	1.4	1.6
		IOT Application In Agricultural Industry	1.8	1.8	2.0	2.0	1.0	2.4	2.2	1.0	1.2	-	2.0	2.0	2.4	2.2	2.0	2.0
		Automation In Agriculture	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6
		Integrated Farming System	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5
		Organic Farming	2.3	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	2.0	2.3	2.7	2.0	2.7
		Soil Fertility and Fertilizers	1.8	1.0	1.8	1.6	2.6	1.6	2.0	-	1.0	-	-	1.8	1.6	1.6	1.6	1.8
	Vertical V	Landscape Architecture	1.7	1.5	2.0	1.5	1.7	1.3	2.5	1.0	2.0	1.5	1.0	1.2	2.0	1.7	2.0	1.8

		Post - Harvest Technology of Seeds	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5
		Intellectual Property Rights In Agriculture	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5
	Vertical VI	Waste and By-Product Utilization	2.0	2.5	2.0	3.0	1.8	-	2.0	-	2.4	2.0	-	-	2.4	1.8	2.5	1.8
		Biomass Management for Fodder and Energy	1.5	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	1.0	2.0	3.0	2.0	2.7
		Agro - Energy Analysis and Economics	3.0	2.0	2.0	1.0	2.0	1.0	-	-	1.4	1.0	-	1.0	1.4	2.0	2.0	1.4
		Energy Management and Auditing	1.5	1.7	3.0	3.0	1.3	1.0	3.0	2.0	1.5	1.0	-	-	-	-	-	-
		Design and Modeling of Renewable Energy Systems	3.0	2.0	3.0	2.8	2.0	-	-	-	-	-	-	-	-	-	-	-
		Solar and Wind Energy System	1.7	1.6	1.4	1.5	2	2	2.5	-	-	-	2.3	1.8	-	-	-	-

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University, Chennai, 'A' grade accredited by NAAC, NBA accredited ISO 9001: 2015 certified)

B.Tech. AGRICULTURAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULAM BASED ON REGULATIONS 2023

(I - VIII SEMESTERS)

SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EN3111	Professional English – I	HSMC	3	0	0	3	3
2.	MA3122	Matrices and Calculus	BSC	3	1	0	4	4
3.	PH3123	Engineering Physics	BSC	3	0	0	3	3
4.	CH3124	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE3133	Basic Civil and Mechanical Engineering	ESC	3	0	0	3	3
6.	GE3111	தமிழர் மரபு/ Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICAL								
7.	EN3119	English Language Learning Laboratory	HSMC	0	0	2	2	1
8.	GE3121	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9.	GE3134	Engineering Practices Laboratory	ESC	0	0	4	4	2
			Total	**16**	**1**	**10**	**27**	**22**

SEMESTER II

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EN3211	Professional English - II	HSMC	3	0	0	3	3
2.	MA3222	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3224	Physics for Agricultural Engineering	BSC	3	0	0	3	3
4.	CH3224	Chemistry for Agricultural Engineering	BSC	3	0	0	3	3
5.	GE3231	Problem solving and Python Programming	ESC	3	0	0	3	3

6.	GE3211	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1	1
THEORY CUM PRACTICAL								
7.	GE3233	Engineering Graphics and Design	ESC	1	0	4	5	3
PRACTICAL								
8.	GE3221	Engineering Sciences Laboratory	BSC	0	0	4	4	2
9.	GE3232	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
10.	GE3251	NSS / YRC / NSO / Club Activities #	PCD	0	0	0	0#	0#
			Total	**17**	**1**	**12**	**30**	**24**

Conducted after college hours

SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MA3321	Transforms and Partial Differential Equations	BSC	3	0	0	3	3
2.	AG3361	Fluid Mechanics and Open Channel	PCC	3	0	0	3	3
3.	AG3362	Hydrology and Water Resources Engineering	PCC	3	0	0	3	3
4.	AG3363	Soil Science and Engineering	PCC	3	0	0	3	3
5.	AG3364	Theory of Machines for Agricultural Engineering	PCC	3	0	0	3	3
6.	CE3363	Surveying and Levelling	ESC	3	0	0	3	3
PRACTICAL								
7.	AG3365	Fluid Mechanics Laboratory	PCC	0	0	3	3	1.5
8.	AG3366	Soil Science Laboratory	PCC	0	0	3	3	1.5
9.	CE3366	Surveying and Levelling Laboratory	ESC	0	0	4	4	2
			Total	**18**	**0**	**10**	**28**	**23**

SEMESTER IV

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MA3426	Applied Mathematics for Agricultural Engineering	BSC	2	0	0	2	2
2.	AG3461	Tractors and Farm Engines	PCC	3	0	0	3	3
3.	AG3462	Irrigation and Drainage Engineering	PCC	3	0	0	3	3
4.	AG3463	Principles and Practices of Crop Production	PCC	3	0	0	3	3
5.	AG3431	Strength of Materials for Agricultural Engineering	ESC	3	0	0	3	3
6.	AG3432	Thermodynamics for Agricultural Engineering	ESC	3	0	0	3	3
7.	GE3451	NCC Credit Course Level – I*	PCD	0	0	3	3	3
PRACTICAL								
8.	AG3464	Crop Husbandry Laboratory	PCC	0	0	3	3	1.5
9.	AG3465	Irrigation Field Laboratory	PCC	0	0	3	3	1.5
10.	AG3433	Strength of Materials Laboratory	ESC	0	0	3	3	1.5
			Total	**17**	**0**	**9**	**26**	**21.5**

* NCC Credit Course level 1 is offered for NCC students only. The grades earned by the Students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	AG3561	Agricultural Structures	PCC	3	0	0	3	3
2.	AG3562	Farm Machinery and Equipment	PCC	3	0	0	3	3
3.	AG3563	Post-Harvest Technology	PCC	3	0	0	3	3
4.	AG3564	Unit Operations in Agricultural Processing	PCC	3	0	0	3	3
5.	CE3531	Environmental Studies	ESC	2	0	0	2	2
6.	PAGXXX	Professional Elective-I	PEC	3	0	0	3	3

7.	PAGXXX	Professional Elective-II	PEC	3	0	0	3	3
8.	GE3551	NCC Credit Course Level-II#	-	0	0	3	3	3
PRACTICAL								
9.	AG3565	Design and Drawing of Farm and irrigation structures	PCC	0	0	3	3	1.5
10.	AG3566	Tractors and Farm Machinery Laboratory	PCC	0	0	3	3	1.5
11.	AG3567	Post-Harvest Engineering Laboratory	PCC	0	0	3	3	1.5
			Total	**20**	**0**	**9**	**29**	**24.5**

NCC Credit Course level II is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER VI

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	AG3661	Design of Agricultural Machinery	PCC	3	0	0	3	3
2.	AG3662	Bio Energy Resource Technology	PCC	3	0	0	3	3
3.	AG3663	Soil and Water Conservation Engineering	PCC	3	0	0	3	3
4.	PAGXXX	Professional Elective-III	PEC	3	0	0	3	3
5.	PAGXXX	Professional Elective-IV	PEC	3	0	0	3	3
6.	MAN10X	Management Elective	HSMC	2	0	0	2	2
7.	MXXXXX	Mandatory Course-I	MC	3	0	0	3&	0
PRACTICAL								
8.	AG3664	CAD for Agricultural Machinery	PCC	0	0	3	3	1.5
9.	AG3641	Mini Project	EEC	0	0	4	4	2
10.	EN3649	Professional Communications Laboratory	EEC	0	0	2	2	1
			Total	**20**	**0**	**9**	**29**	**21.5**

& Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

Management Elective shall be chosen from the Management Elective Courses.

SEMESTER VII

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	AG3761	Food and Dairy Engineering	PCC	3	0	0	3	3
2.	AG3762	Remote Sensing and Geographical Information System	PCC	3	0	0	3	3
3.	PAGXXX	Professional Elective-V	PEC	3	0	0	3	3
4.	PAGXXX	Professional Elective-VI	PEC	3	0	0	3	3
5.	BA3711	Human Values and Ethics	HSMC	2	0	0	2	2
6.	OXXXXX	Open Elective*	OEC	3	0	0	3	3
7.	MXXXXX	Mandatory Course–II	MC	3	0	0	3 &	0
PRACTICAL								
8.	AG3763	Food Process Engineering Laboratory	PCC	0	0	3	3	1.5
9.	AG3741	Internship (2 Weeks)	EEC	0	0	0	0	1
10.	AG3742	Study Tour	EEC	0	0	0	0	1
			Total	**20**	**0**	**3**	**23**	**20.5**

* Open Elective shall be chosen from the emerging technologies & Mandatory Course-II is a Non-credit Course (Student Shall select one course from the list given under MC-II).

SEMESTER VIII

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
PRACTICAL								
1.	AG3841	Project Work	EEC	0	0	20	20	10
			Total	**0**	**0**	**20**	**20**	**10**

TOTAL NO. OF CREDITS – 167

MANAGEMENT ELECTIVES

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MAN101	Principles of Management	HSMC	2	0	0	2	2
2.	MAN102	Total Quality Management	HSMC	2	0	0	2	2
3.	MAN103	Human Resources Management	HSMC	2	0	0	2	2
4.	MAN104	Entrepreneurship Development	HSMC	2	0	0	2	2

MANDATORY COURSES – I

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MBA101	Introduction to Gender Studies	MC	3	0	0	3	0
2.	MEN101	Elements of Literature	MC	3	0	0	3	0
3.	MBA102	Patent drafting for beginners	MC	3	0	0	3	0
4.	MBA103	Industrial Psychology	MC	3	0	0	3	0
5.	MBA104	Indian constitution	MC	3	0	0	3	0

MANDATORY COURSES – II

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MGE201	Well Being with Traditional Practices - Yoga, Ayurvedha and Siddha	MC	3	0	0	3	0
2.	MGE202	History of Science and Technology in India	MC	3	0	0	3	0
3.	MCY201	Awareness of Cyber Security and Cyber Law	MC	3	0	0	3	0
4.	MME201	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES

VERTICALS

VERTICAL I Food Processing	VERTICAL II Farm Machinery	VERTICAL III Water Management and Protected Cultivation	VERTICAL IV IT and Agricultural Business Management	VERTICAL V Integrated Agriculture	VERTICAL VI Application of Renewable Energy
Process Engineering of Fruits and Vegetables	Production Technology of Agricultural Machinery	Protected Cultivation	Principles of Agricultural Economics	Integrated Farming System	Waste and By-Product Utilization
Food Process Equipment and Design	Mechanics of Tillage and Traction	Groundwater and Well Engineering	Agricultural Extension	Organic Farming	Biomass Management for Fodder and Energy
Food Plant Design and Management	Testing and Evaluation of Farm Machinery and Equipment	Micro Irrigation	Agricultural Business Management	Soil Fertility and Fertilizers	Agro - Energy analysis and Economics
Dairy Plant Management	Precision Farming Equipment	Irrigation Water Quality and Waste Water Management	Systems Analysis in Agricultural Engineering	Landscape Architecture	Energy Management and Auditing
Refrigeration and Cold Storage	Special Farm Equipment	Watershed Planning and Management	IOT Application in Agricultural Industry	Post - Harvest Technology of Seeds	Design and Modeling of Renewable Energy Systems
Storage and Packaging Technology	Human Engineering and Safety in Farm Machinery Operations	Climate Change and Adaptation	Automation in Agriculture	Intellectual Property Rights in Agriculture	Solar and Wind Energy Engineering

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V, VI and VII. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI or VII. The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2023. Clause 19. Total number of courses per vertical may change in each programme of study as 6 or 7 or 8. If there is shortage of courses in a vertical the same may be chosen from another vertical of the same programme.

PROFESSIONAL ELECTIVE COURSES

VERTICALS

VERTICAL I: FOOD PROCESSING

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	PAG101	Process Engineering of Fruits and Vegetables	PEC	3	0	0	3	3
2.	PAG102	Food Process Equipment and Design	PEC	3	0	0	3	3
3.	PAG103	Food Plant Design and Management	PEC	3	0	0	3	3
4.	PAG104	Dairy Plant management	PEC	3	0	0	3	3
5.	PAG105	Refrigeration and Cold Storage	PEC	3	0	0	3	3
6.	PAG106	Storage and Packaging Technology	PEC	3	0	0	3	3

VERTICAL II: FARM MACHINERY AND ENERGY

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	PAG201	Production Technology of Agricultural Machinery	PEC	3	0	0	3	3
2.	PAG202	Mechanics of Tillage and Traction	PEC	3	0	0	3	3

3.	PAG203	Testing and Evaluation of Farm Machinery and Equipment	PEC	3	0	0	3	3
4.	PAG204	Precision Farming Equipment	PEC	3	0	0	3	3
5.	PAG205	Special Farm Equipment	PEC	3	0	0	3	3
6.	PAG206	Human Engineering and Safety in Farm Machinery Operations	PEC	3	0	0	3	3

VERTICAL III: WATER MANAGEMENT AND PROTECTED CULTIVATION

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	PAG301	Protected Cultivation	PEC	3	0	0	3	3
2.	PAG302	Groundwater and Well Engineering	PEC	3	0	0	3	3
3.	PAG303	Micro Irrigation	PEC	3	0	0	3	3
4.	PAG304	Irrigation Water Quality and Waste Water Management	PEC	3	0	0	3	3
5.	PAG305	Watershed Planning and Management	PEC	3	0	0	3	3
6.	PAG306	Climate Change and Adaptation	PEC	3	0	0	3	3

VERTICAL IV: IT AND AGRICULTURAL BUSINESS MANAGEMENT

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	PAG401	Principles of Agricultural Economics	PEC	3	0	0	3	3
2.	PAG402	Agricultural Extension	PEC	3	0	0	3	3
3.	PAG403	Agricultural Business Management	PEC	3	0	0	3	3
4.	PAG404	Systems Analysis in Agricultural Engineering	PEC	3	0	0	3	3
5.	PAG405	IOT Application in Agricultural Industry	PEC	3	0	0	3	3
6.	PAG406	Automation in Agriculture	PEC	3	0	0	3	3

VERTICAL V: INTEGRATED AGRICULTURE

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	PAG501	Integrated Farming System	PEC	3	0	0	3	3
2.	PAG502	Organic Farming	PEC	3	0	0	3	3
3.	PAG503	Soil Fertility and Fertilizers	PEC	3	0	0	3	3
4.	PAG504	Landscape Architecture	PEC	3	0	0	3	3
5.	PAG505	Post - Harvest Technology of Seeds	PEC	3	0	0	3	3
6.	PAG506	Intellectual Property Rights in Agriculture	PEC	3	0	0	3	3

VERTICAL VI: APPLICATION OF RENEWABLE ENERGY

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	PAG601	Waste and By-Product Utilization	PEC	3	0	0	3	3
2.	PAG602	Biomass Management for Fodder and Energy	PEC	3	0	0	3	3
3.	PAG603	Agro - Energy analysis and Economics	PEC	3	0	0	3	3
4.	PEE105	Energy Management and Auditing	PEC	3	0	0	3	3
5.	PEE603	Design and Modeling of Renewable Energy Systems	PEC	3	0	0	3	3
6.	PEE606	Solar and Wind Energy System	PEC	3	0	0	3	3

OPEN ELECTIVE LIST

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	OCS101	IoT and its Applications	CSE& CYS	3	0	0	3	3
2.	OCS102	Machine Learning with R	CSE& CYS	3	0	0	3	3
3.	OCS103	Tamil Computing	CSE& CYS	3	0	0	3	3
4.	OCY101	Cyber Forensic and Investigation	CSE& CYS	3	0	0	3	3

5.	OCY102	Social Media Security	CSE& CYS	3	0	0	3	3
6.	OEC101	Introduction to 5G Communication Networks	ECE&MDE	3	0	0	3	3
7.	OEC102	Introduction to Industrial IoT	ECE&MDE	3	0	0	3	3
8.	OEC103	Arduino Programming and its applications	ECE&MDE	3	0	0	3	3
9.	OMD101	Introduction to Food Processing	ECE&MDE	3	0	0	3	3
10.	OMD102	Introduction to Biomedical Instrumentation	ECE&MDE	3	0	0	3	3
11.	OEE101	Renewable Energy Sources	EEE &EIE	3	0	0	3	3
12.	OEE102	Energy Conservation and Management	EEE &EIE	3	0	0	3	3
13.	OEE103	Electric and Hybrid Vehicles	EEE &EIE	3	0	0	3	3
14.	OEI101	Fundamentals of Robotics	EEE &EIE	3	0	0	3	3
15.	OEI102	Sensors for Engineering Applications	EEE &EIE	3	0	0	3	3
16.	OIT101	Multimedia Technologies	IT&AI-DS	3	0	0	3	3
17.	OIT102	3D Printing and Its Applications	IT&AI-DS	3	0	0	3	3
18.	OIT103	Web Frameworks	IT&AI-DS	3	0	0	3	3
19.	OAD101	Foundation of Data Science	IT&AI-DS	3	0	0	3	3
20.	OAD102	Open source software tools	IT&AI-DS	3	0	0	3	3
21.	OME101	Refrigeration and Air-conditioning	MECH	3	0	0	3	3
22.	OME102	Advanced Manufacturing Processes	MECH	3	0	0	3	3
23.	OME103	Material Testing and Characterization	MECH	3	0	0	3	3
24.	OME104	Hazardous Waste Management	MECH	3	0	0	3	3
25.	OME105	Automotive Engineering	MECH	3	0	0	3	3
26.	OPH101	Advanced Functional Materials	PHY	3	0	0	3	3
27.	OCH101	Nanomaterials and Applications	CHE	3	0	0	3	3

SUMMARY

DEPARTMENT OF AGRICULTURAL ENGINEERING

S.No	Subject Area	I	II	III	IV	V	VI	VII	VIII	Credits Total
1.	HSMC	5	4				2	2		**13**
2.	BSC	12	12	3	2					**29**
3.	ESC	5	8	3	7.5	2				**25.5**
4.	PCC			17	12	16.5	10.5	7.5		**63.5**
5.	PEC					6	6	6		**18**
6.	OEC							3		**3**
7.	EEC						3	2	10	**15**
8.	PCD		1#							**0**
9.	Mandatory Course (Non-credit)						0	0		**0**
	Total	**22**	**24**	**23**	**21.5**	**24.5**	**21.5**	**20.5**	**10**	**167**

TOTAL NO. OF CREDITS – 167

COURSES IN MINOR DEGREE
OFFERED BY DEPARTMENT OF MANAGEMENT STUDIES
DEPARTMENT OF AGRICULTURAL ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FOR B.E / B.TECH (HONOURS) / OPTIONAL COURSES (R2023)

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

Enrolment for B.E. / B. Tech. (Honours) / Minor degree (Optional) A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also. Complete details are available in clause 19 of Regulations 2023.

VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other programmes)

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Block chain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis

VERTICAL I: FINTECH AND BLOCKCHAIN								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM101	Financial Management	PEC	3	0	0	3	3
2	BAM102	Fundamentals of Investment	PEC	3	0	0	3	3
3	BAM103	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4	CSM101	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5	BAM104	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6	BAM105	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM201	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2	BAM202	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3	BAM203	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3	3
4	BAM204	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5	BAM205	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6	BAM206	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL III: PUBLIC ADMINISTRATION								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM301	Principles of Public Administration	PEC	3	0	0	3	3
2	BAM302	Constitution of India	PEC	3	0	0	3	3
3	BAM303	Public Personnel Administration	PEC	3	0	0	3	3
4	BAM304	Administrative Theories	PEC	3	0	0	3	3
5	BAM305	Indian Administrative System	PEC	3	0	0	3	3
6	BAM306	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL IV: BUSINESS DATA ANALYTICS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM401	Statistics For Management	PEC	3	0	0	3	3
2	BAM402	Data Mining For Business Intelligence	PEC	3	0	0	3	3
3	BAM403	Human Resource Analytics	PEC	3	0	0	3	3
4	BAM404	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5	BAM405	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6	BAM406	Financial Analytics	PEC	3	0	0	3	3

VERTICAL V: ENVIRONMENT AND SUSTAINABILITY								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	AGM501	Sustainable infrastructure Development	PEC	3	0	0	3	3
2	AGM502	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3	AGM503	Sustainable Bio Materials	PEC	3	0	0	3	3
4	AGM504	Materials for Energy Sustainability	PEC	3	0	0	3	3
5	AGM505	Green Technology	PEC	3	0	0	3	3
6	AGM506	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3

SEMESTER - I

EN3111	**PROFESSIONAL ENGLISH – I**	**L T P C**
		3 0 0 3

OBJECTIVES:

- To upgrade the English language skills of students by introducing communication techniques, speaking and grammar learning activities which are relevant to authentic contexts.
- To improve the basic reading and writing skills of the learners.
- To enhance the communicative competence of the first-year engineering students.
- To enable learners to use language effectively in academic/work contexts.
- To help learners understand content- context in relevant situations.

UNIT – I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION

Listening: Podcast watching – Listening for new words and pronunciation.

Speaking: Note of appreciation for classmates /family member – formal appreciation of someone, expression of feelings.

Reading: Books, shorts stories to be read. Filling forms (i.e.) post office or bank.

Writing: Film and series Review / Book Review, Email and Informal letters.

Language and Vocabulary development: WH questions, Yes/No questions, Single Word Substitutes, Pronouns, Parts of Speech, Question tags, Prefixes and Suffixes.

UNIT – II NARRATION AND SUMMATION

Listening: Books – Short Stories to be read aloud in class for listening purpose.

Speaking: Short stories to be read and narrated in the class.

Reading: Reading favourite blogs on Travel, Sports and Food and expressing opinions regarding the same.

Writing: Paragraph writing, Report – field trip / I.V., Autobiography and Comprehension.

Language and Vocabulary development: Tenses — Past, Antonyms, Synonyms, Subject Verb agreement and Prepositions.

UNIT – III DESCRIPTION OF A PROCESS/PRODUCT

Listening: Listening to snippets from celebrities/ National leaders' lives.

Speaking: Narrating personal experiences/ events — Expression of emotions and feelings.

Reading: Reading short biographies – famous people and description of the same.

Writing: Instruction, Product / Process description and Advertisements (Normal and Block).

Language and Vocabulary development: Adjectives- Degrees of Comparison, Tenses — Present, Compound Nouns, Homonyms, Homophones and Discourse markers — connective and sequence words.

UNIT – IV CLASSIFICATION AND INTERPRETATION

Listening: Listening to Ted Talks.

Speaking: Recreating a Ted talk session in the class.

Reading: Newspaper Reading (Editorial) and understanding.

Writing: Note making, Blogging, Interpretation of charts and graphs.

Language and Vocabulary development: Articles, Collocations and Phrasal Verbs.

UNIT – V EXPRESSION OF THOUGHTS AND IDEAS

Listening: Listening to audio books and answering questions.

Speaking: Presentation on a non-technical topic.

Reading: Edito, rials from newspaper.

Writing: Essay writing – Descriptive and Narrative essays.

Language and Vocabulary development: Tenses – future, Negative statements and questions, Punctuations, Cause and Effect, Content and Function words.

COURSE OUTCOMES

At the end of the course, learners will be able

1. To strengthen the basics of grammar.
2. To narrate informal and informal situations.
3. To describe a process/product and express opinion.

4. To interpret and analyse the content/information given.

5. To write short essays, personal letters and emails in English.

TEXT BOOKS:

1. English for Science and Technology Cambridge University Press,2021. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deep Mary Francis, Dr.K.N.Shoba and Dr.Lourdes Joevani, Department of English, Anna University.
2. Technical Communication — Principles and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.

REFERENCES:

1. Effective Communication Skill, Kulbhusan Kumar, R.S.Salaria, Khanna Publishing House.
2. Wings of Fire - An Autobiography by A.P.J Abdul Kalam with Arun Tiwari, Sangam Books Ltd , Edition: 50, 1999.
3. World's Most Popular Short Stories Saki Maupassant, Anton Chekhov, O Henry Paperback.
4. Professional Speaking skills, Aruna Koneru, Oxford University Press.
5. English For Engineers and Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020.

EN3111	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	2	2	-	-	-	-	3	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	3	1	1	-	-	-	1
CO3	2	-	2	2	-	-	-	-	-	3	-	1	-	-	1	-
CO4	3	3	-	2	-	-	2	-	-	3	-	-	-	-	1	1
CO5	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	**2.2**	**2.6**	**2.0**	**2.0**	**2.0**	**-**	**2.0**	**-**	**-**	**2.8**	**1.0**	**1.0**	**-**	**-**	**1.0**	**1.0**

MA3122 **MATRICES AND CALCULUS** **L T P C**

3 1 0 4

OBJECTIVES:

- To understand and apply matrix techniques for engineering applications.
- To familiarize the student with basic calculus and traditions of traditional calculus.
- To solve the problems in single and multivariable calculus and plays an important role in science, economics, engineering.
- Vector calculus can be widely used for modeling the various laws of physics.
- To familiarize the student with multiple integrals and their usage in find the area and volume of two and three dimensional objects.

UNIT- I : MATRICES **9L+3T**

Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Reduction of a quadratic form into canonical form by orthogonal transformation.

UNIT- II : DIFFERENTIAL CALCULUS OF ONE VARIABLE **9L+3T**

Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Rolle's Theorem and Mean Value theorem -Taylor's series- Maxima and Minima of functions of one variable.

UNIT- III : DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES **9L+3T**

Partial derivatives - Total derivatives - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT- IV : MULTIPLE INTEGRALS **9L+3T**

Double integrals in Cartesian and polar coordinates - Change of order of integration - Area enclosed by plane curves - Change of variables in Polar coordinates - Triple integrals - Volume of solids.

UNIT- V : VECTOR CALCULUS **9L+3T**

Gradient and directional derivative — Divergence and curl — Vector identities — Irrotational and Solenoidal vector fields – Vector Integration Green's, Gauss divergence and Stoke's theorems — Verification and application in evaluating line, surface and volume integrals.

TOTAL: 45L + 15T PERIODS

OUTCOMES:

- To apply the idea of reducing complex problems into simple form using matrix technique.
- Basic application of single variable calculus in engineering problems.
- This course equips the students to have basic knowledge and understanding of multivariable calculus.
- Basic application of Double and Triple integrals used in Engineering real life problems
- To study Vector Calculus and apply the application of vectors in modeling the various laws of physics

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.3. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd.,11th Edition, 2005.
2. Veerarajan.T, “Engineering Mathematics”, McGraw Hill Education(India) Private Ltd 2019.

REFERENCE BOOKS:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt. Ltd., 2011.
2. James Stewart, " Calculus : Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015
3. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2017.
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.

MA3122	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
CO3	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
CO4	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
CO5	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
Average	**3.0**	**2.0**	**2.0**	**1.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.0**	**-**	**-**	**-**	**-**

PH3123 **ENGINEERING PHYSICS** **L T P C**

(Common to all Branches of B.E. / B.Tech. Programmes) **3 0 0 3**

OBJECTIVES:

- To enhance the fundamental knowledge in crystalline materials and its applications.
- To explore the knowledge in the production of ultrasonic waves and its application.
- To familiarize the basics of laser and its technical advances in scientific, industrial and health care areas.
- To understand the principle of optical fibre and its applications.
- To explore basic concepts of quantum and dual nature of particle.

UNIT- I: PROPERTIES OF MATERIALS **9**

Elasticity - Hooke's law - Stress-strain diagram and its uses - Poisson ratio - factors affecting elastic modulus and tensile strength.

Single crystalline, polycrystalline and amorphous materials - unit cell - space lattice - crystal systems - Bravais lattice - Miller indices - d-spacing - characteristics of unit cell - SC, BCC, FCC and HCP structure - - thermal and mechanical properties of materials - crystal growth techniques - Czochralski and Bridgmann.

UNIT- II: ULTRASONICS **9**

Introduction - properties - Production: Magnetostriction and Piezoelectric method **-** Acoustic grating - determination of ultrasonic velocity in liquid - Application: Detection of flaw in materials (Non Destructive Testing) - ultrasonic soldering, welding - SONAR - diagnostic sonography - cars' air bag sensor - dispersion of fog - Probe sonication for 2D material formation.

UNIT- III: LASER AND ITS APPLICATIONS **9**

Basic concepts and characteristics - Einstein's A and B coefficients (derivation) - population inversion - Pumping methods - Nd-YAG laser - CO_2 laser - Semiconductor lasers: homo junction and heterojunction - applications: laser welding, laser cutting, laser cooling, pattern formation by laser etching, laser bar code scanner - LIDAR - Laser tissue interaction, laser surgery - Holography - NLO - electro-optic effect.

UNIT-IV: FIBRE OPTICS **9**

Structure and principle - propagation of light through optical fibre - acceptance angle, numerical aperture - fractional index change - Types of optical fibres (material, mode and

refractive index) - Attenuation: absorption, scattering and bending - dispersion - fibre optic communication system (Block diagram) and advantages over conventional methods - fibre optic sensors: pressure and displacement - Endoscope.

UNIT-V: QUANTUM PHYSICS **9**

Black body radiation and energy distribution spectrum - Planck's theory of radiation - matter waves - de-Broglie wavelength in terms of energy, voltage and temperature - Electron diffraction - G.P.Thomson experiment - wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - Particle in a one-dimensional box- Normalization of wave function - Quantum Tunnelling - Scanning Tunnelling Microscope.

TOTAL: 45 PERIODS

OUTCOMES:

After completion of this course, the students should be able to

1. To understand the properties of materials, crystalline material and growth techniques.
2. To understand the basics, generation and application of ultrasonics.
3. To acquire knowledge on the concepts of lasers and their applications in industry and medical field.
4. To conversant on principle behind the fibres and their applications in communication and devices made out of optical fibre.
5. To get knowledge on advanced physics concepts of quantum theory and its applications.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
4. Brijlal and Subramanyam, "Properties of Matter", S .Chand publishing, 2002.
5. M.N.Avadhanulu & P.G.Kshirasagar, "A Text Book of Engineering Physics" – IX Edition, S.Chand Publications, 2014.
6. V.Rajendiran, Engineering Physics, Tata McGraw-Hill, New Delhi. 2011.

REFERENCES :

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2010.
3. Shatendra Sharma & Jyotsna Sharma, “Engineering Physics”. Pearson, 2018.

PH3123	PROGRAM OUTCOMES												PSO’s			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	1	-	-	1	1	-	-	-	-	1	-	-	-	-
CO2	3	1	1	1	2	1	1	-	-	-	-	1	-	-	-	-
CO3	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
CO5	2	1	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Average	**2.8**	**1.4**	**1.4**	**1.4**	**1.25**	**1.0**	**1.0**	**-**	**-**	**-**	**-**	**1.0**	**-**	**-**	**-**	**-**

CH3124	ENGINEERING CHEMISTRY	L T P C
	(First semester - Common to all Branches)	3 0 0 3

OBJECTIVES

- To make the students familiar with boiler feed water requirements, related problems and domestic water treatment techniques.
- To introduce the basic concepts and applications of chemical thermodynamics.
- To acquaint the student with the principles of chemical kinetics and its applications towards engineering.
- To make the student conversant with the basics of surface chemistry and catalysis.
- To inculcate the students with the basics principles and preparatory methods of nanomaterials.

UNIT-I : WATER TECHNOLOGY **9**

Introduction-sources of water-impurities present in water-hard water and hardness — types, Municipal water treatment: primary treatment and disinfection - Desalination of brackish water: Reverse Osmosis, Boiler troubles: scale and sludge, caustic embrittlement, boiler corrosion priming and foaming, Treatment of boiler feed water — Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning). External treatment: Ion exchange process, cooling waters (Langelier index).

UNIT – II : CHEMICAL THERMODYNAMICS **9**

Introduction-terminology of thermodynamics, the first law of thermodynamics: enthalpy, second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions: Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions, Criteria of spontaneity; Gibbs- Helmholtz equation, Clausius-Clapeyron equation, Maxwell relations, Van't Hoff isotherm and isochore.

UNIT – III: CHEMICAL KINETICS **9**

Introduction-factors influencing the rate of reaction, order and molecularity of a reaction, kinetic equations of different orders (first, second and third order) - determination of the order of a reaction, the temperature dependence of reaction rates, unimolecular reactions, photochemical reactions and chain reactions, Theories of reaction rates, lasers in chemistry, fast reactions.

UNIT - IV : SURFACE CHEMISTRY AND CATALYSIS **9**

Adsorption: classification - adsorption of gases on solids - adsorption from solutions -

adsorption isotherms - applications of adsorption - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm, B.E.T isotherm. Catalysis: introduction - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid - base catalysis - enzyme catalysis - Michaelis - Menten equation.

UNIT – V : NANOCHEMISTRY **9**

Basics: Distinction between molecules, nanomaterials and bulk materials; Size- dependent properties; Types of nanomaterials: Definition, properties and uses of - nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electrospinning. Applications of nanomaterials in medicine, agriculture, food science and energy resources.

Total Periods: 45

OUTCOMES

At the end of the course, the student should be able:

1. To infer the quality of water from quality parameter data and propose suitable treatment.
2. To apply the knowledge of chemical thermodynamics for material design and aspects
3. To recommend the proper chemical kinetics for engineering processes and applications.
4. To recognize the surface morphology and its engineering applications.
5. To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

TEXT BOOKS

1. Payal B. Joshi and Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
2. Shikha Agarwal, "Engineering Chemistry"-Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.
3. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2021.

REFERENCES

1. R. V. Gadag and A. Nithyananda Shetty, "Engineering Chemistry", 3rd Edition, Wiley & I.K. International (P), LTD, New Delhi, 2019.
2. S.S. Dara and S.S. Umare, "A Text Book of Engineering Chemistry", 12th Edition,

S. Chand & Company LTD, New Delhi, 2018.

3. B. Sivasankar, “Engineering Chemistry”, Tata McGraw-Hill Publishing Company LTD, 2023.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.

CH3124	PROGRAM OUTCOMES												PSO’s			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	3	2	-	1	3	-	-	-	-	2	-	-	-	-
CO2	3	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1		-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	2	1	-	1	-	-	-	-	2		-	-	-
Average	**2.8**	**1.8**	**2.2**	**1.2**	**1.0**	**1.0**	**2.0**	**-**	**-**	**-**	**-**	**2.0**	**-**	**-**	**-**	**-**

GE3131	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L T P C 3 0 0 3

COURSE OBJECTIVES

- To introduce the basics of electric circuits and analysis**.**
- To impart knowledge in the basics of working principles and application of electrical machines.
- To introduce analog devices and their characteristics.
- To educate on the fundamental concepts of digital electronics.
- To introduce the functional elements and working of measuring instruments.

UNIT- I : ELECTRICAL CIRCUITS **9**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor — Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources — Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor — Steady state analysis of RLC circuits (Simple problems only).

UNIT-II : ELECTRICAL MACHINES **9**

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, working principle and Applications of Transformer, three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT- III : ANALOG ELECTRONICS **9**

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

UNIT-IV : DIGITAL ELECTRONICS **9**

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations — minimization using K maps (Simple Problems only).

UNIT-V : MEASUREMENTS AND INSTRUMENTATION **9**

Functional elements of an instrument, Standards and calibration, Operating Principle, types Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. Ability to compute the electric circuit parameters for simple problems
2. Ability to explain the working principle and applications of electrical machines
3. Ability to analyze the characteristics of analog electronic devices
4. Ability to explain the basic concepts of digital electronics
5. Ability to explain the operating principles of measuring instruments

TEXTBOOKS

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020.
2. S.K. Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2017.
3. Sedha R.S., “A textbook book of Applied Electronics”, S. Chand & Co., 2008.
4. James A. Svoboda, Richard C. Dorf, “Dorf’s Introduction to Electric Circuits”, Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.

REFERENCE BOOKS

1. Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.
2. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017.
3. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.
4. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010.

GE3131	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	2	-	-	3	-	-	-	-	-	2	-	2	-
CO2	3	2	-	-	-	2	-	2	-	-	-	-	1	2	-	2
CO3	2	3	2	2	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	1	-	3	-	2	-	-	-	-	-	1	-	3	-
CO5	3	3	2	1	-	-	1	-	-	-	-	-	2	1	-	2
Average	**2.8**	**2.8**	**1.8**	**1.7**	**3.0**	**2.0**	**2.0**	**2.0**	**-**	**-**	**-**	**-**	**1.8**	**1.5**	**2.5**	**2.0**

GE3111 **தமிழர்மரபு** **L T P C**

1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம் **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள்- தமிழ் ஒரு செம்மொழி- தமிழ் செவ்விலக்கியங்கள்- சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் மேலாண்மைக் கருத்துகள்- தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்- சிற்றிலக்கியங்கள்- தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் – சிற்பக் கலை **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை –ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் , பொம்மைகள்- தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள்

அலகு III நாட்டுபுறக் கலைகள் மற்றும் வீர விளையாட்டுகள் **3**

நாட்டுப்புற கதைகள், பாடல்கள்-தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து- ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம்- வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள்- தமிழர்கள் போற்றிய அறக்கோட்பாடு –தமிழ் சங்கம்-சங்கம் வளர்த்த தமிழ்- சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்- சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு இந்தியா மற்றும் வெளிநாட்டின் பிற பகுதிகளின் தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமாரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின்

பங்கு- கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு

Total Periods: 15 Hours

TEXT CUM REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

EN3119 ENGLISH LANGUAGE LEARNING LABORATORY L T P C

0 0 2 1

COURSE OBJECTIVE:

The course aims to

- Enhance the employability and career skills of students.
- Orient the students towards grooming as a professional.
- Make them industry ready.
- Develop their confidence and help them attend interviews successfully.
- Help students to interact confidently in a professional scenario.

UNIT 1: PRONUNCIATION 6

Tone- Pronunciation — Intonation- Reading Aloud and Addressing- Syllable- Rhythm- Accent- Wrongly Pronounced words -Poetry Reading

UNIT 2: NON VERBAL COMMUNICATION 6

Non Verbal Communication - Facial expressions- Eye contact - Subtle (and not so subtle) gestures -Tone of voice — Touch- Posture -Personal space.

UNIT 3: SELF INTRODUCTION AND PRESENTATION 6

Self Introduction- Introducing oneself to the audience- Introducing the Topic — answering questions – Individual Presentation Practice – Presenting Visuals effectively - 5 Minute Presentations.

UNIT 4: BASICS OF SOFT SKILLS 6

Recognizing differences between groups and teams — managing time — networking professionally — Respecting social protocols- understanding career management — Developing a long - term career plan- making career changes.

UNIT 5: GROUP DISCUSSION 6

Introduction to Group Discussion – Participating in Group discussions – Understanding group dynamics – Brainstorming the Topic – Questioning and Clarifying – GD Strategies – activities to improve GD Skills.

TOTAL: 30 PERIODS

COURSE OUTCOME:

At the end of the course, the learners will be able to:

1. Pronounce the words correctly.
2. Understand the nonverbal clues.
3. Make an effective presentation.
4. Adequate soft skills required for the workplace.
5. Participate confidently in Group Discussions.

REFERENCES:

1. Professional Communication by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2014.
2. Soft Skills by S. Hariharan , N. Soundarajaran and S.P. Shanmugapriya MJP Publishers, Edition: 2013
3. Soft Skills for Everyone by Butterfield , Jeff, Cengage Learning India Pvt. Ltd.,2015. New Delhi.

EN3119	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	-	1	-	-	-	-	-	3	-	1	-	-	-	-
CO2	1	1	-	-	-	-	1	-	-	2	-	1	-	-	-	-
CO3	2	2	1	2	2	-	-	-	-	3	-	1	-	-	-	-
CO4	2	1	1	-	-	-	3	-	-	3	-	1	-	-	-	-
CO5	-	1	-	1	-	-	-	-	-	3	-	1	-	-	-	-
Average	**1.6**	**1.2**	**1**	**1.3**	**2**	**-**	**2**	**-**	**-**	**2.8**	**-**	**1**	**-**	**-**	**-**	**-**

GE3121 PHYSICS AND CHEMISTRY LABORATORY L T P C

(Common to all Branches of B.E./B.Tech. Programmes) **0 0 4 2**

PHYSICS LABORATORY (Any five experiments to be conducted)

OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Calculation of lattice cell parameter – X-ray diffraction method.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
3. (a). Compact disc- Determination of width of the groove using Laser.
   (b). Determination of particle size using Laser
4. (a) Determination of wavelength using Laser
   (b) Determination of acceptance angle and numerical aperture in an optical fiber.
5. Determination of Planck's constant using LED.
6. Determination of thickness of a thin wire – Air wedge method
7. Determination of wavelength of mercury spectrum – spectrometer grating
8. Determination of rigidity modulus – Torsion pendulum
9. Determination of Young's modulus by non-uniform bending method.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the students should be able

1. Understand the functioning of various physics laboratory equipment.
2. Use graphical models to analyze laboratory data.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.

4. Access, process and analyze scientific information.
5. Solve problems individually and collaboratively.

REFERENCE

1. Wilson J.D. and Hernaandez Hall C.A.,— Physics Laboratory Experiments, Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, A Text Book of Practical Physics, S. Sultan Chand publications. 2005
3. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

GE3121	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

OBJECTIVES

- To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity, hardness, DO, TDS, chloride, and chlorine.
- To familiarise the students with electroanalytical techniques like conductometry and flame photometry to determine the impurities in aqueous solution.
- To find the various characteristics of domestic water.
- To understand the Pseudo first-order kinetics reaction.
- To make the students know the synthesis of nanoparticles.

LIST OF EXPERIMENTS: (Any five experiments to be conducted)

1. Determination of chloride content of water sample by Argentometric method.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Preparation of Na2CO3 as a primary standard and estimation of acidity of a water sample using the primary standard.
5. Determination of types and amount of alkalinity in water samples.
6. Estimation of available chlorine in bleaching powder solution.
7. Conductometric titration of barium chloride against sodium sulfate (Precipitation titration).
8. Estimation of sodium /potassium present in water using a flame photometer.
9. Estimation of TDS of a water sample by gravimetry.
10. Preparation of nanoparticles (Ag/Au/TiO2/ZnO/CuO).
11. Pseudo first-order kinetics- ester hydrolysis.

TOTAL: 30 PERIODS

OUTCOMES

At the end of the course, the student should be able:

1. To infer the quality of water samples for alkalinity, hardness, DO, TDS, chloride, and chlorine.
2. To apply the knowledge on the estimation of metal ions, acidity and its precipitation nature towards their process.

3. To recognize the threshold limit for various characteristics of domestic water.
4. To identify the simple method of synthesis of nanoparticles.
5. To understand the pseudo first-order kinetics reaction from ester hydrolysis.

TEXTBOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).
2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).
3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

GE3121	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	1	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2.4**	**2.6**	**1**	**1.2**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**

GE3134	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all Branches of B.E./B.Tech. Programmes)	0	0	4	2

COURSE OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools
- To gain the skills for making fitting joints and assembling air conditioner
- To develop the skills for making simple electrical wiring connections using suitable tools
- To provide hands on experience for soldering and gain knowledge about the behavior of electronics components.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **15**

Buildings:

a) Study of plumbing and carpentry components of residential and industrial buildings safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

b) Study of pipe connections requirements for pumps and turbines.

c) Preparation of plumbing line sketches for water supply and sewage works.

d) Hands-on-exercise:

Basic pipe connections — Mixed pipe material connection — Pipe connections with different joining components.

e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry works:

a) Study of the joints in roofs, doors, windows and furniture.

b) Hands-on-exercise:

Wood work, joints by sawing, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE 15

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

b) Gas welding practice - Study

Basic Machining:

a) Facing

b) Simple Turning

c) Step Turning

Sheet Metal Work:

a) Forming & Bending

b) Model making – Trays

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending.

b) Foundry operations like mould preparation for gear and step cone pulley.

c) Assembly of centrifugal pump

d) Assembly of air conditioner

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

1. Residential house wiring using Switches, Fuse, Indicator, Lamp and Energy meter.
2. Fluorescent Lamp Wiring.
3. Staircase Wiring.
4. Measurement of Voltage, Current, Power and Power factor in electrical circuit.
5. Measurement of Energy using Analog & Digital Energy meter.
6. Measurement of Earth Resistance.
7. Study of Industrial house wiring.
8. Identification & Study of protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage.

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of Electronic components and equipments — Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.

2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice — Components, Devices and Circuits — Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

1. Carry out various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. Fabricate carpentry components and pipe connections including plumbing works and use welding equipment's to join the structures.
3. Carry out the basic machining operations, make the models using sheet Metal works. Illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.
4. Carry out basic home electrical works and measure the electrical quantities.
5. Elaborate on the electronics components, gates and soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets
4. Models of industrial trusses, door joints, furniture joints	5 each

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets

7. Moulding table, foundry tools — 2 Sets
8. Power Tool: Angle Grinder — 2 Nos.
9. Study-purpose items: centrifugal pump, air-conditioner — One each
10. Fitting tools, Hack saw frame, 12' file, hack saw blade — 15 Nos.

ELECTRICAL

1. Assorted electrical components for house wiring — 15 Sets
2. Fluorescent Lamp — 15 Sets
3. Electrical measuring instruments — 10 Sets
4. Analog & Digital energy meter — 5 Sets
5. Megger — 2

ELECTRONICS

1. Soldering guns — 10 Nos.
2. Assorted electronic components for making circuits — 50 Nos.
3. Small PCBs — 10 Nos.
4. Multimeters — 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply.

GE3134	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
CO2	-	1	2	-	3	-	-	-	-	-	1		-	-	-	-
CO3	-	-	-	3	2	-	-	-	-	-	-	1	-	-	-	-
CO4	-	2	3	1	2	-	-	-	-	-	-		-	-	-	-
CO5	-	3	2	2	-	-	-	-	1	-	-		-	-	-	-
Average	3.0	2.0	2.3	2.0	2.3	1.0	-	-	1.0	-	1.0	1.0	-	-	-	-

SEMESTER - II

EN3211	PROFESSIONAL ENGLISH – II	L T P C
		3 0 0 3

OBJECTIVES

The course prepares the second semester Engineering students

- To develop strategies and techniques to enhance their reading skills.
- To engage them in meaningful activities in order to improve their listening, speaking, reading and writing skills.
- To improve their ability to write effective job application, resumes and draft impressive reports.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To participate in group discussions.

UNIT – I: MAKING COMPARISON 9

Listening: Clippings of Ted talk, cartoon and interviews of sports personalities for listening and discussion.

Speaking: Descriptions and discussions based on newspaper.

Reading: Learning shades of meaning (using Thesaurus) and inferring the context from general passages.

Writing: Compare & Contrast essays and Jumbled Sentences.

Language and Vocabulary development: Prepositional phrases, contextual meaning of words. Verbal Analogy, Same word used as Noun and Verb.

UNIT – II: EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 9

Listening: Anecdotes to be read from books like Chicken Soup books. Evaluative listening — Advertisement and Product description.

Speaking: Marketing a product, persuasive speech

Reading: Description of any product / jewellery, Brochures and Manual.

Writing: Formal letters- letters of complaint, appreciation, and suggestion, Comprehension and E-mail (formal)

Language and Vocabulary development: Active & Passive, Infinitive, Gerund, Purpose Statements, Adverbs and Word formation

UNIT – III: ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 9

Listening: Listen to English songs and find the lyrics/new words

Speaking: Role play and Interviews

Reading: Reading magazine articles, Excerpts from literary texts

Writing: Job Application, Resume, Cover letter, SWOC Analysis and Recommendations.

Language and Vocabulary development: Correction of errors, If conditional, Sentence completion and Connotations.

UNIT – IV: ANALYZING PROBLEMS AND EXPRESSING SOLUTIONS 9

Listening: Watching Stand-up comedies and comprehending ideas expressed there.

Speaking: Speak about the Stand-up comedies viewed and express personal views about the same

Reading: Reading different types of books (novels, short stories, biographies, magazines etc. and speaking about the same.

Writing: Dialogue Writing, Checklist and Problem Solving essays.

Language and Vocabulary development: Reported Speech, Modals, Slogan writing and Conjunctions.

UNIT – V: REPORTING EVENTS 9

Listening: Listening to spot errors, listening to varied dialects and accents of English.

Speaking: Group discussion- Expression of opinions, assertion, coercion etc.

Reading: Reading life experiences of common man from magazines.

Writing: Accident Report / Survey Report and Letters to the Editor.

Language and Vocabulary development: Numerical Adjective, Idioms, Vocabulary – Shades of Meaning.

TOTAL: 45 PERIODS

COURSE OUTCOME

At the end of the course, learners will be able to

1. To compare and contrast ideas and information from technical texts.
2. To incorporate basic grammar structures to express appreciation, suggestion and complaint in writing**.**
3. To draft effective resumes using appropriate vocabulary and to avoid common errors.
4. To analyse problems so as to arrive at appropriate solutions and to communicate relevantly.
5. To draft technical reports, letters and to express ideas creatively.

TEXT BOOKS:

1. English for Science and Technology Cambridge University Press,2021. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deep Mary Francis, Dr.K.N.Shoba and Dr.Lourdes Joevani, Department of English, Anna University.
2. Technical Communication — Principles and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.
3. Technical English for Professional — Advanced by C. Gangalakshmi, B. Rathika and L. Saranraj, Cengage Learning India Pvt. Ltd.,2022.

REFERENCES:

1. Learning to communicate — Dr. V. Chellammal, Oxford Univ.Press,2001 New Delhi.
2. Business Correspondence and Report Writing by Prof. R. C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.
4. Improve Your Writing ed. V.N Arora Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
5. English For Engineers and Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020.

EN3211	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	1	2	1	-	-	-	-	-	3	-	1	-	-	-	-
CO2	2	2	1	2	2	-	-	-	-	3	1	1	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-
CO4	2	3	2	3	-	-	2	-	-	3	-	-	-	-	-	-
CO5	2	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	2.0	2.0	1.4	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-

MA3222 STATISTICS AND NUMERICAL METHODS L T P C

3 1 0 4

OBJECTIVES:

- This course aims at providing the necessary basic concepts of statistical and Numerical Methods for solving numerically different problems of engineering and Technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT- I: STATISTICAL HYPOTHESIS TESTS 9L+3T

Sampling distributions - Tests for single mean and difference of means (Large and small samples) — Tests for single variance and equality of variances — Chi square test for goodness of fit — Independence of attributes.

UNIT- II : EXPERIMENTAL DESIGN FOR ANOVA 9L+3T

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT-III: SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9L+3T

Solution of algebraic and transcendental equations - Fixed point iteration method — Newton - Raphson method - Solution of linear system of equations - Gauss elimination method — Pivoting - Gauss Jordan method — Iterative method of Gauss Seidel — Dominant Eigenvalue of a matrix by Power method.

UNIT-IV: INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9L+3T

Lagrange's and Newton's divided difference interpolations — Newton's forward and backward difference interpolation — Approximation of derivates using interpolation polynomials – Numerical integrations using Trapezoidal, Simpson's rules.

UNIT-V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9L+3T

Single step methods: Taylor's series method - Euler's method - Modified Euler's method Fourth order Runge-Kutta method for solving first order equations - Multi step methods: Milne's and Adams -Bash forth predictor corrector methods for solving first order equations.

TOTAL: 45L+15T PERIOD

OUTCOMES:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering application.

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi,2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition,2015.

REFERENCE BOOKS:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald.C.F., Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, NewDelhi, 2006.

MA3222	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Average	**3.0**	**3.0**	-	-	-	-	-	-	-	-	-	-	**1.0**	-	-	-

PH3224	PHYSICS FOR AGRICULTURAL ENGINEERING	L	T	P	C
	(For Second Semester- B.Tech.Agricultural Engineering)	3	0	0	3

OBJECTIVES:

- To understand the basic properties of soil.
- To enrich the idea of artificial means of growing plants.
- To understand various methods involved in energy harvesting.
- To explore various Physics principles used in agriculture techniques.
- To facilitate the basics of nanotechnology used in agriculture.

UNIT - I: BASICS OF SOIL PHYSICS **9**

Poly-phase system of soil - components of soil - soil profile-Physical properties: Soil texture, mass- volume relationship- Soil structure: aggregation-porosity- pore size distribution- Soil water measurements- Soil water potential- Rheological properties and transport phenomena: stress -strain relations - soil moisture -movements- surface tension - contact angle -Evaporation and solution diffusion-osmosis and osmotic pressure-factors affecting soil temperature and its importance to plant growth.

UNIT- II: PHYSICS OF PRECISION FARMING AND IOT **9**

Planting techniques: vertical farming- hydroponics-Indoor farming-plant environment interactions- Solar radiation and transpiration - greenhouse effect- light- temperature- relative humidity- Precision farming principles-IoT devices- Unmanned Aerial Vehicles (UAVs)- Drones in Agriculture -Types and Properties of Crops Monitored-Basic components of remote sensing- signals, sensors and sensing systems; active and passive remote sensing- Liquid Level Sensors.

UNIT- III: PHYSICS OF ENERGY HARVESTING **9**

Energy sources – Classification – Biomass and its types - Energy from Biomass-Types of biogas plants-constructional details.-Principles of combustion, pyrolysis, gasification and briquetting (qualitative). Wind energy-Types of wind mills, Constructional details and application - Solar energy applications - grain dryers- Refrigeration system- ponds- fencing- pumping systems.

UNIT- IV: PHYSICAL TECHNIQUES IN AGRICULTURE **9**

Basics in Sensing by Electromagnetic Radiation - Emission, Absorbsion, Reflection and Transmission of Radiation-sensing the electrical conductivity of soil- Chlorophyll fluorescence-steady state and non-steady state - Application of X-ray computed tomography to soil science. Infrared radiometer — sensing water supply of crops

transpiration of crops. Sensing techniques in topography-. Soil thermometers-soil heat flux plates, instruments for measuring soil moisture.laser land leveller.

UNIT –V: NANO TOOLS FOR AGRICULTURE 9

Nano materials - properties- -nanofibers-nanowires- biomass waste based nanomaterials-fluroscent C-dots- nano sensors-nano biosensors- nanosmart dust and gas nanosensors-fluorescent dye biosensors- magnetic nanoparticle based sensors-nanophoto semiconductors.

TOTAL: 45 PERIODS

OUTCOMES:

After completion of the course, the students should be able

1. To understand the physical properties and transport phenomena of soil.
2. To apply the concepts of artificial means of growing crops.
3. To apply the physics principles for energy harvesting.
4. To understand the basics of em radiation and apply knowledge for crop growth.
5. To know the concepts and applications of nano materials in agriculture.

TEXT BOOKS:

1. Hand book of Solar Energy, G.N. Tiwari, AravindDivari, Shyam, Springer Publications.
2. Principles of Soil Physics, Rattan LalManoj K .Shukla, New York: Marcel Dekker; London: Taylor & Francis, 2004.
3. Environment Problems and Solution, D. K. Asthana and M. Asthana ,S.Chand Publications.
4. Agricultural Physics, Vikas Singh, Vikas Publications. Bioscientific Publisher Edition: 1, 2017.
5. Precision Farming, Sharma P, Daya Publishing House New Delhi, 2007.

REFERENCES:

1. Non-Conventional Energy Sources,Rai, G.D. Khanna Publishers, New Delhi, 2013.
2. Non-Conventional Energy Resources, B. H. Khan, The McGraw Hill Publishers.
3. Principles of Agricultural Engineering, Michael, A.M. and T.P. Ojha. Volume II. 4th Edition, Jain Brothers, New Delhi, 2003.
4. Soil Physics, Jury, W.A., Gardner, W. and Horton, R., John Wiley and Sons, New York, 2004.
5. Agricultural Nanobiotechnology Modern Agriculture for a Sustainable Future, Fernando López-Valdez FabiánFernández-Luqueño Editors , Springer Nature Switzerland AG

2018.

PH3224	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	1	2	1	1	-	-	-	-	-		1	-	-	-	
CO3	3	2	2	2	1	-	1	-	-	-	-	1	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-
CO5	1	1	1	-	1	1	1	-	-	-	-	1	-	-	-	-
Average	2.6	1.4	1.7	1.6	1	1	1	-	-	-	-	1	-	-	-	-

CH3224	CHEMISTRY FOR AGRICULTURAL ENGINEERING	L	T	P	C
	(Second Semester-B.Tech., Agricultural Engineering)	3	0	0	3

OBJECTIVES

- To understand the biological functions and nutritional importance of carbohydrates, protein, fat, amino acid, starch, gum & dietary fibres, and vitamins.
- To improve biofertilizer technology to ensure high quality and to demonstrate an understanding of the biological compost process.
- To provide a foundation for understanding the principles of nuclear energy, solar cell and batteries for designing and operation.
- To understand the elements of a healthy soil ecosystem to increase soil fertility in crop production.
- To gain knowledge on working principles and theory of instruments for analysis of samples.

UNIT I FOOD CHEMISTRY & MICROBES **9**

Food chemistry: definition, scope and importance of carbohydrate, protein, fat, amino acid, starch, gum & dietary fibres, vitamins in the food, enzymatic & non-enzymatic browning reaction. Contribution to texture, flavour and organoleptic properties of food, food additives - functions. FSSAI: role and function,Microbes: definition, food as a substrate for microorganisms, factors affecting the growth of microbes- pH and water activity.

UNIT II FERTILIZERS AND COMPOST **9**

Chemical fertilizers: classification, composition, manufacturing and properties of major nitrogenous, phosphatic, and potassic fertilizers - secondary and micronutrient fertilizers, complex fertilizers, nano fertilizers, biofertilizers - constraint in the application of biofertilizers. Manures: sources and production.Compost: different composting technologies-mechanical compost plants - vermicomposting.

UNIT III ENERGY STORAGE SYSTEMS **9**

Introduction - nuclear energy - light water nuclear power plant - breeder reactor, solar energy conversion, solar cells- principle, working and applications. Types of batteries - primary battery (alkaline battery), secondary battery (lead acid battery, NICAD battery, lithium-ion battery), fuel cells (H2-O2 fuel cell). Supercapacitors: storage principle, applications. Electric vehicles-working principle.

UNIT IV ELEMENTS IN SOIL **9**

Chemistry of soil (nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients) - source, form, and their behaviour - agricultural significance - biotic factors in soil development, microbial toxins in the soil- factors affecting their availability in soil.

UNIT V ANALYTICAL TECHNIQUES **9**

Introduction, absorption of radiation, types of spectra, UV-Visible, IR spectrophotometer and atomic absorption spectrophotometer (AAS): Instrumentation (block diagram) and applications. Thin layer chromatography (TLC), gas chromatography, high-performance liquid chromatography (HPLC): working principle and applications, C,H,N,O analyser.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student should be able:

1. To apply the gained knowledge on biological functions of carbohydrates, protein, fat, amino acid, starch, gum & dietary fibres, and vitamins.
2. To recommend the utilization of manures, and biofertilizers to increase soil fertility through various approaches.
3. To utilize different renewable sources in the agriculture sector.
4. To identify the physical and chemical properties of soil and their effect on plant health.
5. To get experience in advanced analytical and instrumentation methods in the estimation of elements in the soil.

TEXTBOOKS:

1. D.B. Ray, “Introductory Agricultural Chemistry”, Bioscientific Publisher, Karnataka, 2017.
2. D.S. Yashona, S.B. Aher, “Soil Science and Agricultural Chemistry” NIPA, New Delhi, 2021.
3. J. J. F. Weir,“Elements of Agricultural Chemistry”,AgriHorti Press, New Delhi, 2022.

REFERENCES

1. Rakshit, PriyankarRaha,Nirmal De, Manures Fertilizers and Pesticides. CBS Publishing,Chennai, 2015.
2. Rai G.D, “Non-conventional Energy Sources”, Khanna Publishers, New Delhi,2000.
3. GopalRanjan and A.S.R Rao, “Basic and Applied Soil Mechanics”, New Age International (P) Limited, New Delhi, 2000.

4. L. G. Hargis, “Analytical Chemistry: Principles and Techniques,” Prentice Hall International Editions, Upper Saddle River, 1988.

CH3224	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	1	1	1	2	-	-	-	-	2	-	2	1	-
CO2	2	1	2	1	1	2	2	-	-	-	-	2	-	2	1	-
CO3	2	2	2	2	1	1	2	-	-	-	-	1	-	-	1	-
CO4	3	2	2	1	1	2	2	-	-	-	-	1	-	-	1	-
CO5	3	2	3	3	3	-	-	-	-	-	-	0	-	-	1	-
Average	2.4	1.8	2.2	1.6	1.4	1.2	1.6	-	-	-	-	1.2	-	0.8	1	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

GE3231 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

(Common to All branches) **3 0 0 3**

OBJECTIVES:

- To know the basics of Python programming
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures and its implementation – lists, tuples,dictionaries.
- To understand Object Oriented Concept in Python.

UNIT – I : PYTHON BASICS 9

Introduction to Python — Literals — Variables and Identiiers — Data Types — Input Operation – Comments – Reserved words – Indentation – Operators and Expressions — Modes of python. Conditionals: Boolean values and operators - conditional if - alternative if - chained conditional - Iteration, Illustrative programs: Basic Arithmetic Operations, GCD of numbers, Square root (Newton's Method).

UNIT- II : FUNCTIONS, LIST, TUPLES 9

Functions, function definition and use. **Fruitful functions:** return values, parameters, local and global scope, recursion. **Lists:** list operations, list slices, list methods, list loop, mutability, list parameters; **Tuples:** tuple assignment, tuple as return value. Comparison of Lists and tuples. Illustrative programs: exchange the values of two variables, square root, Linear and Binary search. Fibonacci series using functions.

UNIT – III : STRINGS, DICTIONARY, SET 9

Strings: string slices, immutability, string functions and methods, string module. **Dictionaries:** Operations (create, access, add, remove) and methods. (Insert, delete).Set operation (Access, Add, Remove). Illustrative programs: creates a dictionary of radius of a circle and its circumference.

UNIT- IV : FILES, EXCEPTIONS, MODULES AND PACKAGES 9

Files and exception: Text Files, Reading and Writing files, Format operator; Errors and

Exceptions, Handling Exceptions, Multiple Except blocks, Modules, Packages; Illustrative programs: word count, copy file, Creating user defined Exceptions.

UNIT- V : CLASSES AND OBJECTS **9**

Classes and Objects: Introduction, Classes and Objects, Defining Classes, Creating Objects, Data Abstraction and Hiding, The Class Method and Self Argument, The _init_( ) method, Class Variables and Object Variables, Public and Private data members, Private Methods. Illustrative Programs: Creating Student Class and Objects.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, learners will be able to:

- Develop simple computational problems using control flow statements.
- Decompose a Python program into functions, Modules and Packages.
- Represent compound data using Python lists, tuples, Strings, Set and dictionaries.
- Read and write data from/to files and Exception handling in Python Programs.
- Understand the concepts of Object Oriented Programming.
- To develop real time applications.

TEXT BOOKS:

1. Reema Thareja, **"Python Programming using Problem solving Approach",** Oxford Higher Education,2018.
2. Allen B. Downey, **"Think Python: How to Think Like a Computer Scientist"**, 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
3. Guido van Rossum and Fred L. Drake Jr, **"An Introduction to Python"** — Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. Charles Dierbach, **"Introduction to Computer Science using Python: A Computational Problem-Solving Focus"**, Wiley India Edition, 2013.

2. John V Guttag, **"Introduction to Computation and Programming Using Python''**, Revised and expanded Edition, MIT Press , 2013

3. Kenneth A. Lambert, **"Fundamentals of Python: First Programs"**, CENGAGE Learning, 2012.

4. Paul Gries, Jennifer Campbell and Jason Montojo, **"Practical Programming: An Introduction to Computer Science using Python 3"**, Second edition, Pragmatic Programmers,LLC,2013.

5. Robert Sedgewick, Kevin Wayne, Robert Dondero, **"Introduction to Programming in Python: An Inter-disciplinary Approach"**, Pearson India Education Services Pvt. Ltd., 2016.

WEB REFERENCES:

1. http://greenteapress.com/wp/think-python/

2. www.docs.python.org

3. https://nptel.ac.in/courses/106/106/106106182/

GE3231	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	2	-	-	-	-	-	2	2	2	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	2	2	-	-	3	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	1	-
CO4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	2	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	1
CO6	2	2	-	-	2	-	-	-	-	-	1	-	1	-	-	-
Average	**2.3**	**2.5**	**3**	**2.7**	**1.8**	**-**	**-**	**-**	**-**	**-**	**1.5**	**2**	**2**	**-**	**2**	**1**

GE3211 தமிழரும் தொழில்நுட்பமும் L T P C

1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் : 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு. சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ – சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில்நுட்பம் : 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாகச் செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் : 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் : 3

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி / வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by : International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of river Vaigal' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by : The Author)
11. Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) – Reference Book.

GE3211 TAMILS AND TECHNOLOGY L T P C

1 0 0 1

UNIT- I : WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during sangam Age — Ceramic technology — Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Priod – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold — Coins as source of history — Minting of Coins — Beads making — Industries Stone beads — Glass beads — Terracotta beads — Shell beads / bone beats — Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Perio, Animal Husbandry — Wells designed for cattle use — Agriculture and Agro Processing — Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil — Tamil computing — Digitalization of Tamil Books — Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி / வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)
6. Social Life of the Tamils — The Classical Period (Dr.S.Singaravelu) (Published by : International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of river Vaigal' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by : The Author)
11. Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) — Reference Book.

GE3233 ENGINEERING GRAPHICS AND DESIGN L T P C

(Common to all branches of B.E. / B.Tech. Programmes) **1 0 4 3**

OBJECTIVES:

The main learning objective of this course is to impart knowledge

1. To draw the conics curves and special curves.
2. To draw the orthographic projection of lines and plane surfaces.
3. To draw the projections and solids and Isometric projection of simple solids.
4. To draw the projections and solids and Isometric projection of simple solids.
5. To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT- I: PLANE CURVES AND SPECIAL CURVES 11

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid (Rolling Circle rolls on flat surface only). construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT- II: PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

Orthographic projection- Principles-Principal planes - First angle projection-projection of points at the First Quadrant only. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) which inclined to both the principal planes by rotating object method.

UNIT- III: PROJECTION OF SOLIDS AND ISOMETRIC PROJECTION 12

Projection of simple solids like prisms, pyramids, cylinders and cones when the axis is inclined to one of the principal planes by the rotating object method. Principles of isometric projection — isometric scale — Isometric projections of simple solids - Prisms, pyramids, cylinders, cones - isometric view of the object from the 2D coded plan.

UNIT- IV: PROJECTION OF SECTIONED SOLIDS & DEVELOPMENT OF SURFACES **12**

Sectioning of the above solids in the simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining the true shape of the section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

UNIT- V: FREE-HAND SKETCHING AND PERSPECTIVE PROJECTIONS **12**

Free Hand sketching: Visualization principles — Representation of Three-Dimensional objects — Layout of views- Free hand sketching of multiple views from pictorial views of objects. Perspective projection of simple solids-Prisms and pyramids by visual ray method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able:

1. To construct the conics curves and special curves.
2. To construct the orthographic projection of lines and plane surfaces.
3. To construct the projections and solids and Isometric projection of simple solids.
4. To construct projections of section of solids and development of surfaces.
5. To construct free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

TEXTBOOKS:

1. N.D.Bhatt, “Engineering Drawing (Plane and Solid Geometry)”, Charotar Publishing House PVT. LTD. 53rd Edition 2019 (Fifth Reprint).
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 15th Edition 2018.

REFERENCES :

1. T. Jeyapoovan, “Engineering Graphics Using Auto CAD”, Vikas Publishing House Pvt. LTD, seventh Edition, 2015.
2. Luzzader, Warren.J. and Duff, John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2011.

4. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2011.

5. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scales to fit solutions within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

GE3233	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
CO2	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
CO3	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
CO4	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
CO5	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
Average	2.0	-	3.0	-	1.0	-	-	-	1.0	3.0	-	2.0	2.0	1.0	1.0	1.0

GE3221 ENGINEERING SCIENCES LABORATORY L T P C

0 0 4 2

PHYSICS LABORATORY

OBJECTIVES:

- To gain practical knowledge and to co-relate with the theoretical studies.
- To achieve perfectness in experimental skills and the study of practical applications.
- To bring more confidence and ability to develop and fabricate engineering and technical equipment.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of the electrical conductivity of metals by plotting a current-voltage characteristic curve.
2. Determination of band gap of a semiconductor.
3. Determination of Fermi energy. (Measurement of Fermi energy in copper).
4. Study of I-V characteristics of solar cell and determination of its efficiency
5. Determination of electrical resistivity of metal and alloy –Carey foster Bridge.
6. Measurement of susceptibility of paramagnetic solution by Quinke's method.
7. Study of magnetic Hysteresis-B-H curve.
8. Determination of the dark resistance of light detective resister (LDR).
9. Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the students should be able

1. To understand the functioning of various physics laboratory equipment.
2. To use graphical models to analyze the laboratory data and to solve problems individually and collaboratively.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.

4. Access, process and analyze scientific information.
5. Solve problems individually and collaboratively.

TEXTBOOKS:

1. Wilson J.D. and Hernandez C.A., —Physics Laboratory Experimentsǁ, Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, A Text Book of Practical physics, S. Sultan Chand publications. 2005
3. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

GE3221	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-		-	-	-		-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2.4**	**2.6**	**1**	**1**											

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

OBJECTIVES

- To train the students in basic experimental skills in water contaminants such as copper and chromium.
- To familiarise the students with electroanalytical techniques such as pH metry, potentiometry, and conductometry to determine impurities in aqueous solutions.
- To familiarize the students with the determination of the molecular weight of a polymer by a viscometer.
- To make the student up-to-date with the properties and nature of alloys experimentally.
- To demonstrate the analysis of coal.

LIST OF EXPERIMENTS: (Any five experiments to be conducted)

1. Estimation of copper content of the given solution by Iodometry.
2. Determination of strength and amount of acids in a mixture of acids using a conductivity meter.
3. Determination of strength and amount of HCl present in the whole of the given solution using a conductivity meter.
4. Estimation of the iron content of the given solution using a potentiometer.
5. Determination of chromium by EDTA titration.
6. Determination of strength of given hydrochloric acid using a pH meter.
7. Determine the molecular weight of the polyvinyl alcohol using an Ostwald viscometer.
8. Estimation of Nickel in steel.
9. Proximate Analysis of Coal.
10. Corrosion experiment-weight loss method.
11. Determination of COD value of industrial effluents.

TOTAL: 30 PERIODS

OUTCOMES

At the end of the course, the student should be able:

1. To find the quality of water samples for copper and chromium present in water.

2. To recognize the amount of various ions present in the water sample through volumetric and instrumentation techniques.
3. To identify the molecular weight of the polymer using an Ostwald viscometer.
4. To recognize an environmental hazardous and threshold limit for industrial effluents.
5. To recommend quality of coal and steel when it is exposed to various environment.

TEXT BOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).
2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).
3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

GE3221	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	1	1	1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-
CO3	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	1	1	2	2	2	-	-	-	-	-	-	-	-
CO5	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	**2**	**1.4**	**1**	**1**	**1.2**	**0.4**	**0.6**	**0.4**	**-**	**-**	**-**	**-**	**-**	**0.4**	**-**	**-**

GE3232	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L T P C 0 0 4 2

COURSE OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.
- Knowing about Object Oriented Concepts.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number. (Newton's method)
3. Find exponentiation of a number. (power of a number)
4. Find the maximum of a list of numbers.
5. Program for basic calculator operations using functions.
6. Generate Fibonacci series using function.
7. Program for Armstrong number.
8. Program for check the number is Palindrome or Not.
9. Program for sum of array of numbers.
10. How to create, slice, change, add, delete and index elements using list.
11. Linear search and Binary search.
12. Find First n prime numbers.
13. Program to remove duplicate elements from a list.
14. Program for addition and transpose of a matrix.
15. How to create, slice, change, delete and index elements using Tuple.
16. Write a program to reverse the string.
17. How to change, delete, add and remove elements in Dictionary.
18. Create a dictionary of radius of circle and its circumference.
19. Program for count the number of words in a file.

20. Find the most frequent words in a text read from a file.
21. Program for student information system using class and objects.
22. Program for Employee Payroll Processing using class and objects.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL: 60 PERIODS

GE3232	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	-	-	-	-	-	3	2	1	3	-	-
CO2	3	3	3	3	3	-	-	-	-	-	3	2	-	-	2	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	-	3		2
CO4	3	2	-	2	2	-	-	-	-	-	1	-	-	-	1	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	1	-	2	2
CO6	2	-	-	-	2	-	-	-	-	-	1	-	1	-	1	-
Average	**2.3**	**2.5**	**3**	**2.7**	**1.8**	**0**	**0**	**0**	**0**	**0**	**1.5**	**2**	**2**	**0**	**2**	**1**

GE3251 **NSS/YRC/NSO & CLUB ACTIVITIES** **L T P C**

0 0 0 0#

Unit – 1 : NATIONAL SERVICE SCHEME (NSS)

Objectives:

The main objectives of this course are:

- To help learners know about NSS in the context of youth, community and voluntary service.
- To teach the importance of health, hygiene and sanitation for a healthy Nation.
- To understand the community in which they work.
- To identify the problems of the community and involve them in problem-solving.
- To develop the capacity to meet emergencies and natural disasters.
- To practice the National integration and social harmony.
- To utilize their knowledge in finding practical solutions to individual and community

Credit:

Total Lecture Hours / Semester	Total Tutorial Hours / Semester	Total Practical Hours / Semester	Credit
6	0	18	1*

* To be conducted after college hours and week ends

Outcome:

Learners will have the knowledge about NSS and its role in the fields of health, hygiene, emergencies & natural disasters and involve them in problem-solving of the nearest community so as to build a strong country.

Syllabus:

Semester : I&II Attendance weightage : 50 Activities weightage : 50

Topic - I : Introduction and Basic Concepts of NSS **[8]**

a. History – Aim – Objectives of NSS
b. Emblem – Motto – Badge - Song
c. Organizational structure - Roles and Responsibilities of NSS
d. Regular activities
e. Any approved indoor / outdoor programs by the Principal

Topic-II : Youth Leadership, Social Harmony and National Integration [8]

a. Meaning and types of Leadership

b. Qualities of good leaders and leadership

c. Importance and role of youth leadership

d. Role of youth in peace and Nation building

e. Any approved indoor / outdoor programs by the Principal

Topic-III : Health, Hygiene and Sanitation and Youth Health [8]

a. Definition, Needs and Scope of Health Education

b. Swachh Bharat Abhiyan

c. Healthy Lifestyles

d. HIV, AIDS, Drugs abuse

e. Any approved indoor / outdoor programs by the Principal

Topic-IV : Environment Issues, Emergencies and Disaster Management [8]

a. Environment conservation, enrichment and sustainability

b. Waste management

c. Natural resource management [Rain water harvesting and Energy conservation]

d. Introduction to Disaster Management, Classification of Disasters

e. Any approved indoor / outdoor programs by the Principal

References:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry ofYouth Affairs and Sports, New Delhi.
2. National Youth Policy, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
3. https://nss.gov.in/

NSS/NCC/NSO/YRC & CLUB ACTIVITIES

National Sports Organization (NSO)

OBJECTIVES:

1. To create awareness about basic fitness and mental strength
2. To promote the development of physical fitness
3. To develop the sporting activities of the youth
4. To create the social responsibilities and social interaction through participation

ACTIVITIES **5**

INTRODUCTION - Introduction of NSO & Physical Fitness and games Skills Test **(1)**

PHYSICAL FITNESS ACTIVITIES - Importance of Basic Physical Fitness - BMI Calculation - Identification of deformities, **(2)**

SPORTS PRACTICE - Games and fitness activities Physical Fitness Activities **(2)**

COURSE OUTCOMES:

- Get basic knowledge about physical and mental fitness
- NSO create self-esteem and self confidence
- NSO provide opportunity get social interaction
- Development of character and personality through participation

REFERENCES:

1. www.google.com
2. https://scholar.google.com/
3. https://www.medindia.net/patients/lifestyleandwellness/five-essential-components-of-physical-fitness-references.htm
4. https://pubmed.ncbi.nlm.nih.gov/

NSS/NSO/YRC & CLUB ACTIVITIES

YOUTH RED CROSS – Social Service based activities

OBJECTIVES:

- To enhance the societal awareness
- To upgrade the Personality

ACTIVITIES **5**

1. **HEALTH PROMOTION**- Activities that promotes health **(2)**

2. **SOCIETAL SERVICE**-Social Service activities **(2)**

3. **FRIENDSHIP BUILDING** - Friendship building activities between communities **(1)**

COURSE OUTCOME

1. Enhanced Social Awareness

2. Personality development of the individual

REFERENCES:

1. IRCS/YRC Handbook
2. https://www.indianredcross.org/youth/Guidelines-for-JYRC-LR.pdf

NSS/NSO/YRC & CLUB ACTIVITIES

தமிழ் மன்றம்

பாடத்திட்டத்தின் நோக்கங்கள்

- மாணவர்களை சிறந்த மேடைப்பேச்சாளர்களாக உருவாக்குவது
- தாய்மொழியின் மேன்மையை பாதுகாப்பது..

பயிற்சித்திட்டம்

1. பேச்சுக்கலைப் பயிற்சி
2. கவிதை மற்றும் கட்டுரைகள் எழுதும் பயிற்சி
3. அறிவியல் பொறியியல் தொழில்நுட்பங்களைத் தமிழில் எழுதுதல்.
4. பட்டிமன்ற மேடைகளில் பேசும் பயிற்சி.
5. நாட்டுப்புறப்பாடல்கள் பாடுதல் மற்றும் கதைகள் எழுதும் பயிற்சி.

கற்றல் முடிவு

1. பேச்சுக்கலைப் தேர்ச்சி
2. நாட்டுப்புறப்பாடல்கள் பற்றிய புரிதல்

மேற்கோள்கள்

1. https://eegarai.darkbb.com/t63483-topic
2. https://poriyari.in/

RESONANCE – SKILL BASED ACTIVITIES

OBJECTIVES:

- To know the basics and general principles of Physics.
- To provide knowledge of the current trends in Physics.
- To develop a solid scientific and technical competence for investigating and applying the relationships of Physics *phenomena in* various fields of Physics.

ACTIVITIES **5**

1. **QUIZ** - Basics and general principle **(1)**

2. **PAPER PRESENTATION** - Current trends **(2)**

3. **PROJECTS -** Fun with Physics **(2)**

COURSE OUTCOME

Students were able to:

- Recollect the general principles of Physics.
- To explore the topics in the current trends in Physics.
- *Develop practical expertise in various areas of Physics.*

REFERENCES:

1. Principles of Physics, 10Ed, Isv by Robert Resnick Jearl Walker, David Halliday (2015)
2. 'The Feynman Lectures on Physics' (Volume I, II and III) , Matthew Sands, Richard Feynman, and Robert B. Leighton.
3. https://www.science-sparks.com/top-5-physics-experiments-you-can-try-at-home
4. https://www.electronicsforu.com/category/electronics-projects/hardware-diy.

NSS/NCC/NSO/YRC & CLUB ACTIVITIES

Eclectic Lingua – Skill based activities

OBJECTIVES:

- To enhance the communicative competence of the first-year engineering students by means of creating opportunity for impromptu/ /spontaneous speeches.
- To upgrade the English language skills of students by introducing appropriate vocabulary in different situations.

ACTIVITIES **5**

1. **Extempore**- Giving expression to thoughts **(2)**

2. **Building Vocabulary**-Using relevant set of words for different contexts **(2)**

3. **Pronunciation**- Speaking accurately and fluently **(1)**

COURSE OUTCOME

1. To enable students to express themselves easily and coherently.

2. To help students to speak the language using the right words and pronouncing them correctly.

References

https://www.cambridgeenglish.org/learning-english/activities-for-learners/?skill=pronunciation

https://www.quillsandquotes.ca/post/12-fun-games-to-get-students-public-speaking

NSS/NCC/NSO/YRC & CLUB ACTIVITIES

EULER.COM – Skill based activities

OBJECTIVES:

1. To enhance the Logical reasoning of the first-year engineering students by means of creating opportunity to improve the aptitude skill.
2. To explore the applications of Mathematics in the field of Engineering, Science and Technology and to utilize this skill for their academic activities.

ACTIVITIES **5**

1. OLYMPIAD- The students will be provided with 25 questions in Engineering Mathematics. This should be completed in one hour. **(1)**

2. MATHEMATICAL MODELLING- The students are expected to present physical models (Working as well as static models) based on the application of Engineering Mathematics **(2)**

3. PAPER PRESENTATION- Students will be provided 5-7 minutes of time to present their findings in application of Mathematics. **(2)**

COURSE OUTCOME

1. To enable students to explore their mathematical reasoning skills.

2. To motivate the students to apply Mathematics in Engineering and Technology and demonstrate their work by means of Physical model and present their research article.

References:

1. Advanced Engineering Mathematics , Erwin Kreyszig, 10th Edition, Wiely India Pvt Ltd.
2. https://www.stewartcalculus.com/

NSS/NCC/NSO/YRC & CLUB ACTIVITIES

Fine Arts Club VECTORIANS – Skill based activities

OBJECTIVES:

- To enhance the inbuilt talents in arts and crafts and fine arts activities.
- To explore and exhibit theirs qualities in cultural activities as well as in the leadership.

ACTIVITIES **5**

1. **ARTS & CRAFTS** - The students will be given with innovative Theme, they have to Show their talents in one hour time with basic facilities provided. **(1)**

2. **SINGING & DANCING** - The students are expected to present their talents on spot or With given Theme, either solo or group performance. **(2)**

3. **MIME & DRAMA** - Students will be given 5 - 7 minutes of time to present their variety Entertainments in way of Mono acting or Drama . **(2)**

COURSE OUTCOME

1. To enable students to explore their inbuilt talents in fine arts activities.

2. To motivate the students to show case their cultural and leadership qualities.

REFERENCES:

1. https://www.youtube.com/watch?v=1mkESRWiSKc – Teach your own crafts.
2. https://www.youtube.com/watch?v=YHqwrDGywH4 – How to teach Arts & Crafts

NSS/NCC/NSO/YRC & CLUB ACTIVITIES

Catalysis – Skill-based activities

Objectives:

- To inculcate a scientific attitude and temper.
- To provide an opportunity to develop constructive, explorative & inventive ideas among the students.
- To develop training in the scientific method of problem-solving for engineering

1. **Quiz/debate**- the latest advancement in Chemistry towards engineering **(2)**

2. **Essay competition/Chart preparation** - Environmental sustainability **(2)**

3. **Nature Study - field visit to eco-parks etc.** **(1)**

COURSE OUTCOME

1. To promote inquisitiveness among the students and inculcate Scientific mind mapping.

2. To develop students, interest and participation in the practical applications of the knowledge related to environmental sciences.

3. Take part in practical, hands-on science activities close to nature.

REFERENCE

1. M. Senapati, Advanced Engineering Chemistry, Infinity science press, New Delhi, 2007.
2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/environmental-sustainability
   https://www.indiabix.com/general-knowledge/chemistry.

MA3321 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS LT P C

3 0 0 3

OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To model several physical problems to develop Z transform techniques for discrete time systems.

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS 9

Solutions Lagrange's linear equation –– linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT-II: FOURIER SERIES 9

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Harmonic analysis.

UNIT-III: LAPLACE TRANSFORMS 9

Existence conditions – Transforms of elementary functions – Basic properties – Inverse transforms – Convolution theorem – Transform of periodic functions.

UNIT-IV: FOURIER TRANSFORMS 9

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT-V: Z – TRANSFORMS AND DIFFERENCE EQUATIONS 9

Z- Transforms – Elementary properties – Inverse Z – transform (using partial fraction and residues) – Solution of difference equations using Z – transform.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the fundamental concept of the concepts of Partial differential Equations.
- Understand the basic concepts of mathematical principles on Fourier & Z-transforms.
- Laplace transform and inverse transform of simple functions, properties, are studied.
- Apply the concept of Understand the concept Fourier series and apply the concept in solving PDE.
- Understand the fundamental concept of the concepts of Solution of difference equations

TEXT BOOKS:

1. Veerarajan. T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G “Advanced Mathematics for Engineering Students” Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998.

REFERENCE BOOKS:

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig,“Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.5. Ray Wylie. C and Barrett.L.C, “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
5. P.Sivaramakrishna Das, C.Vijayakumari, Transforms and Partial Differential Equations, Pearson India Education Services Pvt. Ltd, 2019.

	PROGRAM OUTCOMES												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
Average	**3.0**	**3.0**	**-**	**-**	**1.0**	**-**	**-**	**-**	**-**	**-**	**-**	**1.0**	**-**	**-**	**-**	**-**

SEMESTER III

		L	T	P	C
MA3321	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To model several physical problems to develop Z transform techniques for discrete time systems.

UNIT-I:PARTIAL DIFFERENTIAL EQUATIONS **9**

Solutions Lagrange's linear equation — linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT-II:FOURIER SERIES **9**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Harmonic analysis.

UNIT-III: LAPLACE TRANSFORMS **9**

Existence conditions – Transforms of elementary functions – Basic properties – Inverse transforms – Convolution theorem – Transform of periodic functions.

UNIT-IV:FOURIER TRANSFORMS **9**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT-V:Z – TRANSFORMS AND DIFFERENCE EQUATIONS **9**

Z- Transforms – Elementary properties – Inverse Z – transform (using partial fraction and residues) – Solution of difference equations using Z – transform.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the fundamental concept of the concepts of Partial differential Equations.
- Understand the basic concepts of mathematical principles on Fourier & Z-transforms.
- Laplace transform and inverse transform of simple functions, properties, are studied.
- Apply the concept of Understand the concept Fourier series and apply the concept in solving PDE.
- Understand the fundamental concept of the concepts of Solution of difference equations.

TEXT BOOKS:

1. Veerarajan. T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi, 2012.

REFERENCE BOOKS:

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
3. P.Sivaramakrishna Das, C.Vijayakumari, Transforms and Partial Differential Equations, Pearson India Education Services Pvt. Ltd, 2019.

MA3321	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
Average	3.0	3.0	-	-	1.0	-	-	-	-	-	-	1.0	-	-	-	-

AG3361	FLUID MECHANICS AND OPEN CHANNEL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions.
- The students are exposed to the dynamics of fluids, introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes and c) forces on vanes.
- To introduce the students to various hydraulic engineering problems like open channel flows.
- At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

UNIT-I: PROPERTIES OF FLUID **9**

Properties of fluids–definition–units of measurement– Pressure Measurement – Fluid Statics. Hydrostatic forces on surfaces. Archimedes principles–buoyancy-meta centre – meta centric height.

UNIT-II:FLUID FLOW ANALYSIS **9**

Types of fluid flow–Fluid Kinematics - Flow pattern — stream line — equipotential line — stream tube pathline — streak line — flow net — velocity potential — stream function. Principles of conservation of mass — energy — momentum — continuity equation in Cartesian co-ordinates-Euler'sequationofmotion.

UNIT-III:FLOW MEASUREMENT **9**

Bernoulli's equation its applications – Orifice – sharp edged orifice discharging free - submerged orifice – mouth piece - Flow through orifice under variable head – time ofemptying a tank with and without inflow. Flow through pipes – –Chezy's formula – Manning's formula – Hazen- William‟ s formula - Major and minorlossesinpipes– Pipe network.

UNIT-IV:OPEN CHANNEL FLOW **9**

Types of flow in channel – most economical section of channel. Specific energy and critical depth-momentum in open channel flow – specific force – critical flow – computation. Flow measurement in channels – float method - Flow measurement in rivers– current meter – Parshall flume.

UNIT-V:DIMENSIONAL ANALYSIS **9**

Dimensional analysis–Fundamental dimensions–dimensional homogeneity–Rayleigh's method and Buckingham Pi-Theorem- concept of geometric, kinematic, and dynamic similarity. Important non dimensional numbers – Reynolds, Froude, Euler, Mach and Weber.

TOTAL:45 PERIODS

OUTCOMES:

- The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- To understand the types of flow and its pattern.
- Apply the various methods of field measurements and empirical formulae for pipe flow.
- Compute, analyse, and manage the open channel flow.
- They will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

TEXTBOOKS:

1. Modi, P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Publishers Distributors, New Delhi,2010.
2. Bansal, R.K., "A text book of Fluid Mechanics and Hydraulic Machinery", Laxmi Publications (P) Ltd., New Delhi, 2002.
3. Jagdish Lal, "Hydraulic Machines", Metropolitan Book House, New Delhi, 2000.

REFERENCE BOOKS:

1. Garde, R.J., "Fluid Mechanics through problems", New Age International Publishers (P) Ltd., New Delhi, 2002.

2. Michael A.M.and S.D.Khepar, “Water Well and Pump Engineering”, Tata Mc Graw Hill Co. New Delhi,2005.
3. Michael A.M., “Irrigation Theory and Practice”, Vikas Publishing House, New Delhi,2008.

WEBSITES:

1. www.onesmartclick.com/engineering/fluid-mechanics.html
2. www.it.iitb.ac.in/vweb/engr/civil/fluid_mech/course.html

AG3361	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	1	-	1	-	-	-	-	-	3	3	1	3	3
CO2	2	3	2	-	-	-	2	2	-	-	-	2	3	2	3	2
CO3	2	2	3	2	-	-	1	2	-	-	1	2	3	1	2	2
CO4	1	3	-	-	-	1	-	-	-	-	2	3	2	1	2	3
CO5	2	2	2	2	-	-	2	-	-	-	2	3	2	3	2	3
Average	1.8	2.5	2.3	1.7	-	1.0	1.7	2.0	-	-	1.7	2.6	2.6	1.6	2.4	2.6

AG3362	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on the following topics

- To introduce the student to the concept of hydrological aspects of water availability and requirements.
- Students should be able to quantify, control and regulate the water resources.
- To have an insight on runoff, flow measurements and hydrographs, flood, drought.
- To have exposure on flood and drought analysis
- To have a deep learning on principles and design of reservoirs, ground water and its management.

UNIT-I: PRECIPITATION, EVAPORATION AND ABSTRACTIONS **9**

Hydrological cycle- Meteorological measurements — Types and forms of precipitation - Spatial analysis of rainfall data using Thiessen polygon and Iso-hyetal methods- Interception – Evaporation: Measurement, Evaporation suppression – Infiltration: Horton' equation- Double ring infiltrometer, infiltration indices.

UNIT-II:RUNOFF **9**

Catchment: Definition, Morphological characteristics - Factors affecting runoff - Run off estimation using Strange's table and empirical methods–Soil Conservation Service — Curve Number method– Stage discharge relationship- Flow measurements- Hydrograph — Unit Hydrograph — Instantaneous Unit Hydrograph.

UNIT-III: HYDROLOGICAL EXTREMES **9**

Natural Disasters-Frequency analysis-Flood estimation- Flood management- Definitions of drought: Meteorological, hydrological, agricultural and Integrated- India Meteorological Department method-Normalized Difference Vegetation Index analysis- Drought Prone Area Programme.

UNIT-IV: RESERVOIRS **9**

Water Resources - River basins - Development and Utilization in India and Tamil Nadu Irrigation - Classification of reservoirs, General principles of design, site selection- Spillways- Elevation — Area capacity curve - Storage estimation- Sedimentation –life of reservoirs.

UNIT-V: GROUNDWATER AND MANAGEMENT **9**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:

- An understanding of the key drivers on water resources, hydrological processes and their integrated behavior in catchments.
- Apply the knowledge of hydrological models to surface water problems including basin characteristics, runoff and Hydrograph.
- Explain the concept of hydrological extremes such as Flood and Drought and management strategies.
- Ability to conduct spatial analysis of rainfall data and design water storage reservoirs.
- Understand the concept and methods of ground water management.

TEXT BOOKS:

1. Subramanya .K. “Engineering Hydrology”- Tata McGraw Hill, 2010
2. Jayarami Reddy .P. “Hydrology”, Tata McGraw Hill, 2008.
3. Linsley, R.K. and Franzini, J.B.“Water Resources Engineering”, McGraw Hill International Book Company, 1995.

REFERENCE BOOKS:

1. David Keith Todd. “Groundwater Hydrology”, John Wiley & Sons, Inc.2007
2. VenTe Chow, Maidment, D.R. and Mays, L.W. “Applied Hydrology”, McGraw Hill International Book Company, 1998.
3. Raghunath .H.M., “Hydrology”, Wiley Eastern Ltd., 1998

AG3362	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	1	1	-	-	-	-	-	-		2			
CO2	3	2	2	1	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	3	3	-	1	2	-	-	-	2	-	-	2	
CO4	2	2	3	1	2	1	-	-	-	-	2	-	-	2	-	-
CO5	2	2	2	1	2	1	1	-	1	-	-	-	-	-	-	-
Average	2.2	2	2.2	1.4	2	1	1	2	1	-	2	2	2	2	2	-

AG3363	SOIL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To expose students to the fundamental knowledge on Soil physical properties, soil water movement, permeability, infiltration, drainage.
- To introduce students about the types and methods of soil survey, classification of soils in India and Tamil Nadu.
- To introduce students about soil phase relations, atterberg limits and indices.
- To expose students to the engineering properties of soil viz., shear strength, cohesion etc.
- To gain knowledge on Compaction, Bearing Capacity and slope stability.

UNIT-I: INTRODUCTION AND SOIL PHYSICS **9**

Soil - definition - major components — Soil forming minerals and processes - soil profile Physical properties, capillary and non - capillary — plasticity - Soil air - soil temperature - soil water - Infiltration, hydraulic conductivity, percolation, permeability and drainage. Soil colloids — organic and inorganic matter - Ion exchange- pH – Soil reaction, Buffering capacity and EC-plant nutrient availability.

UNIT-II: SOIL CLASSIFICATION AND SURVEY **9**

Soil taxonomy — Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey — Field mapping- mapping units - base maps -preparation of survey reports - concepts and uses - land capability classes and subclasses - soil suitability — Problem soils — Reclamation.

UNIT-III: PHASE RELATIONSHIP AND SOIL COMPACTION **9**

Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil – Soil compaction- factors affecting compaction- the Standard Proctor compaction test - field and laboratory methods.

UNIT-IV: ENGINEERING PROPERTIES OF SOIL **9**

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

Assessment of seepage – Compressibility – Liquefaction.

UNIT-V: BEARING CAPACITY AND SLOPE STABILITY **9**

Bearing capacity of soils - Factors affecting Bearing Capacity- method of improving the bearing capacity of soils.- Shallow foundations- Terzaghis formula- BIS standards — Slope stability-Analysis of infinite and finite slopes- friction circle method- slope protection measures.

TOTAL: 45 PERIODS

OUTCOMES:

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

- To understand the basic soil properties and to describe the various minerals and organic components of soils which affects the various soil physical properties. It is a basic understanding of soil reaction, especially how they relate to nutrient availability.
- An introductory understanding of soil classifications along with land use and problematic soil, including the advantages and limitations of the various soil orders.
- Apply principles of phase diagram for soil properties, their classification and also understand the basic science of soil compaction.
- Learn the concept of engineering properties through standard tests and understand principles of slow and soil permeability through porous medium.
- Understanding the basic concepts of ultimate bearing capacity of shallow foundations including bearing capacity equations and slope stability problems.

TEXT BOOKS:

1. Biswas T.D. and Mukherjee S.K., Second edition. Text Book of Soil Science– Tata McGraw Hill Education, 2017. ISBN-13 : 978-0074620434.
2. Punmia, B.C., “Soil Mechanics and Foundation”, Laxmi Publishers, New Delhi, 16th edition. 2017. ISBN-13 : 978-8170087915.
3. Nyle C. Brady., “The Nature and Properties of Soil”, Macmillan Publishing Company, 10th Edition, New York, 2008.
4. Modi, P.N.2010.”Soil Mechanics and Foundation Engineering”, Rajsons publication, Standard book house, New Delhi.

REFERENCE BOOKS:

1. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 7Th Reprint edition. 2019.
2. Murthy, V.N.S., “Textbook of Soil Mechanics and Foundation Engineering” CBS Publishers and Distributors New Delhi, Geotechnical Engineering Series (Pb 2018) Paperback — 1 January 2018.
3. Sehgal, S.B., “Text Book of Soil Mechanics”, Third edition. CBS Publishers and Distributors New Delhi, 2012. ISBN: 978-8123901237
4. Edward J. Plaster., “Soil Science and Management” 6th Edition, Cengage Learning India Ltd, New Delhi, 2013.

E-REFERENCES:

1. http://www.soils.wisc.edu/courses/SS325/morphology.htm
2. www.asssi.asn.au/.../Understanding_Soils_and_Their_Interactionswith_Land Management_2005.pdf

AG3363	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	1	-	-	3	2	-	-	-	-	-	3	-	3	3
CO2	3	1	2	-	-	-	-	-	2	1	-	3	3	3	-	-
CO3	2	2	-	-	1	2	1	-	-	-	-	3	2	-	-	-
CO4	3	2	2	1	-	1		-	-	-	-	-	3	-	3	2
CO5	3	2	-	-	1	2	3	-	-	-	-	-	2	2	3	1
Average	2.8	1.8	1.7	1.0	1.0	2.0	2.0	-	2.0	1.0	-	3.0	2.6	2.5	3.0	2.0

AG3364	THEORY OF MACHINES FOR AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Applying the basic components of mechanisms.
- Designing cam mechanisms for specified output motions.
- Applying the basic concepts of toothed gearing and kinematics of gear trains.
- Understanding the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.

UNIT-I: BASICS OF MECHANISMS **9**

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains.

UNIT-II: KINEMATICS OF CAM MECHANISMS **9**

Classification of cams and followers — Terminology and definitions — Displacement diagrams — Uniform velocity, parabolic, simple harmonic and cycloidal motions — Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams.

UNIT-III: GEARS AND GEARTRAINS **9**

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting. Gear trains — Speed ratio, train value — Parallel axis gear trains — Epicyclic Gear Trains- Compound gear trains.

UNIT-IV: FORCE ANALYSIS **9**

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle – Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads –Crank shaft torque – Turning moment diagrams –Fly Wheels.

UNIT-V: BALANCING **9**

Balancing of rotating masses — Balancing of several masses rotating in same plane - Balancing of several masses rotating in different planes. Balancing of reciprocating masses– Swaying couple - Hammer blow – Partial balancing of unbalanced primary force in a reciprocating engine

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to:

- Become familiar with the basic components of mechanisms and implement it.
- Create customized cam mechanisms for required particular output motions.
- Understand the basic concepts of toothed gearing and kinematics of gear trains and bring into practicable form of the concepts learned.
- Calculate static and dynamic forces of mechanisms.
- Work out the amount of balancing masses required and their locations of reciprocating and rotating masses.

TEXTBOOKS:

1. Dr.Khurmi R S, “Theory of Machines”, 14th edition, S Chand publications, 2020.
2. Rattan, S.S, “Theory of Machines”, 5th Edition, Tata McGraw-Hill, 2019.
3. D. R. Malhotra & N. Malhotra, “Theory of Machines”, 3rd Edition, Tech India Publications, 2017.
4. Prof. P. L Ballaney, “Theory of Machines”, 25th Edition, Khanna Publications 2017.
5. R.K. Bansal, J.S. Brar, “Theory of Machines”, 5th Edition, Laxmi Publications Publications 2016.

REFERENCE BOOKS:

1. Allen S. HallJr., “Kinematics and Linkage Design”, Prentice Hall, 1961.
2. Cleghorn.W.L,“Mechanisms of Machines”, Oxford University Press, 2017.
3. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt.Ltd., New Delhi, 2015.
4. John Hannah and Stephens R.C.," Mechanics of Machines", Viva Low-Prices Student Edition, 1999.

5. Thomas Bevan, "Theory of Machines", 5th Edition, CBS Publishers and Distributors, 2019.

AG3364	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	3		1			2				1	1		3	
CO2	1	2	3		1			1				2	1		3	
CO3	1	2	3		1			1					1		3	
CO4	1	2	3				2						1	2		
CO5	1	2	3				2						1	2		
Average	1	2	3		1		2	1.3				1.5	1	2	3	

CE3363	SURVEYING AND LEVELLING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To introduce the fundamentals of surveying, its principles, accessories for chain and ranging.
- To expose students about the concepts of compass and plane table surveying.
- To learn the various types of theodolite and modern surveying.
- To introduce the concepts of levelling.
- To impart knowledge on levelling applications.

UNIT-I: FUNDAMENTALS OF CONVENTIONAL SURVEYING **9**

Definition – Classifications – Principles – Equipment and accessories for ranging and chaining – Methods of ranging – Well conditioned triangles – Chain traversing – Compass – Basic principles – Types – Bearing – System and conversions – Sources of errors and Local attraction – Magnetic declination – Dip – compass traversing – Plane table and its accessories – Merits and demerits.

UNIT-II: LEVELLING **9**

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

UNIT-III: THEODOLITE SURVEYING **9**

Horizontal and vertical angle measurements – Temporary and permanent adjustments – Heights and distances — Tacheometric surveying — Stadia Tacheometry — Tangential Tacheometry – Trigonometric leveling – Single Plane method – Double Plane method.

UNIT- IV: CONTROL SURVEYING AND ADJUSTMENT **9**

Horizontal and vertical control – Methods – Triangulation – Traversing –Gale‘s table – Trilateration — Concepts of measurements and errors — Error

propagation and Linearization — Adjustment methods - Least square methods — Angles, lengths and levelling network.

UNIT-V: MODERN SURVEYING **9**

Total Station: Digital Theodolite, Electronic Distance Measurer –- Coordinate Geomentry functions — Field procedure and applications. Geographical positioning system: Advantages – System components – Signal structure – Selective availability and anti spoofing receiver components and antenna — Planning and data acquisition — Data processing – Errors – Field procedure and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:

- Introduce the rudiments of various surveying and its principles.
- Imparts knowledge in computation of levels of terrain and ground features.
- Imparts concepts of Theodolite Surveying for complex surveying operations.
- Understand the procedure for establishing horizontal and vertical control.
- Imparts the knowledge on modern surveying instruments.

TEXT BOOKS:

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

REFERENCES:

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India 2010.
3. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013.

CE3363	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	1	3	-	3	1	3	2	2	3	1	3	3
CO2	2	3	-	-	1	2	-	1	3	2	-	2	2	3	-	2
CO3	3	3	-	-	1	2	-	1	2	2	-	3	3	2	3	2
CO4	2	2	-	-	1	1	-	-	3	3	2	-	2	1	2	3
CO5	2	2	-	3	2	2	2	1	3	2	2	2	2	2	2	3
Average	2.4	2.5	-	3	1.2	2	2	1.5	2.4	2.4	2	2.2	2.4	1.8	2.5	2.6

AG3365	FLUID MECHANICS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To have a knowledge on flow measurements using various devices.
- To give hands on experience on the flow through different types of notches.
- To gain experimental knowledge on computation of major losses in pipes.
- To train students on determination of minor losses in pipes.
- To study the characteristics of various pumps.

LIST OF EXPERIMENTS

1. FLOW MEASUREMENT

- Calibration of Rotameter
- Flow through Venturimeter
- Flow through a circular Orifice
- Determination of mean velocity by Pitottube
- Flow through a Triangular Notch
- Flow through a Rectangular Notch

2. LOSSES IN PIPES

- Determination of friction coefficient in pipes
- Determination of losses due to bends, fittings and elbows

OUTCOMES:

- The students will be able to measure flow through pipes.
- The students will be able to measure flow in open channel.
- The students will be able to compute the major and minor losses in pipes.
- The students will be able to study the characteristics of pumps.
- The students will be able to analyse the performance of pumps.

TOTAL:30 PERIODS

REFERENCEBOOKS:

1. “Hydraulic Laboratory Manual”, Centre for Water Resources, Anna University,2004.Modi P.N. and Seth S.M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 2000.

2. Subramanya,K.,“Flow in Open Channels”, Tata Mc Graw- Hill Pub.Co.1992.
3. Subramanya, K., “Fluid Mechanics”, Tata McGraw-Hill Pub. Co., New Delhi,1992.

LIST OF EQUIPMENTS REQUIRED

- Rotameter–1no.
- Venturi meter–1no.
- Orifice meter–1no.
- Pitot tube–1no.
- Bernoulli‟s theorem apparatus–1no.
- Triangular notch and Rectangular notch–1each(with alinedopen channel setup)
- Coefficient of friction apparatus
- Pipe setup with bends, fittings and elbows for estimating minor losses
- Centrifugal pump, Reciprocating pump, Submersible pump, Jet pump–1 each
- Collecting tank, Stop watch–1no.for each experiment.

AG3365	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	1	-	1	-	-	-	-	-	-	3	1	3	3
CO2	3	3	2	-	-	-	2	2	-	-	-	-	3	2	3	2
CO3	3	3	3	2	-	-	1	2	-	-	-	1	3	1	2	2
CO4	3	3	-	-	-	1	-	-	-	-	-	2	2	1	2	3
CO5	3	3	2	2	-	-	2	-	-	-	-	2	2	3	2	3
Average	3.0	3.0	2.3	1.7	-	1.0	1.7	2.0	-	-	-	1.7	2.6	1.6	2.4	2.6

AG3366	SOIL SCIENCE AND LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- Students will be able to identify the types of rocks and minerals.
- Students should be able to verify various quality aspects of soil and water studied in theory by performing experiments in lab.
- To provide hands on experience on the textural analysis of soil.
- Students should be able to determine the organic carbon and gypsum requirements.
- Students should be able to perform in situ tests on soil samples.

LIST OF EXPERIMENTS

1. Identification of rocks and minerals
2. Collection and processing of soil samples
3. Determination of soil moisture, EC and pH
4. Field density determination by Core Cutter and Sand Replacement method
5. Determination of Specific Gravity
6. Textural analysis of soil by International Pipette method
7. Grain size analysis by using Mechanical shaker
8. Determination of Organic carbon
9. Estimation of Gypsum requirements

TOTAL: 30 PERIODS

OUTCOMES

- Learn about the identification of minerals referred under theory.
- Knowledge of field investigations including collection of soil sampling, Processing and storage through observation of soil.
- Understanding of the physical properties of soil and different laboratory methods
- Be able to perform test to identify the organic carbon and application of soil amendments through chemical analysis of soil.

- Students know the techniques to determine various physical and chemical properties of soil that are applicable for agriculture and irrigation by conducting appropriate tests.

TEXTBOOKS:

1. Punmia, B.C., “Soil Mechanics and Foundation”, Laxmi Publishers, New Delhi, 16th edition. 2017. ISBN-13: 978-8170087915.
2. Laboratory Manual, Centre for Water Resources, Anna University,Chennai,2012.

REFERENCE BOOK:

1. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 7Th Reprint edition. 2019.

AG3366	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	2	-	-	-	-	1	1	-	1	2	-	3	1
CO2	2	2	1	-	2	1	1	-	1	-	-	2	2	2	2	2
CO3	1	1	-	-	-	1	-	-	1	-	-	-	2	2	2	1
CO4	1	1	-	2	-	1	-	-	1	-	-	-	2	2	2	1
CO5	1	1	-	-	-	1	-	-	1	-	-	-	2	2	2	1
Average	1.2	1.3	1.0	2.0	2.0	1.0	1.0	-	1.0	1.0	-	1.5	2.0	2.0	2.2	1.2

CE3366	SURVEYING AND LEVELING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To train the student to acquire skill on chain and compass surveying.
- To train students to gain experience on plane table surveying.
- To have hands on experience on operating theodolite.
- To gain practical knowledge on levelling.
- To gain practical knowledge on total station.

Chain Survey

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset

Compass Survey

2. Compass Traversing – Measuring Bearings & arriving included angles Levelling - Study of levels and levelling staff
3. Fly levelling using Dumpy level &Tilting level
4. Check leveling

Theodolite - Study of Theodolite

5. Measurements of horizontal angles by reiteration and repetition and vertical angles
6. Determination of elevation of an object using single plane method when base is Accessible/inaccessible.

Tacheometry – Tangential system – Stadia system

7. Determination of Tacheometric Constants
8. Heights and distances by stadia Tacheometry
9. Heights and distances by Tangential Tacheometry

Total Station - Study of Total Station, Measuring Horizontal and vertical angles

10. Traverse using Total station and Area of Traverse
11. Determination of distance and difference in elevation between two

inaccessible points using Total station

12. Setting out works – Foundation marking using tapes single Room

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:

1. Impart knowledge on the usage of basic surveying instruments like chain/tape, compass and levelling instruments.
2. Able to use levelling instrument for surveying operations.
3. Able to use theodolite for various surveying operations.
4. Able to carry out necessary surveys for social infrastructures.
5. Able to prepare planimetric maps.

REFERENCES:

1. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune VidyarthiGrihaPrakashan, Pune, 24th Reprint, 2015.
2. Dr. B. C. Punmia, Ashok K. JainandArun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 17th Edition, 2016.
3. James M. anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001.
4. Bannisterand S. Raymond, Surveying, Seventh Edition, Longman 2004 a. David Clark, Plane and Geodetic Surveying for Engineers, Volume I, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
5. David Clark and James Clendinning, Plane and Geodetic Surveying for Engineers, Volume II, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
6. S. K. Roy, Fundamentals of Surveying, Second Edition, Prentice ‘Hall of India 2004.
7. K. R. Arora, Surveying Vol. I & II, Standard Book house, Eleventh Edition, 2013.

CE3366	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	1	1	3	-	3	3	3	2	2	3	1	3	3
CO2	2	3	-	-	1	2	-	1	3	2	-	3	3	1	3	2
CO3	3	3	-	-	1	2	-	1	3	2	-	3	3	3	3	2
CO4	2	2	-	-	1	1	-	-	3	3	2	3	3	1	2	3
CO5	3	3	2	3	2	2	2	1	3	2	2	2	2	2	2	3
Average	2.6	2.7	2	2	1.2	2	2	1.5	3	2.4	2	2.6	2.8	1.6	2.6	2.6

SEMESTER IV

MA3426	APPLIED MATHEMATICS FOR AGRICULTURAL ENGINEERING	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To understand and apply the ordinary differential equations
- To familiarize the student with probability distributions
- To understand the concept of estimation theory.
- To acquaint the student with mathematical tools needed in evaluating integrals.
- To familiarize the student with multiple integrals and their usage in find the area and volume of two- and three-dimensional objects.

UNIT-I: ORDINARY DIFFERENTIAL EQUATIONS **6**

Higher order linear differential equations with constant coefficients – Method of variation of parameters.

UNIT-II: SPECIAL DISTRIBUTIONS **6**

Bernoulli, Binomial, Poisson, uniform, exponential and normal distributions.

UNIT-III: ESTIMATION & SAMPLING DISTRIBUTION **6**

Population, sample, parameters, point estimation, unbiasedness, consistency. Comparing two estimators

UNIT-IV: CORRELATION & REGRESSION **6**

Simple linear regression, curve fitting. Covariance correlation tests for slope and correlation, analysis of variance, regression analysis.

UNIT-V: STATISTICAL QUALITY CONTROL **6**

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) — Tolerance limits - Acceptance sampling. .

TOTAL: 30 PERIODS

OUTCOMES:

1. Understand how to solve the given ordinary differential equations.

2. Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon
3. The concept of estimation and Sampling theory is studied.
4. Understand the basic concepts of two-dimensional random variables and correlation regression and apply them to model engineering problems
5. Understand the control charts and apply in quality control.

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.3. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd., 11th Edition, 2005.
2. Veerarajan.T, “Engineering Mathematics”, McGrawHill Education (India) Private Ltd 2019.

REFERENCE BOOKS:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt. Ltd., 2011.
2. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2017.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.

MA3426	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
Average	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-

AG3461	TRACTORS AND FARM ENGINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the mechanics involved in farm tractors.
- To learn the engine components and operations involved inside the engine.
- To introduce concept of different engine systems and tractor control.
- To impart the knowledge of power transmission to tractor drawn implements.
- To acquaint the procedure for testing and selection of tractors with cost analysis.

UNIT I TRACTORS **9**

Sources of farm power-Classification of tractors - Tractor engines — Types- CI and SI engines, operating principles and function- two stroke and four stroke engine, Comparison - construction of engine blocks, cylinder head and crankcase - features of cylinder, piston, connecting rod and crankshaft — firing order combustion chambers.

UNIT II ENGINE SYSTEMS **9**

Valve system, Valves-inlet and outlet valves – valve timing diagram. Air cleaner, types and performance characteristics- exhaust – silencer. Cooling systems - lubricating systems - fuel injection system, injection pump, types, working principle- Nozzles, types and working principles — governor types and characteristics- electrical system.

UNIT III TRANSMISSION SYSTEMS **9**

Transmission - clutch - gear box - sliding mesh - constant mesh - synchro mesh. Differential, final drive and wheels. Steering geometry - steering systems - front axle and wheel alignment. Brake - types - system.

UNIT IV HYDRAULIC SYSTEMS **9**

Hydraulic system - working principles, three point linkage and hitching system - draft control - weight transfer, theory of traction - tractive efficiency — tractor chassis mechanics — stability - longitudinal and lateral. Controls - visibility -

operator's seat.

UNIT V POWER TILLER, BULLDOZER AND TRACTOR TESTING 9

Power tiller - special features - clutch - gear box - steering and brake. Makes of tractors, power tillers and bulldozers. Bulldozer- salient features — turning mechanism, track mechanism, components — operations performed by bulldozers. Types of tests- test procedure - need for testing & evaluation of farm tractor — Selection of tractor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to

- Get an idea on different types of tractors and tractor mechanics
- Calculate the valve timing of an IC engine and represent by a drawing
- Gain knowledge on the engine control system of a tractor
- Understand the power transmission, hydraulic system and power outlet in a tractor.
- Gain knowledge on testing and evaluation of farm tractor with different procedure.

TEXTBOOKS:

1. Jain, S.C. and C.R. Rai. Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 2023.
2. Senthilkumar, T., R.Kavitha, V.M.Duraisamy and B.Suthakar.Text Book of Farm Machinery, Thannambikkai publishers, Coimbatore, 2019.
3. J. Sahay, "Elements of Agricultural Engineering" Standard Publishers Distributors, India, 2022.
4. R. L. Varshney, A. C. Mathur, "Farm Power and Machinery Engineering", Jain Brothers, 2018.
5. Dr. Er. Mohinder Singh, "Tractor and Farm Machinery' Kalyani Publishers, 2016.

REFERENCES:

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 2020.
2. Domkundwar A.V. A course in internal combustion engines. DhanpatRai& Co. (P) Ltd., Educational and Technical Publishers, Delhi, 2018.

3. Black, P.O. Diesel engine manual. Taraporevala Sons& Co., Mumbai, 2018.
4. Grouse, W.H. and Anglin, D.L. Automative mechanics. Macmillan McGraw- Hill, Singapore, Indian Standard Codes for Agricultural Implements Published by ISI, New Delhi, 1993.
5. JagadeeshwarSahay, Elements of Agricultural Engineering, Standard Publishers Co., New Delhi, 2016.

AG3461	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	2	1	1	-	1	-	1	-	-	1	2	2	1	2	-
CO2	2	-	-	1	2	-	-	-	1	-	-	-	-	-	-	-
CO3	1	-	1	-	-	1	-	-	-	-	1	-	-	1	1	-
CO4	-	2	2	1	-	-	2	-	-	-	-	-	-	-	-	-
CO5	2	2	-	1	-	-	-	-	-	-	2		2	1	1	-
Average	2.0	2.0	-	1.0	-	-	-	-	-	-	2.0		2.0	1.0	1.0	-

AG3462	IRRIGATION AND DRAINAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the necessity of planning an irrigation system to provide water at the right time and right place.
- To understand the basic concepts for planning, design and management of land drainage works in cultivated areas.
- To have vast knowledge on Agricultural farm development works.
- To understand the role of farmers' committee in water distribution and system operation.
- To learn in detail about agricultural drainage and recycling of drainage water for irrigation.

UNIT-I: IRRIGATION REQUIREMENTS **9**

Pump terminology – selection of pump capacity. Types of pumps and impellers - Priming — cavitation — specific speed –characteristic curves. Turbines — jet assembly- Hydraulic ram. Duty and delta - Rooting characteristics - Moisture use of crop - Evapotranspiration plot - Crop water requirement - Effective rainfall - Scheduling Irrigation requirement - Irrigation frequency, Irrigation efficiencies.

UNIT-II: METHODS OF IRRIGATION **9**

Methods of Irrigation - Hydraulics and design - Erodible and non-erodible, Kennedy's and Lacey's theories, Materials for lining water courses and field channel - Underground pipeline irrigation system.

UNIT-III: DIVERSION AND IMPOUNDING STRUCTURE **9**

Head works - Weirs and Barrage - Types of impounding structures - Factors affecting location of dams - Forces on a dam - Design of Gravity dams - Earth dams, Arch dams - Spillways - Energy dissipators - Tank Irrigation.

UNIT-IV: CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT **9**

Classification of canals - Alignment of canals – Design of irrigation canals - Regime

theories -Canal Head works - Canal regulators - Canal drops - Cross drainage works Canal Outlet, Escapes - Lining and maintenance of canals - Excess irrigation and waterlogging problem - Command area - Components of Command Area Development Programme - On Farm Development works, Farmer's committee - its role for water distribution and system operation - Rotational irrigation system.

UNIT-V: AGRICULTURAL DRAINAGE **9**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:

- The students will have knowledge and skills on Planning, design, operation and management of reservoir system.
- The student will gain knowledge on different methods of irrigation.
- To understand about diversion and impounding structures.
- To have an insight of canal classification, alignment and design of canals.
- Imparts the knowledge on agricultural drainage.

TEXTBOOKS:

1. Balram Panigrahi "A Handbook on Irrigation and Drainage", Nipa Publishers, New Delhi, 2021
2. Dilip Kumar Majumdar., "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
3. Garg, S.K, "Irrigation Engineering," Laxmi Publications, New Delhi, 2008.
4. Michael, A.M, "Irrigation Engineering", Vikas Publishers, New Delhi, 2008.

REFERENCES:

1. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013.
2. Basak, N.N, "Irrigation Engineering", Tata McGraw-Hill Publishing Co, New Delhi, 2008.
3. Bhattacharya, A.K, and Michael, A.M, "Land Drainage — Principles,

Methods and Applications", Konark Publishers Pvt. Ltd., New Delhi, 2003.

AG3462	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	2	2	3	1	2	1	-	-	1	2	3	1	-	1
CO2	-	-	1	3	1	2	1	2	1	-	1	3	2	1	2	-
CO3	1	-	3	1	1	2	3	1	2	1	-	-	1	2	3	3
CO4	2	-	-	-	2	1	3	1	2	1	1	-	2	1	3	-
CO5	1	1	2	-	-	-	3	1	3	-	2	-	1	3	-	2
Average	1.3	1.0	2.5	1.0	1.5	1.5	3.0	1.0	2.3	1.0	1.5	-	1.3	2.0	3.0	2.5

AG3463	PRINCIPLES AND PRACTICES OF CROP PRODUCTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the students to the principles of agricultural and horticultural crop production.
- Students will gain knowledge on how to select a crop and its establishment.
- To understand the production practices of agricultural and horticultural crops.
- To impart knowledge on nutrient use and weed management.
- To define the role of agricultural engineers in various fields of Crop production practices

UNIT-I: AGRICULTURE AND CROP PRODUCTION **9**

Introduction to agriculture and its crop production sub-sectors ,Factors affecting crop growth and production-climate and weather parameters — Soil fertility and productivity factors; Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices.

UNIT-II: CROP SELECTION AND ESTABLISHMENT **9**

Regional and seasonal selection of crops; Systems of crop production; Competition among crop plants; Spacing and arrangement of crop plants; Field preparation for crops including systems of tillage; Establishment of an adequate crop stand and ground cover, including selection and treatment of seed, and nursery growing.

UNIT-III: CROP MANAGEMENT **9**

Crop water Management; Crop nutrition management - need for supplementation to soil supplied nutrients, sources, generalized recommendations, methods and timing of application of supplemental nutrients; Crop protection including management of weeds, pests and pathogens; Integrated methods of managing water, nutrients and plant protection; Types and methods of harvest.

UNIT-IV: PRODUCTION PRACTICES OF AGRICULTURAL CROPS **9**

Generalized management and cultivation practices for important groups of field crops in Tamil Nadu: cereal, pulses, legumes, oil seeds , cash crops, and fiber crops, and special purpose crops such as those grown for green manure.

UNIT-V: PRODUCTION PRACTICES OF HORTICULTURAL CROPS 9

Important groups of horticultural crops in Tamil Nadu such as vegetable crops, fruit crops, flower crops; Cultivation practices of representatives of each group; Special features of production of horticultural crops - green house cultivation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:

- On completion of course, students will be able to understand the basics of agriculture and crop production.
- To gain knowledge on crop selection and establishment.
- To have insight on crop nutrition management.
- To exploit the production practices of agricultural crops.
- To exploit the production practices of horticultural crops.

TEXT BOOKS:

1. Rajendra Prasad, “Text Book of Field Crop Production”, Directorate of Information and Publication, Krishi 02 AnusandhanBhavan, Pusa, New Delhi, 2005.
2. Reddy T., Sankara G.H. YellamandaReddi, “Principles of Agronomy”, Kalyani Publishers, New Delhi, 1995.
3. M. Mohamed Amanullah, K. Rajendran, S. Marimuthu "Crop Production Technology I (Kharif Crops)",2023.

REFERENCES:

1. Kumar, N., “Introduction to Horticulture”, Rajalakshmi Publications. Nagercoil, 1993.
2. "Production Technology of Vegetable Crops Practical Manual" Field Crop (Kharif), TNAU Tamil Nadu. 2017.
3. Crop Production Guide Agricultural crops, Tamil Nadu Agricultural University Publication, Coimbatore. 2020.

AG3463	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	3	-	2	1	3	3	-	1	-	2	2	3	2	2	2
CO2	3	2	-	2	1	2	1	-	1	-	2	2	3	3	2	2
CO3	3	2	-	2	-	3	3	1	2	-	2	2	2	2	2	2
CO4	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2
CO5	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2
Average	1.8	1.8	2	2	1	2.4	2.2	1	1.2	-	2	2	2.4	2.2	2	2

AG3431	STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.
- To have understanding on the analysis of plane trusses.
- To gain knowledge on transverse loading and stresses in beam.
- To introduce the concept of torsion in shafts.
- To impart knowledge on deflection of beams.

UNIT ISTRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids - Tension, Compression and Shear Stresses - Deformation of Simple and compound bars - Thermal stresses - Elastic constants - Volumetric strains - Thin shells Circumferential and longitudinal stresses in thin cylinders

UNIT-II:ANALYSIS OF PLANE TRUSSES 9

Determinate and indeterminate plane trusses - Determination of member forces by method of joints, method of sections and method of tension coefficient.

UNIT-III: TRANSVERSE LOADING AND STRESSES IN BEAM 9

Beams - Types transverse loading on beams - Shear force and bending moment in beams - Cantilevers - Simply supported beams and over-hanging beams. Theory of simple bending - bending stress distribution - Shear stress distribution - Flitched beams - Carriage springs.

UNIT-IV: DEFLECTION OF BEAMS 9

Computation of slopes and deflections in determinate beams - Area moment method - Conjugate beam method — Application in Agricultural Structures.

UNIT-V: TORSION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Upon completion of this course, the students can be able to apply mathematical knowledge to calculate the deformation behaviour of simple structures.
- To know about framework, typically consisting of rafters, posts, and struts, supporting a roof, bridge, or other structure.
- To find the deflection of beams through various methods.
- Students will be able to determine the torsion, stresses and deformation in circular and hollow shafts.
- Critically analyse problem and solve the problems related to structural elements and analyse the deformation behavior for different types of loads.

TEXTBOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2018
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2017
3. Khurmi R.S., " Strength of Materials", S Chand and Company Limited, New Delhi, 2019
4. Punmia B.C., et. al "Strength of Materials", Laxmi Publications (P) Ltd., 2018
5. Ramamrutham. S., "Strength of Materials", Dhanpatraj Publications Company, 2020

REFERENCES:

1. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2022
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2007.
3. Rarran S S., "Strength of Materials", Tata Mcgraw hill Education, 2018
4. Bhavikatti S. S., " Strength of Materials", S Chand and Company Limited, New Delhi, 2021
5. Rajput R.K., " Strength of Materials", S Chand and Company Limited, New Delhi, 2020

AG3431	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	1	1	-	1	-	-	-	-	1	1	3	3	1	2
CO2	3	2	2	1	-	1	-	-	-	-	-	1	3	3	1	2
CO3	3	2	2	1	-	1	-	-	-	-	1	1	3	3	1	2
CO4	3	1	2	1	-	1	-	-	-	-	1	1	3	3	1	2
CO5	3	2	2	1	-	1	-	-	-	-	1	1	3	3	1	2
Average	3	1.6	1.8	1	-	1	-	-	-	-	1	1	3	3	1	2

AG3432	THERMODYNAMICS FOR AGRICULTURE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is to impart knowledge on

- Basic concepts of Engineering thermodynamics and application to the first law of thermodynamics.
- Steam power cycles and their application in the steam power plants.
- Concepts of steam nozzles and turbine and to solve problems.
- Concepts of thermodynamic in different air standard cycles and to solve problems.
- Fundamental concept and principles in conductive and convective heat transfer (Use of standard Steam Tables and Mollier diagram)

UNIT-I FIRST LAW OF THERMODYNAMICS **9**

Internal energy – Law of conservation of energy – First law of thermodynamics – Energy - Application of first law of thermodynamics to a non-flow or closed system – Application of first law to steady flow process — Engineering applications of steady flow energy equation (S.F.E.E.).

UNIT-II BASIC STEAM POWER CYCLES **9**

Carnot cycle – Rankine cycle – Modified Rankine cycle – Regenerative cycle – Reheat cycle.

UNIT-III STEAM NOZZLES AND STEAM TURBINES **9**

Introduction – Steam flow through nozzles – Nozzle efficiency – Classification of the steam turbine – Advantages of the steam turbine over steam engines – Methods of reducing wheel – Impulse turbine – Turbine Efficiency.

UNIT-IV GAS POWER CYCLES **9**

Air Standard Cycles — Otto Cycle - Diesel cycle - Dual cycle — Calculation of mean effective pressure - Air standard efficiency - Comparison of cycles.

UNIT-V HEAT TRANSFER **9**

Modes of heat transfer – Heat transfer by conduction – Heat transfer by convection – Heat exchangers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon coupling of this course, the students will be able to:

- Execute the basic concepts of Engineering thermodynamics and application to the first law of thermodynamics.
- Solve problems in Steam power cycles.
- Solve problems in steam nozzles and turbine.
- Explain the concepts of thermodynamic in different air standard cycles and solve problems.
- Appraise the fundamental concept and principles in conductive and convective heat transfer.

TEXTBOOKS:

1. Rajput, R.K., “Thermal Engineering” Tenth Edition, Laxmi Publication (P) LTD, 2017.
2. Kothandaraman, C.P., “A Course in Thermal Engineering",Fifth Edition, Dhanpat Rai and Co, 2002.
3. Yunus Cengel, Afshin Ghajar “Heat and Mass Transfer: Fundamentals and Applications: Fundamentals & Applications”, McGraw-Hill Publication,Sixth Edition,2017.
4. J P Holman, Souvik Bhattacharyya, “Heat Transfer” McGraw-Hill Publication, Sixth Edition,2017.
5. Borgnakke , Sonntag, “Fundamentals of Thermodynamics”, Don Fowley Publication, 8th Edition, 2018.

REFERENCE BOOKS:

1. Ganesan, V. "Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill 2012.
2. Ballaney, P.L. "Thermal Engineering", Khanna publishers, 24th Edition 2012.
3. Ganesan, V. "Gas Turbines" Third Edition, Tata McGraw -Hill 2017.
4. Rudramoorthy, R. "Thermal Engineering", “Tata McGraw-Hill, New Delhi, 2017.
5. Sarkar, B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2019.

AG3432	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4

CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	-	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	-	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	1	1	-	1	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	1	-	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-	1	-
Average	2.0	2.0	1.0	-	-	-	-	-	-	-	-	1.0	1.0	-	1.0	-

GE 3451	NCC Credit Course Level - I	L	T	P	C
	(Common to Army, Navy & Air)	3	0	0	3

OBJECTIVES:

- To know the basic structure of NCC and Role of NCC
- To improve the cadet's personality skill and leadership quality
- To make the interest of cadets to involve in social activities
- Preventing the potential damage and suffering
- to destruction of the enemy's ability to fight and will to fight

Unit - I :INTRODUCTION TO NCC **9**

Aims, Objectives & Organization of NCC, Incentives, Duties of NCC Cadet, NCC Camps and Types National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security.

Unit -II :PERSONALITY DEVELOPMENT **9**

Personal Transformation, Personal Productivity Skills - time management, organizational and planning skills, problem solving and decision-making abilities, basics of psychology, Leadership, Meditation

Unit - III :SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **9**

Basics, Rural Development Programmes, NGOs, Contribution of Youth, Protection of Children and Women Safety, Road / Rail Travel Safety, New Initiatives, Cyber and Mobile Security Awareness

Unit - IV :DISASTER MANAGEMENTS AND ITS AWARENESS **9**

Importance of Hazards and Disaster, Types of disasters, Earthquakes and its types, flood types and its management, landside and its managements case studies of disasters in Sikkim, Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management

Unit – V :WAR AND PEACE IN CONTEMPORARY WORLD **9**

Conceptual framework of War and Peace, Concepts of theories and approaches, Modern war fare: Conventional, nuclear, Guerilla and Irregular Warfare, Limited and

Specialized Warfare with reference to mountain, desert and jungle warfare, terrorism as a new mode of conflict, War as an Economic Problem, Defence and Development, Defence and Development, Defence and Development

TOTAL: 45 PERIODS

Note: NCC Credit Course Level — I is offered for NCC students only. The grades earned by the students will be recorded in the marksheet, however the same shall not be considered for the computation of CGPA

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Understand their roles and responsibilities
- Demonstrate the knowledge of human values and morals
- Actively participate in social service and development activities
- Understand the importance of disaster management
- Analyse the issues related to war and its effects.

TEXT BOOKS:

1. R. Gupta's NCC Handbook of NCC Cadets 'A', 'B' and 'C' certificate Examiantions

REFERENCE BOOKS:

1. V. B. RAO, Personality Development and Soft Skills, BS Publications
2. Harish K. Gupta, Disaster Management, Universities press.

AG3464	CROP HUSBANDRY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide hands on experience to students to prepare land for cultivation.
- To introduce the different crop production practices in wetland,dry land and garden land through hands on experience and demonstrations.
- To have hands on experience on nutrient management.
- Experimental study on water management and irrigation scheduling.
- To introduce about the harvesting tools and their techniques.

LIST OF EXPERIMENTS:

1. Identification of field and horticultural crops and field preparation studies.
2. Seed moisture - estimation of seed rate, germination of seeds, Seed selection and seed treatment procedures.
3. Seed bed and nursery preparation, Sowing/Transplanting.
4. Fertilizers-type, estimation of recommended dose.
5. Water management and irrigation scheduling
6. Weeds, identification of major weed type, demonstration on simple weeding implements. Herbicide uses and caution.
7. Pest identification and control, demonstration of IPM methods
8. Harvesting methods for various field and horticultural crops and implements used.
9. Post harvesting Practices.
10. Biometric observations.

TOTAL:60 PERIODS

COURSE OUTCOMES:

1. On completion of course, the students will be able to prepare field for cultivation.
2. Students will be able to select quality of seeds.
3. Students will have basic knowledge on preparing seed bed and nursery.
4. Students will have hands on experience Water management and irrigation scheduling.
5. Students will be capable of performing irrigation from sowing till harvesting.

AG3464	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	1	1	1	2	2	2	1	2	3	3	2	3	2
CO2	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1
CO3	2	2	2	1	1	1	2	2	2	2	1	2	3	2	3	2
CO4	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1
CO5	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1
Average	2.6	1.4	2	2.2	1.6	1	2.6	2	2	1.5	1.8	2.2	2.4	2	2.4	1.4

AG3465	IRRIGATION FIELD LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Students should be able to study various Meteorological instruments.
- To practically determine the uniformity coefficient of the various irrigation systems.
- To study about the flow properties in open channels.
- To design various types of irrigation system.
- To understand the working principle of various instruments that is available in metrological Laboratory.

LIST OF EXPERIMENTS

1. To study various instruments in the Meteorological Laboratory.
2. To study the characteristics of Centrifugal pump, Submersible pump and Reciprocating pump.
3. Evaluation of surface irrigation.
4. Determination of infiltration rate using double ring and digital infiltrometer.
5. Determination of soil moisture wetting pattern for irrigation scheduling.
6. Measurement of flow in open channels using flumes.
7. Layout of Drip irrigation system.
8. Determination of uniformity coefficient for drip irrigation system
9. Layout of Sprinkler irrigation system
10. Determination of uniformity coefficient for sprinkler system - catch can method.
11. Study of Greenhouse irrigation system design.

TOTAL: 30 PERIODS

OUTCOMES:

1. On the completion of the course the student will have the knowledge on various meteorological instruments.
2. Having a practical knowledge of different irrigational systems.
3. Evaluating the infiltration rate using various methods.
4. Evaluating uniformity coefficient of the various irrigation systems.
5. Measuring the flow in the channel and also conducting the experiment for micro irrigation system.

REFERENCE BOOKS:

1. Michael, A.M, “Irrigation Theory and Practice”, Vikas Publishing House, New Delhi, 1999.
2. Asawa, G.L, “Irrigation Engineering”, New Age International Private Limited, New Delhi,1996.
3. Laboratory Manual, Centre for Water Resources, Anna University, Chennai.

AG3465	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	2	1	3	-	1	2	-	-	2	1	3	2	1	3	1
CO2	2	1	1	2	3	1	1	-	1	2	1	2	1	2	1	3
CO3	3	2	2	3	3	-	-	2	2	3	3	2	2	2	3	1
CO4	2	2	2	1	-	-	-	2	2	3	3	2	2	1	2	3
CO5	1	3	2	1	1	-	-	-	-	2	1	2	1	1	2	2
Average	2.0	2.0	1.6	2.0	2.3	1.0	1.5	2.0	1.7	2.4	1.8	2.2	1.6	1.4	2.2	2.0

AG3433	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

LIST OF EXPERIMENTS

1. Tension test on steel rod.
2. Compression test on wood.
3. Double shear test on metal.
4. Torsion test on mild steel rod.
5. Impact test on metal specimen (Izod and Charpy).
6. Hardness test on metals (Rockwell and Brinell Hardness Tests).
7. Deflection test on metal beam.
8. Compression test on helical spring.
9. Deflection test on carriage spring.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:

1. Find the stress distribution and strains in regular and composite structures subjected to axial loads.
2. Assess the shear force, bending moment and bending stresses in beams
3. Apply torsion equation in design of circular shafts and helical springs

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University,Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, reaffirmed 2013), ‘High strength deformed bars and wires for concrete reinforcement — Specification’, 2008.

AG3433	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	3	-	1	2	-	-	2	1	3	2	1	3	1
CO2	2	1	1	2	3	1	1	-	1	2	1	2	1	2	1	3
CO3	3	2	2	3	3	-	-	2	2	3	3	2	2	2	3	1
CO4	2	2	2	1	-	-	-	2	2	3	3	2	2	1	2	3
CO5	1	3	2	1	1	-	-	-	-	2	1	2	1	1	2	2
Average	2.0	2.0	1.6	2.0	2.3	1.0	1.5	2.0	1.7	2.4	1.8	2.2	1.6	1.4	2.2	2.0

SEMESTER V

AG3561	AGRICULTURAL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand about types and requirements of agricultural structures.
- To gain knowledge on construction priority of structures.
- To learn design procedure of different farm structures.
- To design various types of grain storage storage structures.
- To learn about ventilation requirements in the agricultural structures.

UNIT-I INTRODUCTION 9

Definition – Types of Agricultural Structures- Farmstead planning- introduction, location, size and arrangement - Requirements of farm house - Defects in traditional houses.

UNIT-II DESIGN REQUIREMENTS OF FARM STRUCTURES 9

Site selection - materials of construction — quality — types of masonry — foundation, basement and super structure – types of roofs – building plan and estimation.

UNIT-III DESIGN OF FARM STRUCTURES 9

Threshing floor - Drying floor - Poultry house - Dairy farm - Rat Proof godown and Farm roads - construction procedure. Structures for plant environment - Green houses — Polyhouses - Shadenets — Construction and utilisation.

UNIT-IV GRAIN STORAGE STRUCTURES 9

Feed storage - Existing grain storage methods - Requirements of good storage structures - Bag storage structures -Indigenous storage structures - Bukhari, Morai and Kothar; Grain bins- Cylindrical, rectangular and Pusa bin.

UNIT-V VENTILATION OF AGRICULTURAL STRUCTURES 9

Quantity of air flow for livestock ventilation – fundamental equations - moisture balance - selection of values -Problems on minimum, medium and maximum ventilation rate.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand types of agricultural structures and farmstead design.
2. To specify the construction oriented basic requirements of farm structures.
3. To design threshing floor, dairy farm and poultry houses.
4. To design various types and shapes of grain storage structures.
5. To quantify the ventilation requirement of agricultural structures.

TEXTBOOKS:

1. Pandey, P.H, “Principles and practices of Agricultural Structures and Environmental Control”, Kalyani Publishers, 2019.
2. S. Mangaraj, S. Swain, K. Alagusundaram, “Agricultural Structures Engineering”, Jain Brothers, 1st Edition,2021.
3. Vilas M. Salokhe and Ajay K. Sharma, “Greenhouse technology and Applications”, Agrotech publishing academy, 3rd Edition,2023.
4. Rangwala, “Engineering Materials”, Charotar Publishing House Pvt Ltd.,42th Edition,2021.
5. Jose Perez Alonso, “Agricultural Structures and Mechanization”,MDPI,2022.

REFERENCE BOOKS:

1. Nathonson J.A , “Basic Environmental Technology”, Pearson publisher,6th Edition,2017.
2. Garg S.K, “Water Supply Engineering”, Khanna Publishers, 36th Edition,2023.
3. Dutta B.N, “Estimating and Costing in Civil Engineering”, CBS Publishers & Distributors, 2022.
4. Banerjee G.C, “A Text Book of Animal Husbandry”, Oxford & IBH Publishing Co, 8th Edition, 2018.
5. G C Sahu, Joygopal Jena, “Building Materials and Construction”, McGraw-Hill Education, 2019.

AG3561	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	3	2	2	2	1	2	1	3	2	2	2	2	1	-
CO2	2	2	3	2	2	1	3	2	2	3	2	2	2	2	1	-
CO3	2	3	3	2	2	3	1	1	1	1	2	2	2	2	1	-
CO4	3	3	3	3	2	1	3	1	1	2	2	2	2	2	1	-
CO5	3	3	3	3	2	1	1	2	2	3	2	2	2	2	1	-
Average	2.4	2.6	3	2.4	2	1.6	1.8	1.6	1.4	2.4	2	2	2	2	1	-

AG3562	FARM MACHINERY AND EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce the working principles of farm equipment, tillage implements.
- To expose the students to farm mechanization benefits and constraints, identification of components of primary and secondary tillage implements.
- To learn different seed sowing machinery and transplanter functions.
- To understand the importance of weeding and plant protection equipment.
- To know the principles of harvesting machinery and earth moving equipment.

UNIT-I FARM MECHANIZATION 9

Farm mechanisation — objectives. Types of farm implements - Tillage - objectives - methods – Types - animal drawn ploughs - construction. Field capacity - forces acting on tillage tool.

UNIT-II PRIMARY AND SECONDARY TILLAGE IMPLEMENTS 9

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

UNIT-III SOWING AND FERTILIZING EQUIPMENT 9

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

UNIT-IV WEEDING AND PLANT PROTECTION EQUIPMENT 9

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

UNIT-V HARVESTING MACHINERY 9

Principles of cutting crop - types of harvesting machinery - vertical conveyor reaper and binder - combine harvesters — balers — threshers - combine losses. Machinery for horticulture - agro-forestry and forages - Haulage of agricultural and forest produces - Cost estimation for farm operations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand the basics of mechanizing a farm.
2. To understand the components of various tillage equipment.
3. To study different sowing and fertilizing attachments and stand-alone units.
4. To study about weeder attachments and sprayers.
5. To study about combine harvester-thresher for various crops and forages.

TEXTBOOKS:

1. Jain, S.C. and C.R. Rai, “Farm tractor maintenance and repair”, Standard publishers, 4th Edition, 2018.
2. Senthilkumar, T., R.Kavitha, V.M.Duraisamy and B.Suthakar “Text Book of Farm Machinery”, Thannambikkai publishers, Coimbatore, 2019.
3. Basavaraj, D Srigiri, Jayan P R, “A Textbook of Farm Machinery and Power Engineering”, NIPA Publisher,2019.
4. Srinivasan K, Narayanan V.V,Sanjeev Kumar Singh,Geethalakshmi L, “Tractors and Agricultural Machinery”, New India Publishing Agency, 2nd Edition,2015.
5. S. K. Gupta, “Agricultural Engineering: Principles and Practice”, Khanna Publishers,2017.

REFERENCE BOOKS:

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, “Tractors and their Power Units”, Wiley Eastern Pvt. Ltd., 1997.
2. Domkundwar A.V, “A course in internal combustion engines”, Dhanpat Rai & Co., 2018.
3. John Carroll, “An Illustrated History of Tractors & Farm Machinery”, Lorenz Books, 2018.

4. Jonathan Whitlam, “Tractors & Farm Machinery: An Illustrated History”, Amberley Publishing,2019.
5. Jagadeeshwar Sahay, “ Elements of Agricultural Engineering”, Standard Publishers Dsitributors, 6th Edition, 2022.

AG3562	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO2	2	1	3	-	-	-	3	1	2	1	2	1	1	-	2	1
CO3	-	2	1	-	2	2	1	2	1	1	2	1	2	2	3	1
CO4	1	-	-	2	3	1	3	2	1	-	3	1	-	-	1	3
CO5	2	-	1	2	3	1	3	2	1	-	2	1	1	3	2	1
Average	1	1	-	-	2	2	-	1	2	2	-	3	1	2	1	2

AG3563	POST HARVEST TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To expose the students to the fundamentals of various unit operations of Agricultural Processing
- To expose the students to different Post Harvest operations and processing methods of harvested crops
- To introduce material handling equipment, storage and waste utilization.
- To understand in-depth knowledge on the theory, methods and equipment for the various unit operations of crop processing.
- To utilize the skills on post- harvest machines to increase the market value of the processed food products.

UNIT-I FUNDAMENTALS OF POST – HARVESTING 9

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

UNIT-II PSYCHROMETRY AND DRYING 9

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

UNIT-III CLEANING AND GRADING 9

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

UNIT-IV SHELLING AND HANDLING 9

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

UNIT-V CROP PROCESSING 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the fundamental concepts of post-harvest technology and properties of agricultural materials, post-harvest operations and processing methods of harvested crops.
2. Understand the concept and theory of drying and various dryers.
3. Understand the principles of cleaning, sorting and grading.
4. Understand shelling process and different material handling equipment.
5. Understand the processing of various crops.

TEXTBOOKS:

1. Sadhna Pandey, Pandey S N, Pandey P H. 2016. Post-harvest management of horticultural crops. Kalyani Publishers Edition: 2. ISBN: 9789327263299.
2. Pandey, P H. 2016. Principles and practices of post harvest technology. Kalyani Publishers. Edition: 2. ISBN: 9788127239916.
3. Elhadi M. Yahia. Postharvest Technology of Perishable Horticultural Commodities. 2019. United Kingdom: Woodhead Publishing. ISBN: 9780128132777.
4. A. Chakraverty. 2019. Post-Harvest Technology of Cereals Pulses and Oilseeds 3Ed (Pb 2019). Oxford & Ibh Publishing. ISBN: 9788120409699
5. S. Krishnaprabhu. 2020. Post Harvest Technology A Text Book. Satish Serial Publishing house. ISBN: 9789388020985

REFERENCE BOOKS:

1. C.K.Sunil, K.A. Athmaselvi, N. Venkatachalapathy, C. Anandharamakrishnan, V.M. Balasubramaniam. 2024. “Unit Operations in Food Grain Processing”, Elsevier Science.

2. K.M Sahay and K.K Singh, 2020.“Unit Operations of Agricultural Processing”, Vikas Publication.
3. Amalendu Chakraverty and C. Anandha Ramakrishnan. 2016. "Post-harvest Technology and Food Process Engineering".
4. Verma, L.R. and V.K. Joshi. 2000. “Post harvest technology of fruits and vegetables – Handling, Processing, Fermentation and Waste Management”. Indus Publishing Company. New Delhi.
5. Chadha, K.L. 2009. “Handbook of Horticulture”. IARI Publications, New Delhi

AG3563	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	1	2	3	3	3	1	3	-	3	1	3	1	2	2	1	3
CO2	-	-	2	1	1	1	3	1	1	2	3	1	3	2	1	3
CO3	-	-	2	2	1	1	3	3	1	3	2	2	3	1	3	-
CO4	-	1	1	2	2	3	3	2	-	2	3	-	2	1	2	3
CO5	2	3	1	-	3	1	3	1	2	2	-	-	3	1	3	1
Average	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5

AG3564	UNIT OPERATIONS IN AGRICULTURAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- The students are exposed to the fundamental knowledge in Evaporation and Concentration
- To gain knowledge on mechanical separation, its types and equipment.
- To introduce students to the concepts of size reduction.
- To impart knowledge on the concepts of contact equilibrium separation.
- To gain knowledge on the principles of Crystallization and Distillation in processing of agricultural produce.

UNIT - I EVAPORATION AND CONCENTRATION 9

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 -Types of evaporators - Once through and circulation evaporators - Short tube evaporators and long tube evaporators - Agitated film evaporator.

UNIT - II MECHANICAL SEPARATION 9

Filtration - Definition - Filter media - Types and requirements - Constant rate filtration - Constant pressure filtration - Filter cake resistance - Filtration equipment - Rotary vacuum filter - Filter press - Sedimentation - Gravitational sedimentation of particles in a fluid - Stoke's law, sedimentation of particles in gas - Cyclones - Settling under sedimentation and gravitational sedimentation - Centrifugal separations - Rate of separations - Liquid - Liquid separation - Centrifuge equipment.

UNIT - III SIZE REDUCTION 9

Size reduction - Grinding and cutting - Principles of comminuting - Characteristics of comminuted products - Particle size distribution in comminuted products - Energy and

power requirements in comminuting - Crushing efficiency - Rittinger's, Bond's and Kick's laws for crushing - Size reduction equipments - Crushers- Jaw crusher, gyratory crusher - Crushing rolls - Grinders - Hammer mills - Rolling compression mills - Attrition, rod, ball and tube mills - construction and operation.

UNIT - IV CONTACT EQUILIBRIUM SEPARATION 9

Contact equilibrium separation processes - Concentrations - Gas - Liquid and solid - Liquid equilibrium concentration relationships - Operating conditions - Calculation of separation in contact equilibrium processes - Gas absorption - Rate of gas absorption - Stage - Equilibrium gas - Absorption equipment - Properties of tower packing - Types - Construction - Flow through packed towers - Extraction - Rate of extraction - Stage equilibrium extraction - Equipment for leaching coarse solids - Intermediate solids - Basket extractor - Extraction of fine material - Dorr agitator - Continuous leaching - Decantation systems - Extraction towers - Washing - Equipments.

UNIT - V CRYSTALLISATION AND DISTILLATION 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To examine the evaporation process and types of evaporators for food industry.
2. To analyze the principles of filtration and mechanical separation equipment.
3. To identify size reduction and grinding equipment and understand the factors affecting the process.
4. To identify the gas-liquid and solid-liquid equilibrium concepts and factors influencing equilibrium separation process.
5. To differentiate crystallization and distillation processes and identify processing equipment.

TEXTBOOKS:

1. Nema Prabhat K, “Unit Operations in Food Processing”, New India Publishing Agency, 2023.
2. Deepak Mudgil and Sheweta Mudgil, “Unit Operations in Food Processing”, Scientific Publishers, 2024.
3. C.K.Sunil, K.A. Athmaselvi, N. Venkatachalapathy, C. Anandharamakrishnan, V.M. Balasubramaniam, “Unit Operations in Food Grain Processing”, Elsevier Science, 2024
4. K M Sahay and K K Singh, “Unit Operations of Agricultural Processing”, Vikas Publication, 2020.
5. Amalendu Chakraverty and C. Anandha ramakrishnan "Post-harvest Technology and Food Process Engineering", 2016.

REFERENCE BOOKS:

1. C.K. Sunil, K.A. Athmaselvi, N. Venkatachalapathy, C. Anandharamakrishnan, and V.M. Balasubramaniam, “Unit Operations in Food Grain Processing”, Academic Press, 2024.
2. Seid Mahdi Jafari, “Engineering Principles of Unit Operations in Food Processing”, Woodhead Publishing, 2021.
3. Warren McCabe, Julian Smith and Peter Harriott, “Unit Operations of Chemical Engineering”, McGraw-Hill's, 2021
4. Ray Sinnott and Gavin Towler, “Chemical Engineering Design”, Butterworth-Heinemann Ltd”, 2019.
5. Christie John Geankoplis, A. Allen Hersel and Daniel H. Lepek, “Transport Processes and Separation Process Principles”, Pearson, 2015.

AG3564	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	3	1	2	1	1	1	-	-	-	-	1	1	1	1	1
CO2	2	3	1	2	1	1	-	-	-	-	-	1	1	1	1	1
CO3	2	3	1	1	1	1	1	-	-	-	-	1	1	1	1	1
CO4	2	3	1	1	1	1	1	-	-	-	-	1	1	1	1	1
CO5	2	3	1	2	1	1	1	-	-	-	-	1	1	1	1	1
Average	2.0	3.0	1.0	1.6	1.0	1.0	1.0	-	-	-	-	1.0	1.0	1.0	1.0	1.0

CE3531	ENVIRONMENTAL STUDIES	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT- I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity –endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ and Wild Life Act.

UNIT- II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts, Environmental policies and various Environmental Programmes conducted around the world.

UNIT- III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT- IV SUSTAINABILITY AND MANAGEMENT 6

Definition of Sustainability, Aspects of Sustainability, Transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs). The Role of UN and the Need for SDGs and Adoption by the World, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs Design for sustainability, Thinking Alternatives and Innovation, Causal Mapping, Systemic Mapping and Problem Identification Identifying probable interventions for Sustainable Development, Framework and Structuring of Seventeen SDGs.

UNIT- V SUSTAINABILITY PRACTICES 6

Zero waste and 3R concept, ISO 14000 Series, Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2. To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
3. To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
4. To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
5. To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. Daniel B. Botkin and Edward A. Keller "Environmental Science: Earth as a Living Planet", 8th Edition" Wiley India Publisher ,2024.
3. Deeksha Dave, S.S. Katewa, Chandana Mohanty, Sarbari Acharya, "Textbook of Environmental Studies (3rd Edition), Cengage India Publisher, 2024.
4. P.N. Palanisamy, P. Manikandan, A. Geetha, K. Manjula Rani, "Environmental Science", 4th Edition, Pearson Education Publisher,2023.
5. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 3rd edition, Pearson Education, 2023.
6. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall,2011.
7. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering Applications in Sustainable Design and Development, Cengage learning, 2015.

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CE3531	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-	-
CO2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-	-
CO3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-	-
CO4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-	-
CO5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-	-
Average	2.8	1.8	1.0	1.0	0.0	2.2	2.4	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0

GE3551	NCC Credit Course Level - II	L	T	P	C
	(Common to Army, Navy & Air)	3	0	0	3

OBJECTIVES:

- To know the basic principles of adventure program and creating awareness for social
- To improve the cadet's knowledge in firefighting and their health's
- To create an interest in handling the weapons and read the map
- To know the handling the situation on ground in army battle
- To know about anchors, ropes and communication procedure in the Naval wing

UNIT- I Adventure and Social awareness program 9

Parasailing, Slithering, Rock Climbing, Cycling and Trekking, Obstacle training. Basic Social Service and its needs, Rural Development Programmes. NGOs: Role and Contribution, Responsibility of Swachh Bharat Abhiyanm, Contribution of Youth towards Social Welfare, Social Security Schemes, Social Evils viz Dowry/ Female Foeticide/ Child abuse and trafficking etc. Protection of Children.

UNIT- II Fire Fighting and Health and Hygiene 9

Types of fire, Triangle of fire- Types of fire-fighting, water markings in the ship, NBCD organization and structure, Damage control, Aims of First Aid, Principle of First Aid, Motto of First Aid, List of items in First aid Box, Types of Bandages, Types of Fracture, Dislocation, Types of Wounds, Burns and Scalds, Sprain, Strain, Asphyxia, Drowning, Poison, Shock, Snake bite, Sun and Heat Stroke, Insect bite, Dog bite, Hanging, Artificial Respiration, Artificial respiration, carriage of sick and wounded

UNIT- III Weapon Training and Map Reading 9

Characteristics of a rifle/rifle ammunition and its fire power, Stripping, assembling, care and cleaning and sight setting of .22 rifle, Loading, cocking and unloading, The lying posn, holding and Aiming – 1, Range procedure and safety precautions, Theory of group and snap shooting, Introduction of types of Maps and conventional signs, Scales and Grid system, Topographical forms and technical terms, Relief, contours and Gradients, Cardinal points and types of north, Types of Bearings and use of service protracto, Prismatic compass and its use and GPS, Setting a map, finding north and own position, Map to Ground, Ground to Map, Point to Point March

UNIT- IV Field Craft and Battle Craft 9

Introduction, Judging Distance, Description of ground, Recognition, description and indication of landmarks and targets, Observation, Camouflage and Concealment, Field Signals, Section Formations, Fire Control Orders, Fire and Movement, Types of knots and lashings

UNIT- V Seamanship and Naval Communications 9

Anchor - parts of Anchor , parts of cable Types of Anchor, Rigging- Rope, Types of ropes, Care and maintenance of rope, Bends and Hitches, Shackles and Blocks**,** Introduction to naval modern communication, purpose and principles, duties of various communications department, Semaphore, letters and prosigns, reading and transmission of messages, phonetic alphabets, radio telephony procedure Sonar and Radar.

TOTAL : 45 PERIODS

Note: NCC Credit Course Level – II is offered for NCC students only. The grades earned by the students will be recorded in the marksheet, however the same shall not be considered for the computation of CGPA.

Course outcome:

1. Understand the responsibilities of the social works and adventure
2. Learnt about the techniques of firefighting and importance of hygiene
3. Capable to handle the weapons (Rifle .22) and read the map
4. Understand the importance of field and battle craft
5. Devolve the skills about seamanship and naval communication techniques.

TEXTBOOKS:

1. E- Book , NCC Red Book, Director General NCC, Ministry of Defence, RK Puram New Delhi (link: **red book 26-5-2017.pmd (s3waas.gov.in))**
2. Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, by RPH Editorial Board, Kindle Edition.

AG3565	DESIGN AND DRAWING OF FARM AND IRRIGATION STRUCTURES	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To conceive and design various farm structures related to agricultural engineering
- To conceive, design and draw the irrigation structures in detail showing the plan, elevation and sections
- To gain knowledge about Diversion Head Works.
- To differentiate various cross drainage structures.
- To have knowledge on canal regulators.

LIST OF EXPERIMENTS:

UNIT-I FARM STRUCTURES 15

Design of poultry house - sheep / goat house- farm fencing system- farm trusses ventilation system for dairy and poultry house.

UNIT-II ANK COMPONENTS 15

Fundamentals of design - Tank bunds – Tank surplus weirs – Tank sluice with tower head - Drawings showing foundation details, plan and elevation.

Unit -III CROSS DRAINAGE WORKS 15

General design principles - Aqueducts – Syphon aqueducts – Super passage – Canal syphon – Drawing showing plan, elevation and foundation details.

Unit -IV CANAL REGULATION STRUCTURES 15

General Principles - Canal head works – Canal regulator – Canal escape – Drawing showing detailed plan, elevation and foundation details.

TOTAL:30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. Learned design and draw the plan, elevation and sections of tank components, farm structures, cross drainage works and canal regulation structures
2. Calculate the dimensions of irrigation structures.
3. Gain knowledge about importance of irrigation structures and their applications.

4. Understanding on the ground elevation available, with which can choose the appropriate structure and design its components.
5. To impart deep knowledge on the foundation design.

TEXTBOOKS:

1. José Pérez-AlonsoJosé, Pérez-Alonso, “Agricultural Structures and Mechanization”
2. Santosh Kumar Garg, Irrigation Engineering and Hydraulic Structures [Paperback] 38th, Khanna Publishers, 2023
3. Satya Narayana Murthy Challa, “Water Resources Engineering: Principles and Practice”, New Age International Publishers, New Delhi, 2020.
4. Agarwal, Irrigation Engineering and Hydraulic Structures, S.K. Kataria & Sons, 1st (2014), Reprint 2022.
5. Sharma, Irrigation Engineering And Hydraulic Structures, S Chand Publishing, 2017.

REFERENCE BOOKS:

1. Balasubramanya, Hydraulic Structures & Irrigation Design Drawing, Sapna Book House, 1st 2017.
2. Raghunath, Irrigation Engineering, Wiley India,2011.
3. Biswas, Drip and Sprinkler Irrigation, New India Publishing Agency (NIPA), 2nd Fully Revised and Enlarged Edition 2025.
4. Varshney, Gupta, And Gupta, Theory and Design of Irrigation Structures, NEM CHAND & BROS, 2009.
5. Singh, Banerjee, Dholawala, Irrigation Engineering, Charotar,2015.

AG3565	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	1	2	1	-	-	-	-	-	-	1	1	1	-	1	-
CO2	-	3	2	1	-	-	-	-	-	-	1	-	-	-	2	2
CO3	2	-	1	2	-	-	-	-	-	-		-	1	-	2	2
CO4	2	1	-	2	-	-	-	-	-	-	1	2	1	-	-	2
CO5	-	1	2	1	-	-	-	-	-	-	1	1	1	-	1	-
Average	2	1.5	1.8	1.4	-	-	-	-	-	-	1	1.3	1	-	1.5	2

AG3566	TRACTORS AND FARM MACHINERY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To make the students conversant with the anatomy of farm tractor and farm engines.
- To make them understand the working principle of IC engines, clutch, gear box, differential and final drive.
- The students will be introduced to the practice of different farm machinery in the field on tillage, sowing, plant protection, harvesting and threshing.
- To know the adjustments of farm machines, dismantling and reassembling of a disc harrow, seed-cum fertilizer drill and sprayer.
- To recognize the working principle of various machines used in field.

LIST OF EXPERIMENTS:

1. Identification of major systems of a tractor and general guidelines on preliminary check measures - procedure for starting, running and stopping.
2. Study of electrical system, instruments in the dash board and controls — components: dynamo, starting motor, battery, lights, horn, odometer, ampere meter, accelerator, brake, differential lock, PTO lever, hydraulic lever, draft and position control lever.
3. Identification of components of power tiller, their maintenance and study on preliminary check measures and safety aspects - procedure for starting, running and stopping.
4. Identification and study of different components of diesel engine.
5. Identification and study of different components of petrol engine.
6. Field operation and adjustments of ploughs.
7. Field operation and adjustments of harrows.
8. Field operation and adjustments of cultivators.
9. Field operation of sowing and planting equipment and their adjustments.
10. Field operation of plant protection equipment.
11. Field operation on mowers.
12. Field operation of combine and determination of field losses.

TOTAL: 30 PERIODS

LIST OF EQUIPMENTS REQUIRED:

1. Tractor – 1no.
2. Power tiller – 1no.
3. Disc plough – 1no.
4. Disc harrow – 1no.
5. Multi type cultivator – 1no.
6. Paddy Transplanter – 1no.
7. Seed drill – 1no.
8. Sprayer – 1no.
9. Mower – 1no.
10. Weeder -1no.C
11. Combine harvester -1 no. (optional) – can be had as demonstration.

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. Understand the working of tractors, power tillers and their functions.
2. Identify and rectify problems in the functioning of tractors and power tillers.
3. Summarize the ergonomics of tractors and power tillers.
4. Hands on experience in field operation of ploughs, harrows, cultivators.
5. Determination of field loss and adjustment of till and disc angles.

TEXT BOOKS:

1. Jagdishwar Sahay, “Elements of Agricultural Engineering”, Standard Publishers Distributors, 6th Edition,2022.
2. Michael, A.M. and Ohja, T.P, “Principles of Agricultural Engineering” Volume 1, Jain Brothers, 15th Edition,2023.
3. Jain, S.C. and C.R. Rai, “Farm tractor maintenance and repair”, Standard publishers, 4th Edition, 2018.
4. Jagvir Dixit, Kaley Khan, M. Muzamil, “Farm Machinery and Equipment – Practical Manual”, Brillion Publishing,2021.
5. Basavaraj, D Srigiri, Jayan P R, “A Textbook of Farm Machinery and Power Engineering”, NIPA Publisher,2019.

REFERENCE BOOKS:

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, “Tractors and their Power Units”, Wiley Eastern Pvt. Ltd., New Delhi, 1997.
2. Domkundwar A.V, “ A course in internal combustion engines” Dhanpat Rai & Co. (P) Ltd., Educational and Technical Publishers, 2023.
3. V. Ganesan, “Internal Combustion Engines”, McGraw-Hill Education, 4th Edition, 2019.
4. Jagvir Dixit, “Farm Machinery and Equipment-I (Practical Manual)”, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir,2018.
5. T. Senthil Kumar, B. Sathish Kumar, G. Manikandan, “Farm Machinery and Equipment – Principles & Practice”, Thannambikkai publishers,2019.

AG3566	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	1	2	-	-	-	1	-	2	1	2	1	1	3
CO2	1	-	2	1	2	-	-	-	1	-	1	1	1	1	2	1
CO3	2	1	1	-	1	1	-	1	1	-	1	-	1	2	3	2
CO4	2	1	2	1	-	-	1	-	-	-	1	-	1	2	3	1
CO5	3	2	2	1	1	-	2	-	2	-	1	1	1	2	2	3
Average	2	1.5	1.6	1	1.5	1	1.5	1	1.25	-	1.2	1	1.2	1.6	2.2	2

AG3567	POST HARVEST ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To determine various engineering properties of grains.
- To understand how to test and evaluate different post harvesting machineries.
- To get knowledge about evaluating the shelling efficiency of Agricultural materials.
- To visit industries working on post harvesting technologies.
- To evaluate the working efficiency of various agricultural machineries.

LIST OF EXPERIMENTS:

1. Determination of moisture content of grains by oven method and moisture meter.
2. Determination of porosity of grains.
3. Determination of coefficient of friction and angle of repose of grains.
4. Testing of paddy thresher & paddy winnower.
5. Determining the efficiency and testing of groundnut decorticator.
6. Determining the efficiency maize sheller.
7. Evaluation of thin layer drier.
8. Evaluation of L.S.U..drier.
9. Determining the efficiency of bucket elevator and screw conveyor.
10. Evaluation of shelling efficiency of rubber roll sheller.
11. Determining the oil content of oilseeds.
12. Visit to modern rice mill and pulse milling industry.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. Students will be able to determine various engineering properties of grains and its coefficients.
2. Students are able to done the testing for the various Agricultural machinery of paddy, groundnut and maize.
3. Evaluation of various agriculture machineries can be done by the students.

4. Also getting the knowledge about the shelling efficiency and oil content of oilseed crops.
5. Understanding the concepts of processing done in the various mills.

TEXT BOOKS:

1. K M Sahay and K K Singh, “Unit Operations of Agricultural Processing”, Vikas Publication, 2020.
2. S. Krishnaprabhu. 2020. Post Harvest Technology A Text Book. Satish Serial Publishing house. ISBN: 9789388020985.
3. Elhadi M. Yahia. Postharvest Technology of Perishable Horticultural Commodities. 2019. United Kingdom: Woodhead Publishing. ISBN: 9780128132777.
4. A. Chakraverty. 2019. Post-Harvest Technology of Cereals Pulses and Oilseeds 3Ed (Pb 2019). Oxford & Ibh Publishing. ISBN: 9788120409699.
5. Pandey, P H. 2016. Principles and practices of post harvest technology. Kalyani Publishers. Edition: 2. ISBN: 9788127239916.

REFERENCE BOOKS:

1. C.K. Sunil, K.A. Athmaselvi, N. Venkatachalapathy, C. Anandharamakrishnan, and V.M. Balasubramaniam, “Unit Operations in Food Grain Processing”, Academic Press, 2024.
2. Seid Mahdi Jafari, “Engineering Principles of Unit Operations in Food Processing”, Woodhead Publishing, 2021.
3. Warren McCabe, Julian Smith and Peter Harriott, “Unit Operations of Chemical Engineering”, McGraw-Hill's, 2021
4. Ray Sinnott and Gavin Towler, “Chemical Engineering Design”, Butterworth-Heinemann Ltd”, 2019.
5. Christie John Geankoplis, A. Allen Hersel and Daniel H. Lepek, “Transport Processes and Separation Process Principles”, Pearson, 2015.

AG3567	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	3	-	1	2	-	-	2	1	3	2	1	3	1

CO2	2	1	1	2	3	1	1	-	1	2	1	2	1	2	1	3
CO3	3	2	2	3	3	-	-	2	2	3	3	2	2	2	3	1
CO4	2	2	2	1	-	-	-	2	2	3	3	2	2	1	2	3
CO5	1	3	2	1	1	-	-	-	-	2	1	2	1	1	2	2
Average	2.0	2.0	1.6	2.0	2.3	1.0	1.5	2.0	1.7	2.4	1.8	2.2	1.6	1.4	2.2	2.0

SEMESTER VI

AG3661	DESIGN OF AGRICULTURAL MACHINERY	L	T	P	C
		3	0	0	3

(Note: Use of PSG Design Data book is permitted in the university examination)

OBJECTIVES:

The course prepares to

- Select the materials and design machine members subjected to static and variable loads.
- Design the power transmission systems.
- Design shafts and couplings for various applications.
- Design helical, leaf springs and flywheels for various applications.
- Design and selection of gears and contact bearings.

UNIT-I STRESSES IN MACHINE MEMBERS 9

Introduction to design process- factor influencing the machine design, selection of material based on mechanical properties- Direct and bending equations- calculation of Principal stresses for combined loading - factor of safety — theories of failure- stress concentration- Soderberg and Goodman relations.

UNIT-II DESIGN OF POWER TRANSMISSION SYSTEMS 9

Selection of V-Belts and pulleys- selection of flat belts and pulleys- selection of transmission chains and sprockets. Design of pulleys and sprockets.

UNIT-III DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength and rigidity- Design of keys, keyways and splines- Design of rigid and flexible couplings. knuckle and cotter joints.

UNIT-IV DESIGN OF ENERGY STORING ELEMENTS 9

Design of helical, leaf, and torsional springs under constant loads and varying loads — Concentric torsion springs.

UNIT-V DESIGN OF GEARS AND BEARINGS 9

Gears - spur gear and helical gear - terminology - strength of gear teeth - Lewis equation — Buckingham equation. - Failure of gear teeth. Design of bearings — sliding contact and rolling contact types. Design of journal bearings — Lubrication in journal bearings.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Select the materials and design machine members subjected to static and variable loads.
2. Design the power transmission systems.
3. Design shafts and couplings for various applications.
4. Design helical, leaf springs and flywheels for various applications.
5. Design and selection of gears and contact bearings.

TEXTBOOKS:

1. Khurmi R.S and Gupta J.K, “A Textbook of Machine Design”, Euarsia publication house, 2005.
2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co,2003.
3. Robert L. Mott, “Machine Elements in Mechanical Design”,Pearson Publisher, 6th Edition,2020.
4. Richard G. Budynas, J.K. Nisbett, “Mechanical Engineering Design”, McGraw-Hill Publisher, 11th Edition,2020.
5. P.C. Sharma & D.K. Aggarwal, “Machine Design”,S.K. Kataria & SonsPublisher, 13th Edition,2018.

REFERENCE BOOKS:

1. Norton R.L, “Machine Design – An Integrated Approach”, Pearson Publications,25th Edition, 2006.
2. Srivastava A.K, Goering.C E andRohrbach R.P. “Engineering Principles of Agricultural Machines”, Revised Printing by American Society of Agricultural Engineers.1993.
3. Gary Krutz, Lester Thompson and Paul Clear, “Design of Agricultural Machinery”, John Wiley and Sons, New York, 1984.
4. S.S. Rattan, “Theory of Machines and Machine Design”,McGraw-Hill Publisher, 5th Edition,2019.
5. Robert L. Mott,“ Machine Elements in Mechanical Design”, Pearson Education,5th Edition,2020.

AG3661	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
CO2	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
CO3	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
CO4	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
CO5	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
Average	2.0	2.0	3.0	-	-	-	-	1.0	-	-	-	2.0	3.0	3.0	-	-

AG3662	BIO - ENERGY RESOURCE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To aimed at dissemination of important information of bio-energy to enable students to acquire knowledge on cutting-edge technologies for conversion of various biomass feedstock
- To impart the fundamental knowledge on the importance of Bioenergy and reactors.
- To acquire knowledge on bio-energy / biofuel production and their utilization in combustion engines / devices and fuel cells.
- To introduce the principle of operation and environment impact analysis.
- To successful completion of the course, the students would be able to contribute towards providing biomass based sustainable energy solutions

UNIT-I BIO RESOURCE- AN INTRODUCTION 9

Introduction, Classification and properties of biomass, Biomass characterization, different energy conversion methods, Bio Energy Resources, World Bio Energy Potential, India's Bio Energy Potential, Biomass Resources and classification, Physio- chemical characteristics. Biomass Combustion, Loose biomass densification, Biomass based power generation and utilization for domestic cooking, Improved biomass cookstoves.

UNIT-II BIOENERGY 9

Technology of Biogas production, Biogas Plants, Digester types, Digester design, Chemical kinetics and mathematical modeling of bio methanation process, Dung, Vegetable Waste and Municipal Waste based Biogas plants, Biogas as fuel for transportation, Lighting, Running Dual Fuel Engines, Electricity generation, Biogas Bottling Plant Technology, Application of Biogas slurry in agriculture, Design of Biogas for cold climates. Case studies and numerical.

UNIT-III BIO REACTORS AND FERMENTORS 9

Bio reactors/ fermentors — Batch type — continuous stirred tank reactors- Biological wastewater treatment-Activated sludge process- Downstream processing- Recovery and purification of products.

UNIT-IV ALCOHOL PRODUCTION 9

Bio-ethanol production from lignocelluloses, waste material, including crop residue, sugar and starch- biodiesel production from vegetable oil and animal fat, algae-bio-fuel derived from-economics of bio-fuel production-environmental impacts of bio-fuels- bio- fuel blends- green diesel from vegetable oil- biodiesel production process, by-product utilization. Production of butanol and propanol- Production of bio-hydrogen-production of hydrogen by fermentative bacteria.

UNIT-V SOCIO-ECONOMIC ASPECT OF BIOENERGY 9

Social, economic and environmental aspects of bioenergy resources. Policies and measures to promote the use of bioenergy resources for sustainable environmental - Impact on Environment– Bio energy policy.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To characterize different bioenergy stocks based on its constituents and properties
2. To understand and evaluate various bioenergy pretreatment and processing techniques in terms of their applicability.
3. To impart knowledge on bioenergy and its impact on environment.
4. To understand the principles of alcohol production and its application.
5. To gain brief knowledge on Energy and Environment.

TEXTBOOKS:

1. Mutha, V. K. (2010). Handbook of bio-energy and bio-fuel SBS Publishers, Delhi
2. Dahiya, A. (Ed.). (2014). Bioenergy: Biomass to biofuels. Academic Press.
3. Hall, D. O., & Overend, R. P. (1987). Biomass: regenerable energy.
4. San Pietro, A. (Ed.). (2012). Biochemical and photosynthetic aspects of Elsevier. New York.
5. Abul Kalam Azad, Mohammad Masud Kamal Khan,2021, Bioenergy Resources and Technologies.

REFERENCE BOOKS:

1. Chawla O.P, Advances in BiogasTechnology ICAR publication New Delhi1986
2. Mehrez Ikram, Sutha Shobana, Georgeio Semaan Biomass Based Bioenergy: Technologies and Impact on Environmental Sustainability 2022, Journal of Korean Society of Environmental Engineers.
3. Siwal, S.S.; Sheoran, K.; Saini, A.K.; Vo, D.V.N.; Wang, Q.; Thakur, V.K. Advanced thermochemical conversion technologies used for energy generation: Advancement and prospects. Fuel 2022
4. Alba S. A.E. Humphery and N.E. Milles. (1973). Bio Chemical Engineering
5. Baily, J.E and D.F. Ollies. (1986). Bi Chemical Engineering Fundamentals, Prescott and Dunn Industrial Micro Biology.

AG3662	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	1	-	-	1	3	-	-	-	2	1	2	-	-	2
CO2	-	2	-	1	-	1	2	-	-	-	-	1	-	-	2	1
CO3	1	2	-	-	-	-	1	-	-	-	1	-	1	1	-	-
CO4	-	-	-	2	-	-	-	-	-	-	2	2	2	1	-	3
CO5	2	-	-	-	-	2	2	-	-	-	-	1	-	2	1	-
Average	1.5	2.0	1.0	1.5	-	-	-	-	-	-	1.7	1.3	1.7	1.3	1.5	2.0

AG3663	SOIL AND WATER CONSERVATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand the basic concept and classification of the soil and water erosion.
- To learn about the methods used for estimating the soil erosion.
- To gain knowledge about the Erosion control measures
- To gain knowledge about water conservation measures.
- To expose students about sedimentation, its types, distribution patterns and also the methods to control them.

UNIT-I INRODUCTION FOR SOIL AND WATER EROSION 9

Soil erosion - introduction, causes and types -Geological and accelerated erosion- Erosion agents- Factors affecting and effects of erosion. Water erosion - Mechanics and forms. Gullies –Classification & stages of development- Gully Control Structures: Drop Spillway, Drop Inlet, Chute Spillways.

UNIT-II ESTIMATION OF SOIL EROSION 9

Soil loss estimation – Universal soil loss equation (USLE) and modified USLE, Revised Universal Soil Loss Equation Rainfall erosivity -estimation by KE>25 and EI 30 methods- Measurement of soil erosion - Runoff plots, soil samplers. Soil erodibility and other management factors.

UNIT-III EROSION CONTROL MEASURES 9

Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching; Engineering measures – Bunding: Types and design specifications – Mechanical measures for hill slopes – Terracing: Classification and design specification of bench terrace – Grassed waterways: Location, construction and maintenance – Types of temporary and permanent gully control structures.

UNIT-IV WATER CONSERVATION MEASURES 9

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

UNIT-V SEDIMENTATION 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understanding fundamental concepts of erosion and sedimentation.
2. Gain sufficient knowledge on soil and water conservation measures.
3. Acquire a knowledge to quantify the soil erosion by using various methods.
4. Gaining Knowledge on erosion control measures.
5. Gain knowledge to use conventional methods to determine sedimentation and to conserve water.

TEXTBOOKS:

1. Rajendra Singh, Soil and Water Conservation Structures Design, Springer Nature Singapore, 2023.
2. Suresh R, Soil and Water Conservation Engineering, Standard Publishers, 5th Edition,2023
3. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 15th Edition, Jain Brothers, New Delhi, 2013.
4. Ghanshyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, 2nd Edition, New Delhi, 2009.
5. Ramachandran. J., K. Arunadevi. K, & Anandaraj. N., Basics of Soil and Water Conservation Engineering,

REFERENCE BOOKS:

1. Madan K. Jha V.V.N. Murty, Land and Water Management Engineering, Kalyani Publishers, 2013.
2. Dr.Gummadi Venkata Rao, Soil and Water Conservation Engineering, Mahi Publication, 2023.
3. Manjeet Singh, Urmila and K.K. Yadav, Soil and Water Conservation & Management, ATPA, 2024.
4. Mahnot,S.C, Soil and Water Conservation and Watershe Management. International Books and Periodicals Supply Service, New Delhi, 2014.
5. Mal, B.C. 2014. Introduction to Soil and /Water Conservation Engineering. 2014. Kalyani Publishers.

AG3663	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	1	2	1	-	-	2	-	-	2	1	-	-	2	-
CO2	-	1	-	2	-	-	-	-	1	-	-	-	1	1	-	2
CO3	1	2	2	-	--	-	2	-	-	-	-	-	2	-	1	-
CO4	-	1	2	-	-	-	-	-	-	-	1	-	-	1	2	-
CO5	-	-	2	-	2	-	-	2	-	-	-	1	3	-	2	-
Average	1.5	1.3	1.8	2.0	1.5	-	2.0	2.0	1.0	-	1.5	1.0	2.0	1.0	1.8	2.0

AG3664	CAD FOR AGRICULTURAL MACHINERY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To design and draft various ploughs.
- To design and draft Cultivators.
- To design and draft various harrows.
- To design and draft mower and weeder.
- To introduce the student's various 3D modeling Software's.

LIST OF EXPERIMENTS:

1. Design and Drawing of Mould board plough
2. Design and Drawing of Disk plough.
3. Design and Drawing of Cultivator.
4. Design and Drawing of Disc Harrow
5. Design and Drawing of Mower
6. Design and Drawing of Weeder
7. Introduction & demonstration on 3D modeling softwares like Pro/E, Creo, Solidworks, Solid Edge etc.

TOTAL:30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. Learning about the design and draw the various ploughs.
2. Understanding design and draw the cultivators.
3. Design and draw the various harrows.
4. Studying about design and draw the mower and weeder.
5. learn about the 3D modelling software.

TEXTBOOKS:

1. Sharma D.N. &Mukesh, "Farm Machinery Design Principles & Problems",Jain Bros; 4th edition, December 2012.
2. Massimiliano Varani, Design, Optimization and Analysis of Agricultural Machinery, MDPI Books, 2024.

3. Hijam Jiten Singh, Mukesh Kumar Singh, N. S. Chandel, K. P. Singh, Development and Production of Agricultural Machinery Using Computer-Aided Design, Indian Farming, Vol. 66 No. 1, 2016.
4. Basavaraj, Srigiri, & Jayan, A Textbook of Farm Machinery & Power Engineering, New India Publishing Agency- Nipa,2019.
5. Seung-Kyum Choi, Recep M. Gorguluarslan, and Qi Zhou, Computer-Aided Manufacturing and Design, MDPI Books, 2020.

REFERENCE BOOKS:

1. Karthik, Ravi Natrajan, Design of Agricultural Machinery and Equipment, Agri Horti Press, 2024.
2. Guangnan Chen, Advances in Agricultural Machinery and Technologies, CRC Press, 2018.
3. Mustafa Ucgul and Chung-Liang Chang, Design and Application of Agricultural Equipment in Tillage System, MDPI Books, 2023.
4. Han Zhongzhi, Computer Vision-Based Agriculture Engineering, CRC Press, 2020.
5. Zhuming Bi and Xiaoqin Wang, Computer-Aided Design and Manufacturing, Wiley-ASME Press,2020.

AG3664	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	1	-	3	-	1	3	2	1	3	2	1	3	1
CO2	1	-	3	1	-	1	2	-	1	1	-	3	1	1	3	2
CO3	-	1	-	1	-	2	1	-	-	-	-	1	1	2	3	2
CO4	-	3	2	1	-	1	1	-	1	-	-	2	2	1	2	3
CO5	-	-	3	1	2	1	3	-	1	-	-	3	2	1	3	1
Average	1.5	2.0	2.7	1.0	2.0	1.6	1.8	1.0	1.5	1.5	1.0	2.4	1.6	1.2	2.8	1.8

AG3641	MINI PROJECT	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports
- To train students to face reviews and viva voce examination.
- To guide the students to overcome the practical difficulties in their field of interest.
- To improve the presentation skills of students.

Students in a group of 3 or 4 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on their views by the committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. On completion of the project work, students will be in a position to take up any challenging practical problems.
2. To frame a methodology, with the help of literature review.
3. To execute the project in correct sequence.
4. To get hands on experience in writing report.
5. To gain self confidence in presenting the project.

AG3641	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	3	1	2	2	1	-	3	3	2	2	3	3	3	3
CO2	2	2	2	2	1	1	-	-	3	2	2	3	1	3	3	2
CO3	-	1	3	3	2	1	1	-	3	1	2	2	--	2	2	1
CO4	-	-	-	2	3	2	-	-	2	2	1	2	3	2	2	2
CO5	-	-	-	-	2	1	-	-	2	3	1	3	1	2	3	1
Average	1.5	1.7	2.7	2.0	2.0	1.4	1.0	-	2.6	2.2	1.6	2.4	2.0	2.4	2.6	1.8

EN3649 PROFESSIONAL COMMUNICATION LABORATORY L T P C

0 0 2 1

OBJECTIVES

The course aims to

- Enhance the Employability and Career Skills of students.
- Orient the students towards grooming as a professional.
- To learn how to speak in Group Discussions
- Make them employable Graduates and help them attend interviews successfully.
- Develop their confidence and help them express views clearly

UNIT- I **6**

English for competitive exams —general awareness of current affairs – multiple choice – cloze – vocabulary structure.

UNIT- II **6**

Introduction to soft skills - Interpersonal communication - Introducing oneself to the audience — answering questions – writing a message – memo –mail – asking for comments – giving information – agreeing to requests – apologizing – Complaining – Business proposal – short report – summarizing.

UNIT- III **6**

Introduction to Group Discussion— participating in Group Discussions – questioning and clarifying – GD strategies –monologues – dialogues

UNIT- IV **6**

Interview etiquette – Portfolio development - attending job interviews – FAQs related to job interviews - Interview types – expressing opinions – present circumstances - past experiences – future plans

UNIT- V **6**

Recognizing differences between groups and teams - networking professionally-respecting social protocols- understanding career management- developing a long-term career plan- making career changes. – organizing a larger unit of discourse – expressing and justifying opinions – negotiating – collaborating – disagreeing – speculating – decision taking.

Total Periods: 30

The lab course is offered as an **Employability Enhancement Course**

The course is offered as a **one credit** paper with an End Semester Examination.

OUTCOMES:

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

- Make effective presentations and participate confidently in Group Discussions
- Attend job interviews and interacting in different situations.
- Able to write business reports, proposals and related correspondence.
- Develop adequate Soft Skills required for the workplace

REFERENCE BOOKS:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students, Orient Blackswan: Hyderabad, 2016.
3. E.Suresh Kumar Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharan. Soft Skills. MJP Publishers: Chennai, 2010.
6. Successful Presentations: DVD and Student's Book. A video series teaching business communication skills for adult professionals by John Huges and Andrew Mallett- OUP 2012.
7. Goodheart-Willcox, "Professional Communication", First Edition, 2017. Online test book
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 Edition, 2015
9. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

CO	Programme Outcomes												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	1	-	1	-	-	-	2	-	1	-	-	-	-
2	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	--
3	-	-	-	-	1	-	-	-	-	2	-	1	-	-	-	-
4	-	1	-	-	-	-	-	-	-	2	-	1	-	-	-	-
5	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-

1 - low, 2 – medium, 3 – high, '-' – no correlation

SEMESTER VII

AG3761	FOOD AND DAIRY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To acquire better understanding of the food concentration and thermal processing of foods.
- To know the physical and thermal properties of milk and different methods of milk processing and milk products.
- To gain knowledge on the theory, methods, and equipment for the various unit operations of dairy industry.
- To gain knowledge about the food preserving and packing technology.
- To impart knowledge on nanotechnology in food preservation.

UNIT-I BASIC PROPERTIES AND THERMAL PROCESSING OF FOODS MATERIALS 9

Constituents of food and their energy values — rheological properties of food materials- texture of food materials -viscometry - Concentrations of foods - Thermal processing of foods - kinetics of microbial destruction - microwave and radio frequency heating in food processing - UHT Processing - sterilization of solid and liquid foods - Preservation by retort processing — Canning - Aseptic packaging.

UNIT-II DRYING AND DEHYDRATION 9

Food spoilage - causes for spoilage -Moisture content — Types - equilibrium moisture content - Water activity - sorption behavior of foods - types of dryers – dehydration and its methods.

UNIT-III MILK PROCESSING 9

Physical, chemical, thermal and rheological properties of milk - storage tanks. Receiving handling and testing of milk - storage. Pasteurization – Types – equipments – application. Filling and packaging of milk and milk products.

UNIT-IV DAIRY EQUIPMENT AND PRODUCTS 9

Homogenisation - theory and working of homogenisers — Types and design criteria for homogenizing equipment- cream separators - Clarifiers - butter churner – ice cream freezers - milk products manufacture — Ghee — Whey - condensed milk — milk powder - paneer - casein - probiotic dairy products - kefir-milk plant

sanitation requirements - Cleaning in-place and its functions.

UNIT-V ADVANCED TECHNOLOGIES IN FOOD PROCESSING 9

Non-thermal and other alternate thermal processing in Food processing – Nanotechnology - Nanomaterials - applications in food packaging and products — implications — Impact in environment and global economy - regulation of nanotechnology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Explain physio-chemical properties of food material and select suitable thermal processing method for food products based on their properties.
2. Compare food drying systems and assess their limitations in applying different food products.
3. Explain physical, chemical and thermal properties of milk and compare milk processing techniques.
4. Apply various milk processing equipment for processing and producing milk products and evaluate their performance.
5. Assess the application and limitations of advanced food processing techniques.

TEXT BOOKS:

1. R. Paul Singh, Dennis R. Heldman, Ferruh Erdogdu, " Introduction to Food Engineering", 4th Edition, Academic Press, USA. 2022.
2. Heldman, Dennis R., Daryl B. Lund, and Cristina Sabliov, "Handbook of food engineering" 3rd Edition , CRC press, 2018.
3. Murlidhar Meghwal, Megh R. Goyal, Rupesh S. Chavan, "Dairy Engineering: Advanced Technologies and Their Applications",CRC Press, 2017.
4. Sukumar De, "Outlines of Dairy Technology",48th Edition, Oxford University Press, 2022.
5. Minj Jagrani, Aparna Sudhakaran, and Anuradha Kumari, "Dairy Processing: Advanced Research to Applications", Springer, 2020.

REFERENCE BOOKS:

1. V. Chelladurai, and Digvir S. Jayas, “Nanoscience and nanotechnology in foods and beverages”, CRC Press, 2018.
2. Chandra Gopala Rao,“Essentials of Food Process Engineering”, B.S. Publications, Hyderabad,2023.
3. Zeki Berk, “Food Process Engineering and Technology”, 3rd Edition, Elsevier, 2018.
4. Prof. Liam Edberg, “Technology of Dairy Plant Operations: Principles and Applications”, Arcler Press LLC, 2015.
5. Myer Kutz, “Handbook of Farm, Dairy and Food Machinery Engineering”, 3rd Edition, Academic Press, 2019.

PAG101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	2	1	1	1	-	-	-	-	-	-	2	2	2	2
CO2	1	1	2	3	2	1	1	-	-	-	1	-	2	2	2	2
CO3	2	1	1	1	1	1	1	-	-	-	-	-	2	2	2	2
CO4	1	1	2	3	1	1	1	-	-	-	1	-	2	2	2	2
CO5	2	1	1	3	3	1	1	-	-	-	2	-	2	2	2	2
Average	1.8	1.0	1.6	2.2	1.6	1.0	1.0	-	-	-	1.3	-	2.0	2.0	2.0	2.0

AG3762	REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce the principles and basic concepts of remote Sensing.
- To introduce the remote sensing systems, data products and analysis.
- To introduce about the basic concepts of GIS.
- To introduce the spatial data models, analysis and presentation techniques
- To gain knowledge about the application of remote sensing and GIS in agriculture.

UNIT-I CONCEPTS OF REMOTE SENSING AND SATELLITES 9

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

UNIT-II DATA PRODUCTS AND IMAGE ANALYSIS 9

Data products –based on level of processing- o/p – scale – area/coverage – data availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices.

UNIT-III CONCEPTS OF GIS 9

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

UNIT-IV DATA INPUTAND ANALYSIS 9

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

UNIT-V APPLICATION OF RS AND GIS 9

Crop Acreage estimation - Estimation of Crop Water Requirement - Crop condition - Soil mapping-classification of soil with digital numbers - soil erosion mapping-reservoir sedimentation using image processing - Inventory of water resources - water quality assessment - Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health - Management Decision Support Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understanding the remote sensing principles, remote sensing systems satellite data processing and available data products.
2. Get Knowledge about the input required to run the software
3. Understanding decision making process using DBMS and utilization of these advanced techniques in addressing the real-world problems.
4. Application Remote Sensing and GIS in agriculture, soil and water resources are understand with practical applications.
5. Learn about Real-time crop water requirement is identified accurately.

TEXTBOOKS:

1. Anji Reddy, Textbook of Remote Sensing and Geographical Information Systems, 4th Edition, BS Publications/BSP Books, 2012.
2. Lillesand, Kiefer, and Chipman, Remote Sensing and Image Interpretation, 6ed (WSE), Wiley, 2015.
3. Jensen, Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Edn, Pearson Education India, 2013.

4. Chandra & Ghosh, Remote Sensing and Geographic Information System, Alpha Science International Ltd, 2015.
5. Prasad Thenkabail, Remote Sensing Handbook, Second Edition, Six Volume Set, CRC Press, 2024.

REFERENCE BOOKS:

1. Tammy Parece and John McGee, Remote Sensing with ArcGIS Pro (second edition), Virginia Tech, 2023.
2. Basudeb Bhatta, Remote Sensing And Gis 3e, Oup India, 2021.
3. Alaguraja Palanichamy, Remote Sensing and Geographic Information System (Gis) - A Practical Guide, Mahipublication, 2020.
4. Alaguraja Palanichamy, Venkateswarlu Gogana, Ramya Ranjan Behera, & Amit Kumar Pandey, Fundamentals Of Geographic Information System And Remote Sensing, Academic Guru Publishing House, 2023.
5. Gouri Sankar, Uday Chatterjee & Gopal Krishna Panda Bhunia, Advances in Geoinformatics Remote Sensing and Gis, 2021.

AG3762	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	1	2	3	-	-	-	-	2	-	1	-	2	1	-
CO2	-	1	-	-	3	1	-	-	-	2	-	-	2	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	2	-	2	1	-	-
CO4	-	3	-	2	-	-	-	-	1	-	-	2	-	1	2	-
CO5	1	-	3	1	2	-	2	-	-	-	-	1	-	-	1	2
Average	1.5	2.0	2.0	1.7	2.7	1.0	2.0	-	1.0	2.0	2.0	1.3	2.0	1.3	1.3	1.5

BA3711	HUMAN VALUES AND ETHICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce and educate the students on the concept of Human Values.
- To support students to understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living.
- To help the students to understand social ethics and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

UNIT I: HUMAN VALUES **6**

Human value – needs, Values and its Types - Ethics. Moral values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character.

UNIT II: VALUE EDUCATION **6**

Value Education: Definition, Concept and Need for Value Education. The Content and Process of Value Education. Basic Guidelines for Value Education.

UNIT III: HARMONY **6**

Harmony in the Family- the basic unit of human interaction, Trust and Respect, Harmony of the Self with the Body: Self -regulation and Health. Harmony in Society: Dimensions system of Human Order. Harmony in Nature: The Four Orders in Nature.

UNIT IV: SOCIAL ETHICS **6**

The Basics for Ethical Human conduct - Defects in Ethical Human Conduct - Holistic and Universal order - Universal Human Order and Ethical Conduct.

UNIT V: ETHICS IN PROFESSION **6**

Professional Integrity, Respect & Equality, Privacy, Positive co-operation, Respecting the competence of other professions. - Business ethics - Environmental ethics - Internet ethics - Engineers as expert witnesses and advisors.

TOTALHOURS: 30

OUTCOMES:

1. Students will be able to understand the significance of value inputs in a classroom and start applying them in their life and profession.
2. Students will be able to understand the need, basic guidelines, content and process of value education.
3. Students will be able to the role of a human being in ensuring harmony in society and nature.
4. Students will be able to understand social ethics.
5. Students will be able to Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

REFERENCES:

1. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013.
2. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill - 2003.
3. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Professional Ethics and Human Values”, Prentice Hall of India, New Delhi, 2013.
5. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York, 3rd edition (2017).
6. R. Subramanian, ‘Professional Ethics’ Oxford University Press, 2nd Edition 2017
7. R. S. Nagarazan, ‘A Textbook on Professional Ethics and Human Values’ New Age International Publishers, 2015.
8. World Community Service Centre, “Value Education", Vethathiri publications, Erode, 2011.
9. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
10. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press, 2003.
11. Suresh Jayshree, 2003, Human Values and Professional Ethics, ,S. Chand Publishing, Third Revised Edition.

E-BOOK :

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.
2. R. S. Nagarazan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015.

BA3711	PO							
	1	2	3	4	5	6	7	8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	1	-	-	-	-	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	1	-	-	-	-
CO5	-	-	-	2	-	-	-	-
Average	-	-	1	2	-	-	1	-

AG3763	FOOD PROCESS ENGINEERING	L	T	P	C
	LABORATORY	0	0	3	1.5

OBJECTIVES:

- To get basic knowledge on various properties of food.
- To gets hand on experience on food process technology.
- To get knowledge on food adulteration.
- To determine the properties of various food materials.
- To visit food processing and dairy industry.

LIST OF EXPERIMENTS:

1. Determination of cooking properties of parboiled and raw rice.
2. Estimation of microbial load in food materials.
3. Determination of rehydration ratio of dehydrated foods.
4. Experiment on osmotic dehydration of foods.
5. Experiment of food extruder.
6. Experiment on properties of food through microwave oven heating.
7. Determination of properties of milk.
8. Experiments on cream separator to determine the separation efficiency.
9. Experiments on construction and operation of butter churner and accessories.
10. Experiments on detection of Food Adulteration.
11. Experiments on estimation of protein in food.
12. Experiment on expansion and oil absorption characteristic of snacks on frying.
13. The lab includes visit to food processing and dairy industry.

TOTAL:30 PERIODS

LIST OF EQUIPMENTS REQUIRED:

1. Extruder-1no.
2. Hot airoven-1no.
3. Hand refractometer-1no.
4. Dessicator-1no.
5. Dean and Stark" s apparatus -1no.
6. Cabinet dryer – 1no.
7. Soxhlet flask-1no.

8. Distillation column – 1no.
9. Kjeldahl flask –1no.
10. Distillation apparatus – 1no.
11. Microwave oven –1no.
12. Cream separator -1no.
13. Butter churner -1no.

Other basic requirements like weighing balance, physical balance, blotting papers, tracing sheets, burette, vernier calipers, pipette, conical flask, test tubes, beakers, spatula and other glass wares, food samples, chemicals should be available.

COURSE OUTCOMES:

On completion of laboratory course, the student should be able to

1. Get experience on various characteristics of food processing.
2. Gain knowledge on determining cooking properties and rehydration ratio.
3. Get experimental knowledge about osmotic rehydration and food extruder.
4. Acquire Knowledge about food adulteration.
5. Get hands on experience about various food processing tests.

TEXTBOOKS:

1. Susanta Kumar Das & Madhusweta Das, “Fundamentals and Operations in Food Process Engineering”, CRC Press,1st Edition, 2019.
2. Megh R. Goyal, N. Veena, Ritesh B. Watharkar, “Advances in Food Process Engineering: Novel Processing, Preservation, and Decontamination of Foods”, Apple Academic Press, 1st Edition, 2023.
3. Zeki Berk,“ Food Process Engineering and Technology”, 3rd Edition, Elsevier,2018.
4. Gustavo V. Barbosa-Cánovas, Li Ma, and Blas J. Barletta, “Food Engineering Laboratory Manual”, CRC Press, 2017.
5. Akash Pare and B.L. Mandhyan, “Food Process Engineering and Technology”, New India Publishing Agency- Nipa, 2020

REFERENCE BOOKS:

1. Walstra, P. T.J. Geurts, A. Nooman, A. Jellema and M.A. J.S Van Boekel, “Dairy Technology”,CRC Press, 2nd Edition, 2005.
2. Clunie Harvey, W.M and Harry Hill,“Milk Products”, 6th Edition, Biotech Books,

New Delhi, 2016.

3. Charm, S.E,"The fundamentals of Food engineering", Medtech,4th Edition,2019.
4. Shri K. Sharma, "Food Process Engineering: Theory and Laboratory Experiments",Wiley,2019.
5. Romeo T. Toledo, "Fundamentals of Food Process Engineering",Springer,4th Edition,2018.

AG3763	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	2	1	1	1	1	-	-	1	-	3	3	2	3	3
CO2	-	1	1	-	1	-	1	-	-	-	-	2	-	1	2	1
CO3	-	-	1	-	1	1	2	-	-	-	-	2	1	-	2	2
CO4	-	-	3	2	1	2	2	-	-	1	1	3	3	3	3	1
CO5	-	-	1	2	1	2	2	-	-	1	1	2	3	3	2	1
Average	-	1.0	1.6	1.7	1.0	1.5	1.6	-	-	1.0	1.0	2.4	2.5	2.3	2.4	1.6

AG3741	INTERNSHIP (2 Weeks)	L	T	P	C
		0	0	0	1

OBJECTIVES:

- To train the students in field work by attaching to any industry / organization so as to have a firsthand knowledge of practical problems in Agricultural Engineering.
- To gain working experience and skills in carrying out engineering tasks related to various fields of agriculture.
- To know about the on-field requirement and to gain knowledge to bridge the gap between theoretical and practical.
- To have knowledge on report writing.
- To provide exposure to the students, to work as a team.

The students individually undertake training in reputed engineering companies / Govt organisations / NGOs / Educational Institutions who work in the area of Agricultural Engineering for the specified 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 a team of internal staff.

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. Gain practical knowledge by attaching themselves to the industry
2. Gain Hands on experience and skills in their specialization.
3. To work efficiently as a team.
4. To execute the theoretical concepts experimentally in field.
5. At the completion of the training, students will be able to furnish a full report on the work done.

AG3741	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	3	-	1	2	2	1	2	2
CO2	3	1	1	2	-	-	-	-	2	-	2	3	3	2	1	2
CO3	2	2	2	1	-	-	-	-	3	2	-	2	2	1	1	2
CO4	3	3	3	2	-	-	-	-	-	-	1	1	2	1	2	1
CO5	-	1	1	1	-	-	-	-	1	1	-	2	2	1	1	2
Average	2.8	1.8	1.8	1.4	-	-	-	-	2.3	1.5	1.3	2.0	2.2	1.2	1.4	1.8

AG3742	STUDY TOUR	L	T	P	C
		0	0	0	1

OBJECTIVES:

- Agriculture study tours are designed to enhance and broaden the on-campus learning experience by visiting areas of horticultural and agricultural interest and their impact on the local culture and society.
- Students will be expected to conduct pre-tour research on a specific topic related to the purpose of the tour and a post-tour analysis and synopsis of the tour experience.

VISIT PLACES:

- Visit to places of interest in Tamil Nadu & Pondicherry States related to the subjects taught in Farm Machinery and Power, soil and Water Conservation Engineering, Food and Agricultural Process Engineering, Bio Energy and Agricultural Structures, Viz.,
- Visit to sugar mill — building construction material production units — paddy processing research centre, Tanjore – earth moving equipments – open mines and briquetting plants at Neyveli lignite corporation — food industries — biscuit manufacturing, macroni, vermicelli plants at Pondicherry – packaging units – power blending units – cold beverages manufacturing and bottling units at Madras – dairy milk processing units — pelletizing and granual coating plants, plastics for agriculture at CIPET. Centre for water resources, Anna University Chennai.
- Visit to water harvesting water sheds — improved water conveyance, distribution structures and erosion control structures at institute of hydrology, Poondi. — Structural engg. Research centre, CSIR complex and farm equipment- manufacturing units — institute of remote sensing.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. To generate qualified human resource in the field of agriculture and its allied subjects for meeting out the requirement at local, state, national and global level.
2. To improve quality of Agricultural Education and develop human recourse for competing with emerging challenges for livelihood security and sustainability.

SEMESTER VIII

AG3841	PROJECT WORK	L	T	P	C
		0	0	0	10

OBJECTIVES:

- To develop the ability to solve specific problem.
- To the Students will be able to identify the problem and successfully find the solution with the help of literature review.
- To train the students in preparing project reports in standard format.
- To prepare students to face reviews and viva voce examination.

Students in a group of 3 or 4 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. On completion of the project work, students will be in a position to take up any challenging practical problems.
2. To frame a methodology, with the help of literature review.
3. To execute the project in correct sequence.
4. To get hands on experience in writing report.
5. To gain self confidence in presenting the project.

AG3841	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	3	-	1	2	2	1	2	2
CO2	3	1	1	2	-	-	-	-	2	-	2	3	3	2	1	2
CO3	2	2	2	1	-	-	-	-	3	2	-	2	2	1	1	2
CO4	3	3	3	2	-	-	-	-	-	-	1	1	2	1	2	1
CO5	-	1	1	1	-	-	-	-	1	1	-	2	2	1	1	2
Average	2.8	1.8	1.8	1.4	-	-	-	-	2.3	1.5	1.3	2.0	2.2	1.2	1.4	1.8

MANAGEMENT ELECTIVE

MAN101	PRINCIPLES OF MANAGEMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To study the principles of management, functions and their application in an organization.
- To educate the students on the concept of planning and decision-making.
- To understand the dynamics of human relations in organisations.
- To learn about motivation, communication and leadership aspects.
- To study the process of controlling and the various techniques involved in controlling.

UNIT- I INTRODUCTION TO MANAGEMENT 6

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers managerial roles and skills –Evolution of Management – Scientific, human relations, system and contingency approaches. Current trends and issues in Management.

UNIT- II PLANNING 6

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management –types of strategies.

UNIT- III ORGANISING 6

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning.

UNIT- IV DIRECTING 6

Motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – the process of communication – barrier in communication.

UNIT- V CONTROLLING 6

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Quality control and Inventory Control - Productivity problems and management.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will be able to have a clear understanding of managerial functions.
2. Students would have the knowledge to apply planning techniques and decision-making.
3. Understand the concept of Human Resource Management.
4. Students would be able to understand motivation, leadership and communication principles.
5. Students would be able to apply control techniques in the organization.

TEXTBOOKS:

1. Stephen P. Robbins & Mary Coulter, “Management”, 14th Edition, Pearson, 2017
2. AF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson, 2004.

REFERENCE BOOKS:

1. R.S.N. Pillai, S.Kala, Principles of Management, S. Chand Publishing, 2013.
2. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 10th Edition, Pearson Education, 2016.
3. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.

4. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill, 2006.

5. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 6th edition 2017.

MAN101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1															
CO2		2														
CO3					1											
CO4			1													
CO5		1														
Average	1.0	2.0	1.0		1.0											

MAN102	TOTAL QUALITY MANAGEMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To understand the Total Quality Management Concepts and Dimensions of Customers quality.
- To familiarise the various contributions of Quality Gurus.
- To understand the Framework of Quality Management.
- To educate about tools and techniques in Quality Management.
- To impart knowledge to implement the Quality Management System.

UNIT- I INTRODUCTION 6

Introduction - Need for quality - Evolution of quality - Definition of quality, Benefits & amp; Obstacles, Quality – vision, mission and policy statements - Attitude and involvement of top management, Customer Focus – customer perception - Customer retention. Introduction to SERVQUAL.

UNIT- II OVERVIEW OF THE CONTRIBUTIONS 6

Philosophies of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa - Concept of Quality circle.

UNIT- III TQM FRAMEWORK 6

Culture, Leadership – Quality Council, Employee Involvement, Motivation, Empowerment, Recognition and Rewards, International/National Quality Awards.

UNIT- IV TOOLS AND TECHNIQUES 6

Six Sigma, Kaizen, 5S, 7QC Tools, Quality function deployment (QFD) – Benefits, Voice of customer, Information Organization, Building a House of Quality (HOQ), Bench marking and Poka-Yoke.

UNIT- V QUALITY MANAGEMENT 6

Quality Audits – Quality Council. ISO 9001:2015 (Quality Management) AS9100

(Aerospace), ISO 14001(Environment), ISO/TS 16949 (Automotive), ISO 17025 (Testing/FDA), TL 9000 (Telecommunication), ISO 13485 (Medical Devices), ISO 27001 (Information Security), ISO 29001 (Oil / Gas).

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will have an understanding of Quality Management concepts and Customers
2. Students will be able to apply Quality principles provided by the authors and implement.
3. Students will have an understanding of Framework of Quality Management.
4. Students will be able to apply tools and techniques to improve business process.
5. Students will be able to understand Quality System available.

REFERENCE BOOKS:

1. James R. Evans, William M.Lindsay, “Total Quality Mangement”10 th Edition, Cengage, Phillippine Edition, 2019.
2. Ray Tricker, Quality Management Systems: A Practical Guide to Standards Implementation, Routledge; 1st edition, 2019
3. Poornima M. Charantimath, Total Quality Management, Pearson Education, 2 nd Edition,2017.
4. Dale H. Besterfield, Carol Besterfield, Michna, Glen H. Besterfield, Mary Besterfield, Sacre, Hermant, Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised 4 th Edition, Pearson Education, 2013.
5. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, 2 nd Edition 2010.
6. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 7 th Edition, Wiley India Pvt Limited, 2012.
7. Indian Standards – Quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

MAN102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1				1												
CO2	1															
CO3				1												
CO4		2														
CO5				1												
Average	1.0	2.0		1.0												

MAN103	HUMAN RESOURCES MANAGEMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To enable students to gain knowledge on Human resource management concepts and principles.
- To familiarise students about HRP process and Job Analysis.
- To illustrate the techniques and tools for Training and Development and Performance appraisal.
- Students will be able to illustrate the techniques and tools for compensation.
- To understand concepts of Performance evaluation, Industrial Relations System and Grievance redressal mechanism.

UNIT- I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 6

Meaning – Definition – Nature – Scope and significance – Evolutionary growth of HRM – Functions of HRM - Role of Human resource manager – Personnel Management vs HRM.

UNIT- II TALENT MANAGEMENT 6

Job Analysis – Job description & specification - Human Resource Planning – Forecasting human resource requirement –Recruitment - Selection –Induction.

UNIT- III TRAINING AND DEVELOPMENT 6

Need for Training – Process -Types of Training methods – On the job & Off the job - Purpose – Benefits – Management development programmes – Training vs Development -Effectiveness of training.

UNIT- IV COMPENSATION MANAGEMENT 6

Introduction – Compensation – Forms & Types of compensation – Determinants of compensation – Components of Pay structure – Significance in Employee morale.

UNIT- V PERFORMANCE MANAGEMENT AND CONTROL PROCESS 6

Performance Management System – Process – Appraisal methods – Evaluation of managerial Implications – Control process – Importance – Methods – Requirement of effective control systems.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will be able to gain knowledge on Human resource management concepts and principles.
2. Students will be able to do human forecasting and handle HRM issues in the context of outsourcing.
3. Students will be able to design and implement appropriate Training and Development programmes.
4. Students will be able to develop relevant Compensation system to meet individual and organisational strategic needs.
5. Students can develop Performance appraisal system and effectively handle Disciplinary andgrievance mechanisms.

REFERENCE BOOKS:

1. Gary Dezzler & Biju Vaarkey, Human Resource Management, Pearson 16th edition 2020.
2. S S Khanka, Human Resource Management (Text and Cases), S. Chand Publishing, 2019.
3. Decenzo and Robbins, Fundamentals of Human Resource Management, Wiley, 11th Edition,2013.
4. Luis R. Gomez-Mejia, David B. Balkin, Robert L Cardy, Managing Human Resource, PHILearning, 2012.
5. Bernadin, Human Resource Management, Tata Mc Graw Hill, 8th Edition 2012.
6. Wayne Cascio, Managing Human Resource, Mc Graw Hill, 9th Edition, 2012.
7. Ivancevich, Human Resource Management, Mc Graw Hill, 2012.

8. Uday Kumar Haldar, Juthika Sarkar. Human Resource Management, Oxford 2012.

MAN103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1				1												
CO2		1														
CO3				1												
CO4		1														
CO5				1												
Average		1.0		1.0												

MAN104	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- Develop and strengthen entrepreneurial qualities and entrepreneur's role in economic growth
- Impart understanding on Entrepreneurial Training and Development Programs.
- Develop understanding on the business environment and to manage projects.
- Create an understanding on project finance and accounting principles
- Create awareness on entrepreneurial support offered through government agencies and schemes.

UNIT- I INTRODUCTION 6

Entrepreneur – Types of Entrepreneurs – Entrepreneurship as a Career – Entrepreneurial Personality - women entrepreneurship, rural and urban entrepreneurship, Entrepreneur – Knowledge and Skills of Entrepreneur. Difference between Entrepreneur and Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT- II ENTREPRENEURIAL MOTIVATION 6

Major Motives Influencing an Entrepreneur, motivation theories-Maslow's Need Hierarchy Theory – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT- III BUSINESS ENVIRONMENT AND PROJECT MANAGEMENT 6

Business Environment - Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and

Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT- IV FINANCING AND ACCOUNTING 6

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, and Management of working Capital. Accounting – Double Entry system of accounting.

UNIT- V SUPPORT TO ENTREPRENEURS 6

Entrepreneur Support Organizations - Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

1. Gain knowledge and skills needed to run a business.
2. Understanding the concept on entrepreneurial motivation.
3. Formulate project proposals based on understanding on business environment.
4. Evaluate accounting and financial aspects of business.
5. Understanding on project funding and support agencies.

TEXTBOOKS:

1. Khanka. S.S"Entrepreneurial Development" S.Chand&Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 10th Edition, Cengage Learning, 2017

REFERENCE BOOKS:

1. Hisrich R D, Peters M P, "Entrepreneurship" 10th Edition, Tata McGraw-Hill, 2017.
2. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.

3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII “Faculty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad, 1986.

MAN104	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1															
CO2				1												
CO3				1												
CO4		2														
CO5				1												
Average	1.0	2.0		1.0												

MANDATORY COURSES - I

MBA101	INTRODUCTION TO GENDER STUDIES	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To provide awareness on how gender operates on Institutional and cultural context.
- To understand about gender roles in society.
- To understand the institutions of family and its influence on women's status.
- To educate students on the gender issues.
- To familiarize students with women development with gender perspective.

UNIT- I INTRODUCTION TO WOMEN STUDIES 9

Women & Gender Studies Perspectives & Practices - Need, Scope and challenges of Women's Studies – Need for Gender Sensitization - Women's Movements – global and local - National Committees and Commissions for Women.

UNIT- II FEMINIST THINKERS AND THEORIES 9

Liberal Feminism, Marxist Feminism, Radical Feminism, Socialist Feminism, Indian Feminism, Black Feminism, Eco-Feminism - New Feminist Debates- Contemporary Contestations - Feminist thinkers in 18th, 19th, 20h and 21st Century.

UNIT- III WOMEN, WORK AND EMPLOYMENT 9

Concept of Work – Productive and non – productive work – Use value and market value - Gender Division of Labour – Mode of Production – Women in organized and unorganized sector - New Economic Policy and its impact on Women's Employment – Globalization – Structural Adjustment Programs.

UNIT- IV GENDER AND ENTREPRENEURSHIP 9

Concept and meaning, Importance of Entrepreneurship, Entrepreneurial traits, Factors contributing to Entrepreneurship, enabling environment, small Enterprises, women in agri-business - Gender and emerging Technology – Impact -Self-help

Groups and Micro Credit.

UNIT- V WOMEN DEVELOPMENT 9

Theories of Development, Alternative approaches – Women in Development (WID), Women and Development (WAD) and Gender and Development (GAD) - Empowerment- Concept and indices: Gender Development Index (GDI), Gender Inequality Index (GII), Global Gender Gap Index (GGGI) - Women Development approaches in Indian Five – Year Plans - Women and leadership– Panchayati Raj and Role of NGOs and Women Development - Sustainable Development Goals, Policies and Programmes.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will have an understanding on gender and its operations on Institutional and cultural context.
2. Students will be able to understand about gender roles in society.
3. Students will be able to understand the institutions of family and its influence on women's status.
4. Students will be educated on the gender issues.
5. Students will be familiarized on women development with gender perspective.

REFERENCE BOOKS:

1. Susan Shaw and Janet Lee, Women's Voices, Feminist Visions, McGraw Hill Pub, 6 th edition, 2014.
2. Rege, Sharmila (ed), Sociology of Gender: The Challenge of Feminist Sociological
   Knowledge, Sage, New Delhi, 2003.
3. Bonnie G. Smith,2013Women's Studies:the Basics,Routledge
4. Uma Chakravarti. Gendering Caste: Through a Feminist Lens. Sage, 2018.

MBA101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1							1									
CO2							1									
CO3				1												
CO4							1									
CO5							1									
Average				1			1									

MEN101	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To make the students aware of the finer sensibilities of human existence through an art form.
- To enable students to appreciate different forms of literature.
- To help students understand that literature is an expression of life's experience.
- To improve the aesthetic sense of the students by exposing them to various forms of literature.
- To improve the creative abilities of students by giving them opportunities to review forms of literature.

UNIT- I INTRODUCTION TO ELEMENTS OF LITERATURE 9

- Reading, thinking, discussing and writing skills
- Finer sensibility for better human relationship
- Understanding of the problem of humanity without bias
- Space to reconcile and get a cathartic effect

Assessment- Declamation /Solioquy

UNIT- II ELEMENTS OF FICTION 9

- Plot, character and perspective
- Analysing works of literature
- Character analysis
- Short story reading

Assessment- Short Story Analysis

UNIT- III ELEMENTS OF POETRY 9

- Emotions and imaginations
- Figurative language
- Simile, metaphor, conceit, symbol, pun and irony
- Personification and animation

Assessment – Appreciation Poetry

UNIT- IV ELEMENTS OF DRAMA 9

- Drama as representational art
- Content, mode and elements
- Features of tragedy, comedy and satire

Assessment – Presenting a play/Skit/ Street Play

UNIT- V IMPACT OF LITERATURE ON SOCIETY 9

- Translation of original literature in English
- Comparative literature
- Expression of finer feelings in different forms of literature.
- Influence of literature in society

Assessment- Project: Under the guidance of the teachers, the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context (sociological, psychological, historical, autobiographical etc).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand the relevance of literature in human life.
2. To appreciate the aspects of literature in developing finer sensibilities.
3. To enhance reading, thinking, discussing opinions and to understand finer feelings.
4. To identify the creative uses of language in literary texts.
5. To write reviews and comments about forms of literature.

REFERENCE BOOKS:

1. Seasons of Life: A Poetic Anthology (Literary Classics) by Nigel Collins, Jim Herrick, John Pearce (ISBN: 9781573927710)
   Web Link :https://www.amazon.co.uk/Seasons-Life-Anthology-Literary-Classics/dp/1573927716
2. New One-Act Plays for Acting Students: A New Anthology of Complete One-Act Plays for One, Two or Three Actors Paperback – by Norman Bert (Author), Deb Bert (Editor)
   Web Link : https://www.amazon.in/New-One-Act-Plays-Acting-Students/dp/1566080843
3. Student Text (Drama Essentials: An Anthology of Plays) Paperback – by Matthew C. Roudane (Editor)
   Web Link : https://www.amazon.in/Drama-Essentials-Student-Anthology-Plays/dp/0618474773
4. Famous Novels and Short stories in English.(to be recommended by teachers to individual students)
5. Collection of poems by Robert Frost, William Wordsworth, Rabindranath Tagore, Walt Whitman , Maya Angelou, Rudyard Kipling (to be recommended by teachers to individual students)

MBA102	PATENT DRAFTING FOR BEGINNERS	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights.
- To identify the significance of practice and procedure of Patents.
- To make the students to understand the statutory provisions of different forms of IPRs in simple forms.
- To learn the procedure of obtaining Patents, Copyrights, Trade Marks & Industrial Design
- To enable the students to keep their IP rights alive.

UNIT- I UNDERSTANDING AND OVER VIEW OF THE IPR REGINE 9

Introduction, types of intellectual property- Industrial property, Artistic and literary Property, Need for intellectual property rights, Rationale for protection of IPR, Impact of IPR on development, health, agriculture, and genetic resources, IPR in India- Genesis and development, IPR in abroad- some important examples of IPR, International organizations, agencies, and treaties.

UNIT- II PATENTS 9

Need for patent, Macro-economic impact of the patent system, Classification of patents in India, Classification of patents by WIPO, Categories of Patent, Special Patents, Patenting Biological products, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models, Case Study.

UNIT- III COPYRIGHT 9

Rights and protection covered by copy right- law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, obtaining copyright registration, notice of copy rights, international copyright law, infringement of copy right under copyright Act.

UNIT- IV TRADEMARKS AND TRADE SECRET 9

Overview of Trademarks & Trade Secret, Importance of Trademarks & Trade secret, Rights of Trademark & Trade Secret, Types of Trademarks, Registration process for Trademark &Trade Secret, Duration of Trademark and trade secret, Case Study.

UNIT- V APPLICATIONS 9

Overview of Geographical Indications, Importance of Geographical Indication Protection.Geographical Indication of Goods- Type, why and how GI need protection and GI Laws. Indian GI Act. Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Student will be able to define need and importance of intellectual property rights.
2. Rules and process for IPR registration.
3. Patent Searching, Patent Drafting, filing, Protection and duration of a patent in India and abroad.
4. Legal concepts in Science, Engineering, Technology and Creative Design.
5. Clarity on the influence of Geographical Indications on Trade Secrets.

REFERENCE BOOKS:

1. Watal,Jayashree, Intellectual Property Rights In The WTO And Developing Countries,Oxford University Press
2. R. Anita Rao & Bhanoji Rao, Intellectual Property Rights- A Primer, Eastern Book Co.
3. Shiv Sahai Singh, The Law Of Intellectual Property Rights, Eastern Book Co.
4. Deepa Goeland Shomini Parashar, IPR, Biosafety and Bioethics, Pearson publisher

5. Pandey, Neeraj, Dharni, Khushdeep, Intellectual Property Rights, PHI, 2020.
6. Sople, Vinod V. Managing Intellectual Property: The Strategic Imperative, PHI, 2020.

MBA102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1				1												
CO2	1															
CO3				1												
CO4		2														
CO5				1												
Average	1	2		1												

MBA103	INDUSTRIAL PSYCHOLOGY	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To understand the core concepts, history, and significance of Industrial Psychology
- To analyze factors influencing employee attitudes, behaviors, and well-being.
- To apply principles of ergonomics and human factors to improve workplace design and safety.
- To evaluate different theories of motivation and their practical applications in organizational settings.
- To assess team dynamics, cultural diversity, and organizational change processes in modern workplaces.

UNIT- I FOUNDATIONS OF INDUSTRIAL PSYCHOLOGY AND JOB ANALYSIS **9**

Definition, Characteristics, Goals, and Importance of Industrial Psychology - Brief History of Industrial Psychology - Major Fields in Industrial Psychology - Research Methods in Industrial Psychology - Job Analysis: Methods and Techniques - Performance Measurement: Concepts and Practices - Performance Rating and Evaluation - The Social Context of Performance Evaluation.

UNIT- II EMPLOYEE ATTITUDES, BEHAVIOUR, AND WELL-BEING **9**

Work Attitudes and Employee Engagement - Job Satisfaction and Organizational Commitment - Positive Employee Behaviors - Worker Stress: Sources, Consequences, and Coping Strategies.

UNIT- III ERGONOMICS AND ENGINEERING PSYCHOLOGY **9**

Principles of Ergonomics and Human Factors - Work Design for Productivity and Well-being - Psychological Aspects of Workplace Safety - Human-Technology

Interaction.

UNIT- IV MOTIVATION IN THE WORKPLACE 9

Defining and Theories of Motivation - Need-Based Theories of Motivation (e.g., Maslow's Hierarchy of Needs, Alderfer's ERG Theory) - Behaviour-Based Theories of Motivation (e.g., Skinner's Reinforcement Theory) - Job Design Theories of Motivation (e.g., Hackman and Oldham's Job Characteristics Model) - Motivation and Performance - Practical Techniques to Enhance Motivation.

UNIT- V GROUP DYNAMICS AND ORGANIZATIONAL CULTURE 9

Defining Work Groups and Teams - Types of Teams and Team Processes - Group Decision- Making and Effectiveness - Diversity and Multiculturalism in Teams - Organizational Culture and Development - Social Dynamics and Change Management.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will be able to understand Industrial Psychology by practicing Management theories in solving Industrial relations problems.
2. Students can apply critical thinking with regard to human attitudes and behavior for better decision making.
3. The managerial competencies among students can be enhanced by employing human factor with suitable ergonomics in workplace.
4. To inculcate value based leadership abilities amongst students in achieving individual as well as organizational goals.
5. Students can withhold cultural diversity in globalized business and engage in lifelong learning.

REFERENCE BOOKS:

1. Aamodt, M. G. (2016). Industrial/Organizational Psychology: An Applied Approach (6th Edition), Cengage Learning.
2. Landy, F. J., & Conte, J. M. (2016). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology (4th Edition), Wiley.

3. Riggio, R. E. (2017). Introduction to Industrial and Organizational Psychology (6th Edition), Routledge.
4. Salvendy, G. (2006). Handbook of human factors and ergonomics (3rd ed.). New York: Wiley.
5. Levy, P. E. (2017). Industrial/Organizational Psychology: Understanding the Workplace (5th Edition), Macmillan Learning
6. Culbertson, S. S., & Muchinsky, P. M. (2022). Psychology Applied to Work (13th Edition), Hypergraphic Press.
7. Spector, P. E. (2017). Industrial and Organizational Psychology: Research and Practice (7th Edition), Wiley.
8. Truxillo, D. M., Bauer, T. N., & Erdogan, B. (2016). Psychology and Work: Perspectives on Industrial and Organizational Psychology (1st Edition), Routledge.

MBA103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3			1				1								
CO2		3	2		1		1									
CO3	1					1										
CO4	2		2		1		1									
CO5				3				2								
Average	2	3	2	2	1	1	1	2								

MBA104	INDIAN CONSTITUTION	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To create an awareness on the constitution of India and its amendments.
- To educate the students with fundamental duties and rights of the citizens.
- To equip with the functions of central government and its' structure.
- To learn the state government structure and its' functions.
- To understand the judiciary structure and its functions in India

UNIT - I INTRODUCTION 9

Introduction to constitution of India – Philosophical Foundations and Historical Background – Preamble – Schedule – 42nd Amendment - 44th Amendment – 73rd Amendment - 74th Amendment – Articles Related to Amendments.

UNIT- II FUNDAMENTAL DUTIES AND RIGHTS OF CITIZENS 9

Citizenship – Citizenship Amendment Act (CAA) – Union of States - Union Territories - Fundamental Rights – Directive Principles of State Policy (DPSP) – Fundamental Duties - Reference of Articles for Granting of Special Status to Various States in the Country.

UNIT- III CENTRAL GOVERNMENT STRUCTURE AND FUNCTIONS 9

Government at Central Level – President of India – Powers of President of India – Structure of Central Government – Functions of Central Government – Vice President – Powers of Vice President – Powers of Prime Minister – Powers of Cabinet Ministers – Powers of Parliament.

UNIT- IV STATE GOVERNMENT STRUCTURE AND FUNCTIOONS 9

Government at State Level – Structure of State Government – Functions of State Government – Governor – Powers of Governor – Chief Minister – Powers of Chief

Minister – State Legislature – Powers of Cabinet Ministers in State Legislature – Cabinet Ministers Responsibilities in State Government

UNIT- V JUDICIARY STRUCTURE AND FUNCTIONS 9

Supreme Court of India – Judiciary System in Indian Constitution – Judicial Systems Central Government Level – Judiciary System in State Government Level – High Courts and Subordinate Courts – Election Commission of India – Case Studies of Major Disputes.

TOTAL HOURS: 45

OUTCOMES:

1. Students will be able to understand the constitution of India and its' amendments.
2. Students will be able to analyze the fundamental duties and rights of citizens.
3. Students will be able to narrate the central government structure and its functions.
4. Students will be able to discuss the state government structure and its functions.
5. Students will be able to derive judiciary structure and its functions.

REFERENCES:

1. Basu, D. D. (1966). Introduction to the Constitution of India. LexisNexis, India.
2. Khosla, Madhav (2012). The Indian Constitution. Oxford University Press, India.
3. R.C.Agarwal (1997). Indian Political System. SChand Company Ltd., India.
4. Bakshi, P. (2023). The Constitution of India. LexisNexis, India.
5. V. N. Shukla (2017). Constitution of India, 13th Ed., Eastern Book Company

MBA104	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2			1				1								
CO2	2		3	2	3	3	1	1								
CO3	2	3	2	1		1										
CO4	2		2	1		1										
CO5	2		2	1	2	1	1									
Average	2	3	1.8	1.2	2.5	1.5	1	1								

MANDATORY COURSES - II

MGE201	**WELL BEING WITH TRADITIONAL PRACTICES - YOGA, AYURVEDHA AND SIDDHA**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**0**

OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health.
- To adopt a few lifestyle changes that will prevent many health disorders.
- To be cool and handbill every emotion very smoothly in every walk of life.
- To learn to eat cost-effective but healthy foods that are rich in essential nutrients.
- To develop immunity naturally that will improve resistance against many health disorders.

UNIT- I HEALTH AND ITS IMPORTANCE 2+4

Health: Importance of maintaining health- prevention than treatment - Ten types of health - Physical - Mental - Social – Financial - Emotional - Spiritual - Intellectual - Relationship – Environmental and Occupational/Professional health.

Present health status - The life expectancy- present status - mortality rate - dreadful diseases - Non- communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time.

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age)- Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI-Importance and actions to be taken.

UNIT- II DIET **4+6**

Role of diet in maintaining health - energy one needs to keep active throughout the day – nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong. **Balanced Diet and its 7 Components** - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions.

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes. Different cooking methods, merits and demerits of each method.

UNIT- III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH **4+4**

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal.

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder.

UNIT- IV MENTAL WELLNESS 3+4

Emotional health - Definition and types - Three key elements: the subjective experience – the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances – Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life -Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.
Sleep - Sleep and its importance for mental wellness - Sleep and digestion.
Immunity - Types and importance - Ways to develop immunity.

UNIT- V YOGA 2+12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for Individuals according to the Age - The Eight Limbs of Yoga - Simple yoga asanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS (Lecture 19 + Practice 26)

COURSE OUTCOMES:

After completing the course, the students will be able to:

1. Learn the importance of different components of health.
2. Gain confidence to lead a healthy life.

3. Learn new techniques to prevent lifestyle health disorders.
4. Understand the importance of diet and workouts in maintaining health.
5. Understand the practice of yoga.

TEXTBOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California
3. Yoga and Empowerment, WCSC-VISION for Wisdom, 3rd Edition 2018, Vethathiri Publications, Erode.
4. SIDDHA MEDICINE HANDBOOK OF TRADITIONAL REMEDIES Kindle Edition by Paul Joseph Thottam (Author) 2012.
5. The Ayurvedic Pharmacopoeia of India Part-I Volume-VII First Edition [Minerals & Metals] by Central Council for Research in Ayurveda and Siddha, 2008.

REFERENCE BOOKS:

1. What we know about emotional intelligence how it affects learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001.
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
4. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-betterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time %20to%20cook.

5. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
6. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
7. Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html
8. Food additives https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food additives
9. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/ https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---whore commendations
10. Yoga https://www.healthifyme.com/blog/types-of-yoga/ https://yogamedicine.com/guide-types-yoga-styles/
11. Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in ayurveda
12. Siddha:http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp

MGE202	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To know the contributions of the scientists for the development of society over a period of time.
- To understand the Science and Technological developments that lead to human welfare.
- To appreciate the Science and Technological contributions for the development of various sectors of the country.
- To identify the technical transfer versus economic progress of the countries.
- To know the students get a holistic view of the development of science and technology as a historical and cultural phenomenon.

UNIT- I HISTORICAL PERSPECTIVE OF SCIENCE AND TECHNOLOGY 9

The nature of science and technology, Roots of science and technology in India, Science and society, Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Indian contribution to science and technology (from Ancient to Modern). Aryabhata, Charaka, Bhaskara II, Sushruta, J C Bose, C V Raman, Homi J Bhaba, Dr APJ Abdul kalam.

UNIT- II SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Scientific and Technological Developments in Medieval India; Influence of the Islamic world and Europe; The role of maktabs, madrasas and karkhanas set up. Developments in the fields of Mathematics, Chemistry, Astronomy and Medicine. Innovations in the field of agriculture - new crops introduced new techniques of irrigation etc.

UNIT- III SCIENCE AND TECHNOLOGY IN COLONIAL INDIA 9

Early European Scientists in Colonial India- Surveyors, Botanists, Doctors, under the

Company‘s Service- Indian Response to new Scientific Knowledge, Science and Technology in Modern India- Development of research organizations like CSIR and DRDO; Establishment of Atomic Energy Commission; Launching of the space satellites.

UNIT- IV IMPACT OF SCIENCE AND TECHNOLOGY IN MAJOR AREAS **9**

Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology.Ocean Development – Objectives of ocean development, Biological and mineral resources, Marine research and capacity building. Defence Research – Spin-off technologies for civilian use, Biotechnology – Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry Energy – Research and development in conservation of energy, India’s nuclear energy program, technology spin-offs.

UNIT- V NEXUS BETWEEN TECHNOLOGY TRANSFER AND DEVELOPMENT **9**

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology- Criteria and selection of Appropriate technology: Technology assessment, Technological forecasting, Technological innovations and barriers of technological change. Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. The origins of scientific knowledge, Names, major milestones in the life and work of prominent scientists and engineers.
2. Periodization of the history of science and technology.
3. Major events, dates of the most significant achievements in the development

of science and technology at different stages of history;

4. Features of the network of scientific and technical institutions, the history of formation and development of leading research centers, in particular higher education institutions as centers of basic and applied research.
5. Features of science and technology and it development

TEXTBOOKS:

1. Kalpana Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi – 58.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd., New Delhi.

REFERENCE BOOKS:

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Developlemnt, K., Nayudamma Memorial Science Foundation, Chennai – 8.
2. Kohili, G.R., The Role and Impact of Science and Technology in the Development of India, Surjeet Publications. Government of India, Five Year Plans, Planning Commission, New Delhi.
3. Government of India, Five Year Plans, Planning Commission, New Delhi.
4. Sharma K.D., and Quresh M.A., Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

ONLINE LINK

Swayam online course History of Science and Technology:
https://onlinecourses.swayam2.ac.in/arp19_ap87/preview

MCY201	AWARENESS OF CYBER SECURITY AND CYBER LAW	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To understand the basics of cyber security and cyber law.
- To understand the problems and issues associated with it.
- To understand the various act or regulations.
- To understand the various approaches for incident analysis and response.
- To understand the ethical laws of computer for different countries.

UNIT- I INTRODUCTION TO CYBER SECURITY AND CYBER CRIME 9

Introduction–Cyber Crime: Definition and origins– Cyber crime and information Security– Cyber criminals– Classification of Cyber crimes.

UNIT- II LEGAL PERSPECTIVES 9

Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India.

UNIT- III CYBER ACT 9

Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

UNIT- IV CYBER LIABILITY 9

Private ordering solutions, Regulation and Jurisdiction for global Cyber security, Copy Right–source of risks, Pirates, Internet Infringement, Fair Use, postings, criminal liability, First Amendments, Data Losing.

UNIT- V CYBER CHANGES 9

Ethics, Legal Developments, Cyber security in Society, Security in cyber lawscase studies, General law and Cyber Law–a Swift Analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- Understand key terms and concepts in cyber security and cyber law, intellectual property and cyber– crimes, trademarks and domain theft.
- Determine computer technologies, digital evidence collection.
- Determine evidentiary reporting in forensic acquisition.
- Secure both clean and corrupted systems, protecting personal data, securing simple computer networks, and safe Internet usage.
- Incorporate approaches for incident analysis and response.

TEXTBOOKS:

1. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, WileyIndia Pvt. Ltd, 2011.
2. Jonathan Rosenoer, “Cyber Law: The law of the Internet”, Springer–Verla..

REFERENCE BOOKS:

1. Mark F Grady, Fransesco Parisi, “The Law andEconomics of Cyber Security”, Cambridge University Press, 2006.
2. 2. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency– Faridabad.

MCY201	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2											2	1			
CO2		2		2		2									2	2
CO3								2					1			
CO4		3	2					2				2			2	1
CO5	2					2								2		
Average	2	2.5	2	2		2		2				2	1	2	2	1.5

MME201	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To discuss the basic approaches of the organizations and safety management
- To discuss the concept of Work design and facility planning
- To comprehend the accident investigation process and accident reports
- To discuss the principles of safety performance monitoring
- To elaborate the methods of safety education and training

UNIT- I BASICS OF SAFETY ENGINEERING & ACTS 9

Evolution of modern safety concept – Safety audit – Acts: Factories act – 1948 – Statutory authorities – Tamil Nadu factories Rules 1950 under safety and health – Environment act – 1986 –Air act 1981, Water act 1974 – other acts; Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process. Introduction to Electrical Acts.

UNIT- II SAFETY MANAGEMENT 9

History of Safety movement –Evolution of modern safety concept General concepts of management – Planning for safety for optimization of productivity, quality and safety line and staff functions for safety, budgeting for safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT- III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – Principles of accident prevention, Supervisory role - Role of safety committee – Accident causation models Cost of accident. Overall accident investigation process Response to accidents, India reporting requirement, Planning

document, Planning matrix, Investigators Kit, Functions of investigator, Four types of evidences, Records of accidents, Accident reports Class exercise with case study.

UNIT- IV SAFETY PERFORMANCE MONITORING 9

Reactive and proactive monitoring techniques, Permanent total disabilities, Permanent partial disabilities, Temporary total disabilities - Calculation of accident indices, Frequency rate, Severity rate, Frequency severity incidence, Incident rate, Accident rate, Safety "t" score, Safety activity rate problems.

UNIT- V SAFETY EDUCATION AND TRAINING 9

Importance of training identification of training needs training methods – programme, seminars, conferences, competitions – method of promoting safe practice motivation – communication role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Learn the basic approaches of the organizations and safety management
2. Perform work design and facility planning
3. Study the accident investigation process and accident reports
4. Learn the principles of safety performance monitoring
5. Study the methods of safety education and training

TEXTBOOKS:

1. L M Deshmukh, Industrial safety management, TATA McGraw Hill, 2017.
2. Heinrich H.W., Industrial Accident Prevention, McGraw Hill Company, New York, 2001.

REFERENCE BOOKS:

1. Garg, HP, Maintenance Engineering, S. Chand Publishing, 2012
2. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

MME204	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		1			2			1			2	1			
CO2		1		2				2			1		1			
CO3	2			2			1			2		2	1			
CO4	2		3			2			2		1		1			
CO5		2			2			1				1	1			
Average	**3**	**1**	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**	**1**	**1**			

VERTICAL I

PAG101	PROCESS ENGINEERING OF FRUITS AND VEGETABLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Post-Harvest Technology of fruits and vegetables through their structure and composition
- To study the different methods of processing and preservation of fruits and vegetables including drying and dehydration.
- To learn the latest methods of storage of fruits and vegetables.
- To gain knowledge on the importance of cleaning.
- To expose students to the concept of On-Farm processing of fruits and vegetables.

UNIT - I INTRODUCTION TO FRUITS AND VEGETABLE PROCESSING **9**

Indian and global scenario on production and processing of fruits and vegetable- Quality requirements of raw materials for processing; sourcing and receiving at processing plants- primary processing: grading, sorting, cleaning, washing, peeling, slicing and blanching-minimal processing Importance of post-harvest technology of horticultural crops – post harvest losses –factors causing losses

UNIT - II STRUCTURE, COMPOSITION, RIPENING AND SPOILAGE CLEANING, GRADING AND ON-FARM PROCESSING **9**

Structure, cellular components, composition and nutritive value of horticultural crops – fruit ripening – mechanism and equipment – spoilage of perishable commodities – mechanism and factors causing spoilage Harvesting and washing of fruits and vegetables – cleaning and grading fruits and vegetables – peeling – equipments– construction and working – pre-cooling –importance, methods, pretreatments and advantages.

UNIT - III PROCESSING OF HORTICULTURAL COMMODITIES – FRUITS AND VEGETABLES **9**

Processing for pulp, puree and concentrates, especially from mango, tomato, guava, Papaya, apple, pineapple, pomegranate, grapes. Technology for processed products like pickles, chutneys, sauces particularly from raw mango, lime and other regional fruits and vegetables of importance. Processing of fruits for candies, bars, toffees, jams and jellies, squashes and syrups using locally available fruits like papaya, mango, aonla and other under-utilized fruits.

UNIT - IV PRESERVATION OF FRUITS AND VEGETABLES **9**

Thermal and non-thermal techniques of preservation of fruits and vegetables and their products – methods – commercial canning of fruits, vegetables and other perishable commodities – processing and concentration of juice –membrane separation process and application – hurdle technology of preservation and techniques.

UNIT - V DRYING ,DEHYDRATION AND STORAGE **9**

Dehydration of fruits and vegetables using various drying technologies. Fruit powders using spray drying. Principles, construction, operation and applications–quality parameters and advantages. Storage of fruits and vegetables storage– concept and methods – modified atmosphere packaging – gas composition, quality of storage – waxing of fruits – types of wax, equipment and advantages

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To in various methods of processing, preservation and storage of fruits and vegetables using latest technologies.
2. To understand the Importance of postharvest technology of horticultural crops.
3. To do cleaning, grading and on-farm processing of fruits and vegetables.
4. To gain principles, construction, operation and applications of dehydration.
5. To understand storage methods of fruits and vegetables.

TEXTBOOKS:

1. R.P. Srivastava, Sanjeev Kumar, “Fruit & Vegetable Preservation: Principles and Practices”, CBS Publishers and Distributors PVT LTD, 2017.
2. J L Antony B Subbulakshmi, B Muralidharan, G Gurumeenakshi, P Balasubramanian , “Textbook on Processing of Horticultural Crops Perfect”, Narendra Publishing House; 1st edition, 2023.
3. NIIR Board of Consultants & Engineers, “The Complete Technology Book on Processing, Dehydration, Canning, Preservation of Fruits & Vegetables” (Processed Food Industries) NIIR PROJECT CONSULTANCY SERVICES, 2024.
4. Kshirod Kumar Dash, Mudasir Ahmad Malik, “Food Processing and Preservation Technology” , Nipa Genx Electronic Resources & Solutions 2023
5. H.R Naik/Tawheed, A, “Processing and Preservation of Foods”, Narendra Publishing House ,2022

REFERENCE BOOKS:

1. Heid,J.L. and M.A.Joslyn, “Food processing operations”. Vol. II. AVI Publishing Co.Inc. Westport, Connecticut, 1983.
2. Potter, N.N.1976. Food science. AVI Publishing Co.Inc. West port, Connecticut, 2nd edition.
3. Sivetz Michael and N.W.Desrosier, Coffee Technology. AVI Publishing Co.Inc. Westport, Connecticut.
4. Frank.H.Slade.1967.Food Processing Plant.Volume1.LeonardHillBooks.London.
5. Sudhir Gupta. Cold storage unit. Atif printers, Lal Kuan, Delhi.

PAG101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	3	2	-	-	2	-	-	3	-	2	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
CO3	3		-	2	-	-	3	-	-	2	-	1	2	3	-	-
CO4	2	2	-	-	3	-	2	-	-	-	-	3	2	-	-	3
CO5	-	-	-	2	-	-	3	3	-	2	-	2	-	2	-	3
Average	2.0	2.5	-	2.0	3.0	2.5	2.4	2.5	-	2.0	-	2.3	2.3	2.7	2.0	2.7

PAG102	FOOD PROCESS EQUIPMENT AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares to

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

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.

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

UNIT-III HEAT EXCHANGER 9

Design of tubular heat exchanger – shell and tube heat exchanger and plate heat exchanger – Problems on tubular heat exchanger – Types of shell and tube type heat exchanger and plate heat exchanger

UNIT-IV CONVEYING SYSTEM 9

Design of belt conveyer – screw conveyer and bucket elevator – Design of dryers.Design of milling equipment.

UNIT-V CAD 9

Optimization of design with respect to process efficiency – energy and cost – Computer Aided Design.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- Analyse the various process equipment design.
- Understand the design procedure the development of vessels and cleaners.
- Analyse the different type's heat exchanger methods.
- Apply the different methods of conveying system.
- Optimize the variables using CAD for the process equipment design.

TEXTBOOKS:

1. Rajput R K, 2019. Heat and Mass Transfer. S Chand Publishers.
2. Chakraerty, A. Post-Harvest Technology of cereals, pulses and oilseeds, 2019.Oxford & IBH publishing Co. Ltd., New Delhi.
3. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers,2018, New Delhi.
4. Sahay, K.M. and Singh, K.K. 2004. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.
5. Myer Kutz,Handbook of Farm, Dairy and Food Machinery Engineering (3rd Edition, 2019)

REFERENCE BOOKS:

1. Earle, R.L. 2013. Unit Operations in Food Processing. Pergamon Press.Oxford.
2. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering,2024, Chapman an hall, London.
3. McCabe, W.L., Smith J.C. and Harriott, P. Unit operations of Chemical Engineering, McGraw Hill publication,2017.
4. Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd Edition. Academic Press,2021, London.
5. Don W. Green & Marylee Z. Southard, Perry's Chemical Engineers' Handbook, 9th Edition, and McGraw-Hill Publisher 2018.

PAG102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	1	1	1	2	1	2	1	1	1	1	1	2	1	-
CO2	2	1	2	1	2	1	2	1	1	2	1	2	1	1	2	-
CO3	1	1	1	2	1	1	1	1	2	1	1	1	2	1	1	-
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
CO5	2	1	3	1	1	1	2	2	1	2	1	3	1	2	2	-
Average	1.4	1.0	1.6	1.2	1.2	1.2	1.4	1.4	1.2	1.4	1.0	1.6	1.2	1.4	1.4	-

PAG103 FOOD PLANT DESIGN AND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The course prepares to

- State the different specifications and processes involved in the design and development of food processing plant.
- Define the processes involved in layout design.
- Evaluate the projects and cost estimation of designing food plant.
- Outline the product cost and plant overheads.
- Perform profitability analysis in food processing industry.

UNIT-I PLANT LAYOUT-INTRODUCTION 9

Design considerations of processing agricultural and food products – Plant design concepts and general design considerations: Plant layout, plant location, location factors and their interaction with plant location – Location theory models, and computer aided selection of the location – Human factors in design, selection of materials of construction and standard component – Design standards and testing standards.

UNIT-II PROCESS ECONOMICS OF PLANT LAYOUT 9

Feasibility analysis and preparation of feasibility report – Plant size, factors affecting plant size and their interactions, estimation of break -even and economic plant size; Product and process design – Process selection, process flow charts – Plant utilities, electricity, water, steam, air, raw material requirements – Computer aided development of flow charts.

UNIT-III DEVELOPMENT AND PRESENTATION OF LAYOUT 9

Hygienic design aspects and worker's safety – functional design of plant building and selection of building materials – estimation of capital investment, analysis of plant costs and profitability's – management techniques in plant design including applications of network analysis – preparation of project report and its appraisal.

UNIT-IV FOOD PROCESSING PLANT & EQUIPMENT LAYOUT 9

Plant layout and design of bakery and biscuit industries – fruits and vegetables processing industries including beverages – milk and milk products – meat, poultry and fish processing industries – Equipment layout in Food Industries: Basic understandingof equipment layout and. Preparation of flow sheets for material movement and utility consumption in food plants.

UNIT-V PROJECT EVALUATION AND COST ESTIMATION 9

Preparation of flow sheets for material movement and utility consumption in food plants – Application of Program Evaluation and Review Technique (PERT) – Critical Path Method (CPM) in project planning and monitoring – Cost estimation for a Food Plant; Scale-up – Case Study: Preparation of plant layout and cost estimation for a food processing plant

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Design and construct the well-equipped food processing plant for effective processing.
2. List the start – to – end facilities, infrastructure, utilities, investments alongwith the government regulations and specifications for plant layout.
3. Evaluate and estimate the capital investments and methods of cost estimation of designing food plants.
4. Assess the overall production cost, profitability and factors involved in the cost estimation of products manufactured.
5. Analyze problems involved in deciding the level of manufacture of a food product.

TEXTBOOKS:

1. Maroulis, Z.B. and Saravacos, G.D. Food Process Design. Marcel DekkerInc,. 2016.
2. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas,“Food Plant Design (Food Science and Technology)”, CRC Press, 2019.
3. Antonio Lopez-Gomez & Gustavo V. Barbosa-Canovas, Food Plant Design. Taylor & Francis .2016.

4. Langley and C. Billy, Refrigeration and Air conditioning,3rd edition , Engle wood Cliffs (NJ), Prentice.2016.
5. Madeleine Pullman and Zhuhai Wu, Food Supply Chain Management: Building a Sustainable Future (2nd Edition), Routledge, 2021.

REFERENCE BOOKS:

1. Theunis C. Robberts . Food plant engineering system. II Edition, CRC Press, Washington, 2013.
2. M Moore, Mac Millan, Plant Layout & Design. Lames, New York, 1971.
3. Jaturapatr Varith, Food Plant Design, Maejo University, 2020.
4. Mr. A. K. Sharma & Dr. B. K. Kumbhar, Food Processing Plant Design & Layout PDF Book,2016.
5. Michael M. Cramer, ood Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices (2nd Edition), CRC Publication, 2013.

PAG103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	3	1	1	2	1	2	-	-	1	1	1	1	1	-
CO2	1	1	3	2	1	2	1	2	-	-	3	1	3	3	3	-
CO3	1	1	3	2	1	2	1	2	-	-	3	1	3	3	3	-
CO4	2	1	3	2	1	2	1	2	-	-	3	1	3	3	3	-
CO5	1	1	3	3	1	2	1	2	-	-	3	1	3	3	3	-
Average	1.4	1.0	3.0	2.0	1.0	2.0	1.0	2.0	-	-	2.6	1.0	2.6	2.6	2.6	-

PAG104	DAIRY PLANT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To learn about production management in dairy plant.
- To analyse efficiency of plant operations.
- To learn about energy conservation and factory act regulations.
- To explore the processes involved in human resource management.
- To study the safety hazards in dairy plant operations.

UNIT-I PRODUCTION MANAGEMENT 9

Definition – Function and structure of Production Management – Production planning & Control – Work study and measurement motion and time study.

UNIT-II EFFICIENCY OF PLANT OPERATION 9

Product accounting – setting up norms for operational and processing losses forquantity, fat and SNF– monitoring efficiency.

UNIT-III PLANT OPERATIONS 9

Energy conservation and Auditing – Product and process control, Control charts, Process Sigma – Efficiency factors losses – Financial and Managerial efficiency – Provision for Industrial Legislation in India – particularly in dairy industry– Factory Act& Regulations.

UNIT-IV HUMAN RESOURCE MANAGEMENT 9

Personnel Management, Manpower planning, recruitment, training, transfer, promotions policies, Job specifications, Job evaluation, Job enhancement, Job enrichment, MBO, working conditions.

UNIT-V SAFETY HAZARDS 9

Hazards prevention – security for plant machinery and the employees – Plant Maintenance – Spare parts inventory, tools & lubricants, etc.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Make the production planning and control of dairy plant.
2. Estimate the efficiency of plant processes.
3. Have knowledge on financial planning and regulations of dairy plant.
4. Gain knowledge on manpower upskilling and promotion policies.
5. Understand safety hazards, security for plant machinery and the employees.

TEXT BOOKS:

1. Tufail Ahmed: Dairy plant engineering & management
2. David, J. 2007. Contemporary Trends in Dairy Plant Management. Gyan Books Pvt. Ltd., Delhi.
3. Kumar, H.D. 1998. Environmental Pollution and Waste Management. MD Publ. Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Warner, J. N. 1976. Principles of Dairy Processing. John Wiley Publ., NewYork.
2. Maliwal, G.L. 2007. Hand book of Environmental Management. AgrotechPubl. Academy, India.

PAG104	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	3	2	1	1	1	-	-	-	-	-	-	2	2	2	2
CO2	1	1	2	3	2	1	1	-	-	-	1	-	2	1	2	2
CO3	2	2	1	1	2	2	1	-	-	-	-	-	2	2	1	2
CO4	1	1	2	3	1	1	1	-	-	-	1	-	1	2	2	2
CO5	2	1	1	3	3	1	1	-	-	-	2	-	2	2	2	2
Average	1.6	1.6	1.6	2.2	1.8	1.2	1.0	-	-	-	1.3	-	1.8	1.8	1.8	2.0

PAG105	REFRIGERATION AND COLD STORAGE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To interpret principles of operation of different Refrigeration & Air conditioning systems.
- To understand the types of compressors and expansion devices and their applications.
- To combine the parameters involved in design of the various air conditioning and cold storage systems.
- To study about the basic psychometric properties.
- To study about the basic concept of refrigeration and air conditioning systems.

UNIT-I REFRIGERATION PRINCIPLES AND COMPONENTS 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 chloroflouro carbon (CFC) refrigerants - effect on environmental pollution – alternate refrigerants

UNIT-II VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE 9

Simple vapour compression cycle - T-S diagram - p-h chart- vapour compression system-different types-vapour absorption cycle simple and practical vapour absorption system-advantages- ideal vapour absorption system- Electrolux refrigerator Lithium bromide refrigeration-construction and principles.

UNIT-III APPLIED PSYCHROMETRY 9

Principle and properties of psychrometry, Representation of various psychometric processes on psychometric chart and their analysis, by-pass factor, sensible heat factor, room sensible heat factor, equipment sensible heat factor, grand sensible heat factor,

apparatus dew point, ventilation and infiltration, energy efficiency ratio. Use of psychometric charts. Cooling and heating load calculations.

UNIT-IV AIR CONDITIONING SYSTEM 9

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

UNIT-V APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Select appropriate components of the refrigeration unit and analyze the effect of different refrigerants on environment.
2. Differentiate various refrigeration cycles and its applicability.
3. Apply knowledge of psychrometry for air conditioning & various food processing operations.
4. Apply the knowledge of refrigeration and air conditioning in persevering foods using domestic and industrial refrigeration systems.
5. Choose and design appropriate cold storage system for ensuring the product quality.

TEXTBOOKS:

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2017.
2. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2019.

3. Roy J. Dossat, Principles of Refrigeration, Pearson Education, New Delhi,2017.
4. N. F Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill,New Delhi, 2018.
5. Ajay Kumar Gupta, The Complete Book on Cold Storage, Cold Chain & Warehouse (with Controlled Atmosphere Storage & Rural Godowns) , 5th Edition Nair Project Publisher,2022.

REFERENCE BOOKS:

1. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd., 2017
2. J. B Hains, Automatic Control of Heating & Air conditioning, Tata McGraw Hill Publishing Company Private Limited, 2020.
3. Ibrahim Dincer, Refrigeration Systems and Applications, 2016.
4. Orhan Ekren, Refrigeration Design, IntechOpen Publication,2017.
5. Cold Storage Basics, ISHRAE (Indian Society of Heating, Refrigerating and Air Conditioning Engineers).

PAG105	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	1	1	2	1	-	-	-	1	2	2	2	2
CO2	3	1	2	1	1	1	-	1	-	-	-	1	2	2	2	2
CO3	3	2	2	1	1	1	-	1	-	-	-	1	2	2	2	2
CO4	3	1	2	1	1	1	2	1	-	-	1	1	2	2	2	2
CO5	3	2	2	1	2	1	1	1	-	-	1	1	2	2	2	2
Average	3.0	1.6	2.0	1.0	1.2	1.0	1.7	1.0	-	-	1.0	1.0	2.0	2.0	2.0	2.0

PAG106	STORAGE AND PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand the underlying principles of spoilage and storage.
- To provide knowledge on different storage methods and packaging techniques.
- To learn testing of different food packaging materials.
- To understand various maintenance of CA storage facilities.
- To provide knowledge about losses in storage and to estimate the losses

UNIT-I SPOILAGE AND STORAGE 9

Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses

UNIT-II STORAGE METHODS 9

Improved storage methods for grain-modern storage structures-infestation- temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities.

UNIT-III FUNCTIONS OF PACKAGING MATERIALS 9

Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials.

UNIT-IV FOOD PACKAGING MATERIALS AND TESTING 9

Introduction – paper and paper boards - flexible - plastics - glass containers – cans – aluminium foils - package material testing-tensile, bursting and tear strength.

UNIT-V SPECIAL PACKAGING TECHNIQUES 9

Vacuum and gas packaging - aseptic packaging - retort pouching – edible film packaging – tetra packaging – antimicrobial packaging – shrinks and stretches packaging.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. The students will have a clear understanding of various methods of storage and different packaging techniques for food
2. The students will gain knowledge on different materials that can be used for food packaging
3. At the end of this course, the students will be thorough in testing of packaging materials.
4. The students will be able to enlist the functions of various packaging materials.
5. The students will learn about the special packaging techniques.

TEXTBOOKS:

1. Anne Emblem and Hendry Emblem, “Packing Technology”, Wood head publishers, 2019
2. Himangshu Barman, "Post Harvest Food grain storage", Agrobios (India), 2023.
3. Sahay, K.M. and K.K.Singh, “Unit operations of agricultural processing”, Vikas Publishing House Pvt. Ltd., New Delhi,1996
4. Food Packaging Technology Hand book, NIIR Board, New Delhi ,2006.
5. Pandey, P.H, “Post- harvest engineering of horticultural crops through objectives”, Saroj Prakasam, Allahabad, 2005.

REFERENCE BOOKS:

1. Himangshu Barman and Jodhpurs Chakaraverty, “A Post Harvest Food grain storage Agrobios” (India), 3rd edition, 2008.
2. Post-harvest technology of cereals, pulses and oil seeds”. Oxford & IBH publishing & Co.Pvt.Ltd, New Delhi.
3. R Sasi Kumar, "Agri-Food Crops: Processing, Value Addition, Packaging and Storage", New India Publishing Agency, 2022
4. Duncan Manley , "Biscuit, Cookie and Cracker Manufacturing Manuals: Manual 6: Biscuit Packaging and Storage" by CRC Press, 2023

5. Achilleas Bouletis and Ioannis Arvanitoyanni , "Application of Modified Atmosphere Packaging on Quality of Selected Vegetables", Springer 2021.

PAG106	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	2	3	1	3	-	-	-	2	3	-	2	1
CO2	2	-	-	-	3	3	2	3	-	-	1	1	3	-	3	1
CO3	1	-	-	2	3	-	2	1	2	-	-	-	-	2	2	1
CO4	3	2	-	1	-	-	3	2	1	2	-	3	3	-	2	3
CO5	1	-	-	-	3	3	2	2	-	-	2	2	-	3	-	2
Average	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6

VERTICAL II

PAG201	PRODUCTION TECHNOLOGY FOR AGRICULTURAL MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To study about the basic agricultural machinery components.
- To study about the tractor materials and their tools.
- To study about different materials phase change diagrams.
- To study about the jigs & Fixture.
- To study about the basic CNC machine tool controller.

UNIT-I AGRICULTURAL MACHINERY 9

Critical appraisal in production of Agricultural Machinery; Modelling and stress analysis of Machinery parts by using standard software.

UNIT-II TRACTOR MATERIALS AND TOOLS 9

Advances in material used for tractor & Agri. Machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques like powder metallurgy, EDM (Electro- Discharge Machining), Heat Treatment of Steels.

UNIT-III MATERIALS PHASE CHANGE DIAGRAM 9

Ferrous metallurgy, iron-carbon diagram, alloying of elements, phase diagram, TTT diagram, and surface treatment techniques: thermo chemical treatment including pack carburizing shot pining process, chemical vapor deposition (CVD).

UNIT-IV JIGS AND FIXTURES 9

Limits, Fits & Tolerances, Jigs & Fixtures, and Microstructure Analysis. Industrial layout Planning, Quality management, Economics of process selection. Techno-economic feasibility of Project Report. Selection of Standard/ critical components.

UNIT-V CNC MACHINE TOOL CONTROLLER 9

Case studies of manufacturing of Agricultural Machinery. Servomotors, drives & controllers, CNC controllers for machine tools. CNC programming. Assembly and plant automation. Storage and transportation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to learn

- The tractor parts and analysis process.
- Selection procedure of tractor materials.
- Phase change diagram for different materials.
- Different tool handling machines and selection of standard components.

TEXTBOOKS:

1. Callister, W.D. Materials science and engineering. Wiley Publication, New Delhi,2017.
2. Everett.E.Adam and JR.Ronald. J.Ebert. Production and operations management concepts, models and behaviour. Prentice Hall of India Pvt Ltd, New Delhi,2018.
3. Martand.T.Telsang. Production management. S Chand and company Ltd, Ram nagar,New Delhi.2016.
4. Guangnan Chen, Advances in Agricultural Machinery and Technologies, CRC Press Publication,2018.
5. Dr. P. Kamaraj & Dr. V. R. Ramachandran, Production Technology of Agricultural Machinery, AgriMoon Publication, 2020.

REFERENCE BOOKS:

1. Paul Degram.E, Blach.J.T and Ronald A Kosher. Materials and process in manufacturing.,Prentice Hall of India,2016.
2. Prabhu Dev. Handbook of heat treatment of steel. Tata McGraw Hill.Ltd, New Delhi,2020.
3. Myer Kutz, Handbook of Farm, Dairy and Food Machinery Engineering (3rd

Edition), Academic Press Publication,2019.

4. Donnell Hunt, Farm Power and Machinery Management (11th Edition), WileyBlackwell Publication,2017.
5. Jeroen C. J. M. van der Vorst, George W. J. Gijsenbergh, & Adrie J. M. Beulens, Operations Management in Agriculture, Routledge publications, 2018.

PAG201	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	1	1	2	2	1	-	-	-	1	2	1	2	2
CO2	2	1	2	1	1	2	-	1	-	-	-	1	2	1	2	2
CO3	2	2	2	1	1	2	-	1	-	-	-	1	2	1	2	2
CO4	2	1	2	1	1	2	2	1	-	-	1	1	2	1	2	2
CO5	2	2	2	1	2	2	1	1	-	-	1	1	2	1	2	2
Average	2.0	1.6	2.0	1.0	1.2	2.0	1.7	1.0	-	-	1.0	1.0	2.0	1.0	2.0	2.0

PAG202	MECHANICS OF TILLAGE AND TRACTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the fundamental knowledge of mechanics and dynamics in various tillage implements.
- To study the tires, traction and its applications.
- To understand the concepts of mechanics, dynamics and traction of implements and their applications.
- To gain knowledge on Tillage tools operation.
- To expose the students to the concept of soil compaction.

UNIT - I INTRODUCTION TO MECHANICS OF TILLAGE TOOLS AND ENGINEERING PROPERTIES OF SOIL **9**

History of Tillage- Soil-Machine Crop System- Mechanics of Tillage Tools- Analysis of soil-Machine Dynamics in Tillage- Physical Properties of Soils- MechanicalProperties of Soils-Assessment of the Dynamic Properties of Soils.

UNIT - II DESIGN OF TILLAGE TOOLS, PRINCIPLES OF SOIL CUTTING **9**

Design of Tillage Tools- Design of Tillage Tools- Mould Board Plow Surfaces- Principles of Soil Cutting- Design Equation- Dimensional Analysis- Methods of Dimensional Analysis.

UNIT - III INTRODUCTION TO TRACTION AND MECHANICS, OFF ROAD TRACTION AND MOBILITY **9**

Traction Model -Traction Improvement and Traction Prediction - Cone Index and Tire Basics -Tires for Agricultural Tractors- Tire Terminology and Selection of Tires.

UNIT - IV SOIL COMPACTION AND PLANT GROWTH, VARIABILITY **9**

Soil Compaction- Mechanical and Hydraulic Properties of Compacted Soil - Soil Physical Properties and Plant Growth.

UNIT - V APPLICATIONS **9**

Measures for Optimizing Crop Growth by Avoiding Excessive Soil Compaction Geo Statistics/Kriging - GIS for Soil Variability Studies.

TOTAL :45 PERIODS

COURSE OUTCOMES:

After completion of this course,

1. Students should be able to understand the concepts of mechanics, dynamics and traction of implements.
2. Students will gain knowledge on engineering properties of soil.
3. The students will be able to understand and differentiate the applications of mechanics and dynamics.
4. The students can design tillage tools.
5. The students will be taught about tires in detail.

TEXTBOOKS:

1. A.M. Michael, T.P. Ojha, “Principles of Agricultural Engineering”, Jain Brothers, 2025.
2. M. Muzamil, Asima Jillani, “Farm Power and Machinery Agricultural Engineering”, Kalyani Publishers, 2023.
3. Basavaraj , D Srigiri , Jayan P R, “A Textbook of Farm Machinery & Power Engineering” New India Publishing Agency- Nipa, July, 2019.
4. Dr. D. Anantha Krishnan, Dr. Ananthachar, Mechanics of Tillage and Traction,2020.
5. W R Gill, G E Vanden Berg, Soil Dynamics in Tillage and Traction, 2013.

REFERENCE BOOKS:

1. Mustafa Ucgul, Chung-Liang Chang, “Design and Application of Agricultural Equipment in Tillage System”, MDPI, 2023.
2. W.R. Gill & G.E. Vanden Berg, “Soil Dynamics in Tillage and Traction”, Scientific Publishers, 2013.
3. Yu F Kazakov, V I Medvedev and V M Ivanov, On the development of combined tillage working bodiesmechanisms, 2019, International AgroScience Conference.
4. Jain S.C & Rai C.R, “Farm Tractor Maintenance & Repair”, Standard Book House, 2019.
5. James Henry Stevenson, “Traction Farming and Traction Engineering”, Legare Street Press, 2022.

PAG202	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
CO3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
CO4	3	2	-		3	2	-	-	-	-	-	3	2	-	-	3
CO5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
Average	2.3	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	2.0	2.3	2.7	2.0	2.7

PAG203	TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To study about crop characteristics and drainage.
- To study the tools in precision farming.
- To study about different mowers and harvesters.
- To study about Threshers and its applications.
- To study about special and advanced equipments.

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 EVALUATION OF AGRICULTURAL EQUIPMENT 9

Laboratory and field-testing of manual and power operated intercultural machinery and plant protection machine - Laboratory and field-testing of reaper, thresher and chaff cutters.

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 : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Understand the basics of testing procedures and standards of tractor testing.
2. Understand the testing procedures and standards of tillage, sowingequipment.
3. Understand the testing procedures and standards of intercultural equipment.
4. Understand the testing procedures and standards of harvesting equipment.
5. Understand the safety standards and testing procedures.

TEXTBOOKS:

1. Metha M.L., SR.Verma, K Mishra and VK Sharma. 2005. Testing and Evaluation of Agricultural Machinery, National Agricultural Technology Information Centre, Ludhiana.
2. Indian Standards Test Codes related to tractors, power tillers and agricultural implements,1998.
3. FAO Agricultural Services, Testing and evaluation of agricultural machinery and equipment – Principles and practices,1994.
4. Brian Bell , "Farm Machinery Film Records: Testing and Prototypes Pt. 3", Old Pond Publishing Ltd, 2019
5. Rolfe Cobleigh, "Handy Farm Devices: And How to Make Them", Skyhorse publishers, 2020

REFERENCE BOOKS:

1. Inns F M. 1986. Selection, Testing and Evaluation of Agricultural Machines and Equipment.
2. Barger E L, Liljedahl J B David W. Smith, and Makato Hoki, 2004. Tractors and their Power Units. Eastern Wiley 4th Edition.
3. Myer Kutz, "Handbook of Farm, Dairy and Food Machinery", Springer publishes, 2020.
4. Testing and Evaluation of Agricultural Machinery, M. L. Mehta, S.R. Verma, S. K. Misra Daya Publishing House 2016
5. Non Destructive Test and Evaluation of Materials, J Prasad, C. G. Krishnadas Nair McGraw-Hill 2017.

PAG203	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	2	3	1	3	-	-	-	2	3	-	2	1
CO2	2	-	-	-	3	3	2	3	-	-	1	1	3	-	3	1
CO3	1	-	-	2	3	-	2	1	2	-	-	-	-	2	2	1
CO4	3	2	-	1	-	-	3	2	1	2	-	3	3	-	2	3
CO5	1	-	-	-	3	3	2	2	-	-	2	2	-	3	-	2
Average	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6

PAG204 PRECISION FARMING EQUIPMENT L T P C

3 0 0 3

OBJECTIVES:

The course prepares

- To study about crop characteristics and drainage.
- To study the tools in precision farming.
- To study about different mowers and harvesters.
- To study about Threshers and its applications.
- To study about special and advanced equipments.

UNIT-I COMPONENTS OF PRECISION FARMING 9

Crop Characteristics – Detailed soil layer with physical and chemical properties Micro- climate data (seasonal and daily) - Surface and sub-surface drainage conditions Farm machinery and other equipment with sensor

UNIT-II TOOLS IN PRECISION FARMING 9

Auto-guidance equipment - Variable-Rate Technology - Internet of Things - Proximate Sensors Technology - Global Positioning System and Geographical Information System -Grid sampling - Remote sensors – Yield Monitoring and mapping

UNIT-III MOWERS AND HARVESTERS 9

Mower mechanism – 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 SPECIAL EQUIPMENTS 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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Obtain knowledge on crop characteristics and drainage
2. Obtain knowledge on precision farming
3. Obtain knowledge on different mowers and harvesters
4. Obtain knowledge on Threshers and its applications
5. Obtain knowledge on special and advanced equipments.

TEXTBOOKS:

1. Louise Jupp 2018. Precision Farming From Above: How Commercial Drone Systems are Helping Farmers Improve Crop Management, Increase Crop Yields and Create More Profitable Farms., Delhi 6.
2. Kishore Chandra Swain 2018. A Textbook on Precision Agriculture Technology, New Delhi.
3. Brahma Singh. 2020. Precision Farming and Protected Cultivation. New India Publishing Agency, Delhi.
4. Precision Agriculture in the 21st Century: Geospatial and Information Technologies in Crop Management" by National Research Council and Board on Agriculture
5. Jirí Blahovec and Miroslav Kutílek, "Physical Methods in Agriculture: Approach to Precision and Quality", Kluwer Academic/Plenum Publishers, 2021

REFERENCE BOOKS:

1. Qin Zhang 2016. Precision Agriculture Technology for Crop Farming, CRC press ., Taylor and Francis Group
2. Pankajkumar V Patil & Kalpana D Bangar Wale, Vishal D, 2021 Precision Farming and Geoinformatics, Daya Publishing House
3. John V Stafford, "Precision Agriculture", Wageningen Academic Publishers, 2023
4. C Lokhorst and P W G Groot Koerkamp, "Precision Livestock Farming",

Wageningen Academic Publishers, 2021

5. Ilan Halachmi, "Precision Livestock Farming Applications: Making Sense of Sensors to Support Farm Management", Wageningen Academic Publishers, 2020

PAG204	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	2	3	1	3	-	-	-	2	3	-	2	1
CO2	2	-	-	-	3	3	2	3	-	-	1	1	3	-	3	1
CO3	1	-	-	2	3	-	2	1	2	-	-	-	-	2	2	1
CO4	3	2	-	1	-	-	3	2	1	2	-	3	3	-	2	3
CO5	1	-	-	-	3	3	2	2	-	-	2	2	-	3	-	2
Average	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6

PAG205 SPECIAL FARM EQUIPMENT L T P C
3 0 0 3

OBJECTIVES:

The course prepares

- To study about weeding equipment and its applications.
- To study spraying equipment and its applications.
- To Study about the harvesting equipment and its applications.
- To study about Threshers and its applications.
- To study about seeders and weeders.

UNIT-I WEEDING EQUIPMENT 9

Weeding and intercultural equipment. Junior hoe - blade harrow - rotary weeders for upland and low land - selection, constructional features and adjustments - Spading machine – coir pith applicators

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 - Aerial spraying – Air assist sprayers - orchard sprayers - Dusters - types - mist blower cum duster - other plant protection devices, care and maintenance.

UNIT-III MOWERS AND HARVESTERS 9

Mower mechanism – 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 SPECIAL EQUIPMENTS 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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Obtain knowledge on weeding equipment and its applications.
2. Obtain knowledge on spraying equipment and its applications.
3. Obtain knowledge on the harvesting equipment and its applications.
4. Obtain knowledge on Threshers and its applications.
5. Obtain knowledge on seeders and weeders.

TEXTBOOKS:

1. Jagdishwar Sahay. 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi.
2. Michael and Ojha. 2005. Principles of Agricultural Engineering. Jain brothers, New Delhi.
3. Kepner, R.A., et al. 1997. Principles of farm machinery. CBS Publishers and Distributers, Delhi.
4. Brian Bell, "Farm Machinery Film Records: Testing and Prototypes", Old Pond Publishing Ltd,2019
5. Rolfe Cobleigh, "Handy Farm Devices: And How to Make Them", Skyhorse publishers, 2020

REFERENCE BOOKS:

1. Harris Pearson Smith et al. 1996. Farm machinery and equipments. Tata McGraw-Hill pub., New Delhi.
2. Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford and IBH Pub.Co., New Delhi.
3. Myer Kutz, "Handbook of Farm, Dairy and Food Machinery", Springer publishes, 2020
4. Randy Leffingwell, "Farm Tractor Milestones", Motorbooks International, 2021
5. Ralph Alcock, "Tractor-Implement Systems", Springer-Verlag New York, 2020

PAG205	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	3	-	2	1	3	3	-	1	-	2	2	3	2	2	2
CO2	3	2	-	2	1	2	1	-	1	-	2	2	3	3	2	2
CO3	3	2	-	2	-	3	3	1	2	-	2	2	2	2	2	2
CO4	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2
CO5	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2
Average	1.8	1.8	2.0	2.0	1.0	2.4	2.2	1.0	1.2	-	2.0	2.0	2.4	2.2	2.0	2.0

PAG206	HUMAN ENGINEERING AND SAFETY IN FARM MACHINERY OPERATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To study the physical work load, equipment/work place design, safety and occupational health hazards in farm operations
- To introduce the concepts of man machine systems and techniques of providing human comfort in man-making work systems.
- To study the applications of ergonomic principles and physiology ofworkers.
- To gain knowledge on concept of Ergonomics.
- To expose students to the concept of Cost benefit analysis.

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.

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

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 requirement of the operator – Occupational health hazards - Noise – Dust- Vibration in Tractor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. The student will gain knowledge to improve the performance of the farm systems by improving the human - machine interaction with safety measures.
2. The student will be able to know the risk factors, guide lines for safe design ofman machine systems considering human factors.
3. The students will be able to relate the human and workplace factors which contribute to ergonomic hazards
4. The students will be able to identify ergonomic hazards and recommendappropriate controls.
5. The students will have the knowledge on earth moving machineries, tractor classification and tillage implements.

TEXTBOOKS:

1. C R Mehta, Adarsh Kumar, L P Gite, K N Agrawal.”Textbook of Ergonomics and Safety in Agriculture”.2022 (ISBN: 978-8171642342)
2. Gavriel Salvendy, Waldemar Karwowski. 2021. Handbook Of Human Factors And Ergonomics. John Wiley & Sons, Inc. ISBN:9781119636083
3. P. K. Nag, L. P. Gite. 2020. Human-Centered Agriculture. Springer Nature Singapore Pte Ltd. ISBN: 978-981-15-7268-5.
4. Sharma, D.N. and Mukesh, S. 2018. Design of Agricultural Tractor (Principles and Problems), 3 rd Edition. Jain Brothers, New Delhi.

5. Tillman, Barry, David J. Fitts, Wesley E. Woodson, Rhonda Rose-Sundholm, and Peggy Tillman. 2016. *Human Factors and Ergonomics Design Handbook*. 3rd edition. New York:McGraw-HillEducation.

REFERENCE BOOKS:

1. A. K. Gupta. 2024. Industrial Safety and Environment. Laxmi Publications Pvt Ltd
2. Tillman, Barry, David J. Fitts, Wesley E. Woodson, Rhonda Rose-Sundholm, and Peggy Tillman. 2016. *Human Factors and Ergonomics Design Handbook*. 3rd ed. New York: McGraw-HillEducation.
3. Gite L P, Agrawal K N, Mehta C R, Potdar R R and Narwariya B S. 2019. "Handbook of Ergonomical Design of Agricultural Tools, Equipment and work Places". Jain Brothers, New Delhi. 2019.
4. Arudra Ashok Kumar. 2014. Precautions to Overcome Tractor Accidents in the Farm. LAP Lambert Academic Publishing. ISBN: 978-3659579158
5. Segun R. Bello. 2012. Agricultural Machinery Hazards: Safety Practices (Agricultural Mechanization). Createspace Independent Pub. ISBN: 978-1477536643.

PAG206	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	-	-	-	2	-	-	2	-	-	-	2	-	-	3
CO2	2	-	3	-	-	-	2	2	-	3	2	-	-	-	3	-
CO3	-	-	3	-	2	-	2	-	-	-	-	2	-	2	2	-
CO4	3	-	3	-	2	-	-	-	2	-	3	3	-	1	-	2
CO5	2	-	-	-	-	-	-	2	-	-	3	2	-	2	-	-
Average	2.5	2.0	3.0	-	2.0	2.0	2.0	2.0	2.0	3.0	2.7	2.3	2.0	1.7	2.5	2.5

VERTICAL III

PAG301	PROTECTED CULTIVATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To impart knowledge on the protected cultivation of vegetables, fruits and flower crops.
- To sensitize the students on hi-tech production technology of fruits,vegetables and flower crops.
- To gain knowledge about precision technology and implementing it onfarming activities.
- To learn and practice the various production practices of flower and otherhigh value crops.
- To understand the disease management in the vegetable and flowercrops.

UNIT-I PROTECTED CULTIVATION AND ITS TYPES 9

Importance and methods of protected culture in horticultural crops - Importance and scope of protected cultivation – different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house - study of environmental factors influencing greenhouse production – cladding /glazing / covering material – ventilation systems – cultivation systems including nutrient film technique / hydroponics / aeroponic culture – growing media and nutrients – canopy management – micro irrigation and fertigation systems.

UNIT-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 cut roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut

foliages and fillers – integrated pest and disease management – postharvest handling.

UNIT-IV PRECISION FARMING TECHNIQUES 9

Concept and introduction of precision farming – Importance, definition, principles and concepts – Role of GIS and GPS - Mobile mapping system and its application in precision farming – design, layout and installation of drip and fertigation – georeferencing and photometric correction – Sensors for information gathering – UAV - geostatistics – robotics in horticulture - postharvest process management (PPM) – remote sensing.

UNIT-V PRECISION FARMING OF HORTICULTURAL CROPS 9

Precision farming techniques for horticultural crops - Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to gain

1. Knowledge about the importance and types of productive cultivation.
2. The students will be able to appreciate the different methods of protected cultivation practices available for vegetable crops and flowers.
3. Understanding the disease and pest management in the vegetable and flower crops
4. Introduction to precision farming techniques using GPS and GIS.
5. A clear understanding of precision farming techniques and its application to horticultural crops.

TEXTBOOKS:

1. Ashok Kumar, B. Eggadi Ramesh, V.Sindhu. 2022. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops. Jain Brothers. ISBN: 9789390576364.

2. P. Kandasamy. 2022. Fundamentals of Crop Processing Technology and Protected Cultivation. **Brillion Publishing.** ISBN:9789392725487
3. V. Sindhu Dr. B. Ashok Kumar, Eggadi Ramesh. 2021. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops.science technology; 1st Edition, 2021
4. Kumar, S., Saravaiya, S.N., & Pandey, A.K. 2021. Precision Farming and Protected Cultivation: Concepts and Applications (1st ed.). CRC Press. https://doi.org/10.1201/9781003196846.
5. *Itigi Prabhakar, B.L. Manjunatha, Swetha B.S.* Protected Cultivation of Horticulture Crops. Satish Serial Publishing house. ISBN: 9789388892278.

REFERENCE BOOKS:

1. R. Suresh, S.K. Nirala. 2024. Precision Farming Techniques For Protected Cultivation. PHI Learning Pvt. Ltd.

2. Ashok Kumar, B. Eggadi Ramesh, V.Sindhu. Textbook of Protected Cultivation snd Precision Farming For Horticultural Crops. Jain Brothers.2022. ISBN: **9789390576364**

3. D. Kent Shannon, David E. Clay, Newell R. Kitchen. 2020. Precision Agriculture Basics. John Wiley & Sons, Inc.

4. Singh, A. K. 2020. Textbook of Floriculture And Landscaping. India: Nipa Genx Electronic Resources and Solns Pvt Limited. ISBN: 9789386546005.

5. *Dhaliwal, S S. 2020. Precision Farming : Geoinformative & Nano Technology. Narendra Publishing House.*

PAG301	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	1	1	3	-	-	3	-	1	1	1	3	3	1	3	3
CO2	-	-	-	-	3	3	2	1	1	2	1	3	2	1	3	3
CO3	1	3	3	1	3	1	-	-	-	-	1	2	1	1	3	1
CO4	-	-	1	1	3	2	1	1	-	1	1	3	2	3	2	1

CO5	-	-	2	1	1	-	2	-	1	-	1	1	2	1	1	3
Average	**1**	**2**	**1.8**	**1.5**	**2.5**	**2**	**2**	**1**	**1**	**1.3**	**1**	**2.4**	**2**	**1.4**	**2.4**	**2.2**

PAG302	GROUNDWATER AND WELL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce the concepts of groundwater, its availability, assessment and utilization.
- To understand the theory behind well construction and maintenance of wells.
- To gain knowledge about groundwater pollution.
- To understand the importance of groundwater management.
- To gain knowledge about the groundwater development policies.

UNIT-I GROUND WATER OCCURRENCE 9

Occurrence of groundwater, temporal and spatial variability of groundwater, methods for groundwater exploration, determination of aquifer parameters, pumping tests, assessment of groundwater potential

UNIT-II WELL CONSTRUCTION 9

Groundwater structures, groundwater development and utilization, types of water wells, design and construction of water wells, drilling methods, well development, well maintenance and rehabilitation, groundwater monitoring, monitoring wells, design and construction of monitoring wells

UNIT-III GROUNDWATER POLLUTION 9

Groundwater development and quality considerations, groundwater contamination, sources and causes of groundwater pollution, contaminated systems and their rehabilitation, groundwater bioremediation, management of salt water ingress in inland and coastal aquifers.

UNIT-IV GROUNDWATER MANAGEMENT 9

Management of declining and rising water table, Natural and artificial groundwater recharge, Groundwater recharge basins and injection wells. Groundwater management in irrigation command, conjunctive water use, water lifting, different types of pumps, selection of pumps, pump characteristics curve, cost of groundwater pumping, comparative economics of surface and groundwater use for irrigation

UNIT-V GROUNDWATER DEVELOPMENT POLICIES 9

Major issues related to groundwater development and management in India, Legal aspects of groundwater exploitation, Diagnostic survey of sick wells/tube wells and their rehabilitation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. The students will be able to describe the concepts of aquifer parameters
2. The students will be able to describe the components involved in Groundwater structures
3. The students will be able to describe the Groundwater development and quality considerations
4. The students will be able to describe the Management of declining and rising water table
5. The students will be able to prioritize and execute the Groundwater development programme

TEXTBOOKS:

1. R. David G. Pyne “Groundwater Recharge and Wells” CRC Press, 2019.
2. K umar. P “Ground Water and Well Drilling” CBS Publishers, 2018.
3. K aranth K.R. “Groundwater Assessment, Development and Management”. Tata mcgraw Hill. New Delhi, 2017.
4. Jo hn H. Cushman, Daniel M. Tartakovsky “The Handbook of Groundwater Engineering”, CRC press, 2017.
5. Yi qun Tang, Jie Zhou, Ping Yang, Jingjing Yan, Nianqing Zhou “Groundwater Engineering”, Tongji University Press, 2016.

REFERENCE BOOKS:

1. E

. R. Chahar, “Hydrology of Groundwater”, Pearson, 2024.

2. S
ughosh Madhav and Pardeep Singh, “Groundwater Geochemistry: Pollution and Remediation Methods”, Wiley-Blackwell, 2021

3. L
. W. Canter and R.C. Knox, “Groundwater Pollution”, CRC Press, 2020.

4. Y
iqun Tang, Jie Zhou, Ping Yang, Jingjing Yan, Nianqing Zhou “Groundwater Engineering”, Springer, 2016.

5. M
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PAG302	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	2	2	1	2	3	1	2	2	2	2	2	2	2
CO2	3	2	2	2	3	1	3	3	1	3	3	2	2	2	2	2
CO3	2	2	2	2	2	1	2	2	2	2	2	3	2	2	2	2
CO4	2	3	2	1	2	2	1	3	1	1	2	2	2	2	2	2
CO5	2	1	1	2	3	3	2	3	2	1	1	2	1	1	1	1
Average	2.2	2.0	1.8	1.8	2.4	1.6	2.0	2.8	1.4	1.8	2.0	2.2	1.8	1.8	1.8	1.8

PAG303	MICRO IRRIGATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce the concept of micro irrigation system.
- To impart knowledge about the Drip irrigation system and design.
- To expose the students about the components and design of drip irrigation system.
- To know the concept of fertigation, types and application methods.
- To learn about the automation techniques and application.

UNIT-I INTRODUCTION TO MICRO IRRIGATION 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- Economics of micro-irrigation system.

UNIT-II DRIP IRRIGATION DESIGN 9

Drip irrigation - Components- Dripper- types and equations governing flow through drippers- Wetting pattern- Chemigation application- Pump Capacity-Installation-Operation and maintenance of Drip irrigation system. - Design of surface and sub-surface drip irrigation.

UNIT-III SPRINKLER IRRIGATION DESIGN 9

Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance-Sprinkler discharge- Water distribution pattern- Droplet size, filtering unit, fertigation – System maintenance

UNIT-IV FERTIGATION APPLICATION in DRIP IRRIGATION 9

Introduction to Fertigation- Need of Fertigation- Advantages and limitations of fertigation- Types of fertigation- Fertilizers solubility and their compatibility-Safety precautions and back flow prevention Fertigation system Design - estimation of available nutrients in soil, estimation of amount of fertilizer required,

frequency of fertigation, fertilizer tank capacity, irrigation water requirement, capacity of drip system, injection duration, estimation of concentration of nutrients in irrigation water and injection rate.- Fertigation Application Methods.

UNIT-V AUTOMATION IN MICRO IRRIGATION 9

Introduction to Automation techniques- Need for Automation for Micro Irrigation- Merits and Demerits of Automation- Semiautomatic and Fully Automatic Systems of Automation- Automatic Controllers- Components of Automation System- Types of Controls and Automation in Micro Irrigation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To find the low-cost micro irrigation system.
2. To design the drip irrigation and its components.
3. To design of Sprinkler irrigation and it components.
4. To understand the concept of fertigation and its types.
5. To gain knowledge about the automation in the irrigation.

TEXTBOOKS:

1. Megh R. Goyal, Balram Panigrahi, Sudhindra N. Panda, Micro Irrigation Scheduling and Practices, Apple Academic Press, 2021.
2. Megh R. Goyal, Management of Drip/Trickle or Micro Irrigation, Taylor & Francis, 2024.
3. R.K. Biswas, Drip and Sprinkler Irrigation: 2nd Fully Revised and Enlarged Edition, 2025.
4. Sinobas, Leonor Rodr, Micro Irrigation Management Agricultural Science, Excelic Press,2020.
5. Singh A, Microirrigation Systems Principles And Practices, CBS, 2020.

REFERENCE BOOKS:

1. Megh R. Goyal, Vishal K. Chavan, Vinod K. Tripathi, Innovations in Micro Irrigation Technology, Apple Academic Press, 2016.
2. Uddipta Ghosh, Nabanita Sarkar and Debargha Banerjee, Micro Irrigation: Empowering Agriculture, One Drop at a Time, LAP Lambert Academic Publishing, 2024.

3. Megh R. Goya and Ajai Singh, Micro Irrigation Engineering for Horticultural Crops: Policy Options, Scheduling, and Design, Innovations and Challenges in Micro Irrigation (9 books), 2017.
4. Santosh Kumar Garg, Irrigation Engineering and Hydraulic Structures [Paperback] 38th, Khanna Publishers, 2023.
5. Dr. Suresh R., "Principles of Micro-Irrigation Engineering", Standard Publishers Distributors, New Delhi, 2010.

PAG303	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	-	-	2	-	2	-	-	2	1	-	-	2	-	1
CO2	2	-	2	2	-	1	-	2	1	-	-	2	2	1	-	2
CO3	-	2	-	1	-	2	-	1	-	2	-	2	2	-	2	-
CO4	1	-	2	2	-	2	2	-	2	-	1	-	1	2	-	1
CO5	2	1	-	2	2	-	-	2	-	-	2	1	-	2	-	2
Average	1.8	1.3	2.0	1.8	2.0	1.7	2.0	1.7	1.5	2.0	1.3	1.7	1.7	1.8	2.0	1.5

PAG304	IRRIGATION WATER QUALITY AND WASTE WATER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares the students

- To understand water quality concepts, its evaluation for irrigation purposes.
- To investigate the relevant environmental problems and recycle and reuse concepts.
- To understand the importance of water quality for irrigation.
- To evaluate the major uses of water and environmental issues related to it.
- To understand the water utilization and wastewater generation.

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.

UNIT-II 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 QUALITY MANAGEMENT 9

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

UNIT-IV POLLUTANTS AND ITS CONTROL 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.

UNIT-V 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.

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To relate water quality and its dependence on sources of water pollution.
2. To understand and interpret water quality data for beneficial uses and in water quality models.
3. To appreciate the need to manage water quality.
4. To suggest water recycling and reuse options.
5. To analyse the water quality and determine the water quality indices.

TEXTBOOKS:

1. R. Suresh, *Watershed Planning and Management*, Standard Publishers Distributors, New Delhi, 2020.
2. J.V.S. Murty and J. Jha, *Watershed Management*, New Age International Publishers, New Delhi, Revised Edition 2022.
3. S.C. Sharma, *Watershed Management and Planning*, Katson Publishing House, New Delhi, 2021.
4. K.N. Tiwari, *Watershed Management*, Kushal Publications & Distributors, Cuttack, 2018.
5. Rajvir Singh, *Watershed Planning and Management*, Yash Publishing House, New Delhi, 2016.
6. A.M. Michael, *Irrigation: Theory and Practice* (Relevant chapters on watershed hydrology and planning), Vikas Publishing House, New Delhi, Revised Edition 2017.
7. D.K. Das, *Introductory Soil Science* (Chapters on soil and water conservation), Kalyani Publishers, New Delhi, 2020.

REFERENCE BOOKS:

1. USDA Natural Resources Conservation Service, *National Watershed Program Manual*, USDA NRCS, Washington, D.C., 2024.
2. California Department of Water Resources, *Watershed Management Resource Management Strategy*, California DWR, Sacramento, 2024.
3. New York State Department of Environmental Conservation, *Watershed Management: Hudson River Estuary Program*, NYSDEC, Albany, 2025.
4. R.S. Ayers and D.W. Westcot, *Water Quality for Agriculture*, FAO Irrigation and Drainage Paper 29 (Rev.1), Food and Agriculture Organization of the United

Nations, Rome, 1985.

5. C.A. Scott, N.I. Faruqui, and L. Raschid-Sally (Eds.), *Wastewater Use in Irrigated Agriculture: Confronting the Livelihood and Environmental Realities*, CABI Publishing, Wallingford, UK, 2004.
6. CPHEEO, *Manual on Sewerage and Sewage Treatment Systems*, Ministry of Housing and Urban Affairs, Government of India, New Delhi, 2013.

PAG304	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	-	-	-	1	2	1	-	-	-	1	3	-	2	1
CO2	3	-	2	1	-	1	-	-	1	2	-	1	2	1	-	3
CO3	3	3	3	-	2	-	2	1	-	-	-	2	3	2	3	2
CO4	2	2	2	-	-	2	1	-	-	1	2	-	2	1	-	2
CO5	2	1	1	-	-	2	1	-	-	-	-	1	2	2	3	2
Average	2.6	2.0	2.0	1.0	2.0	1.5	1.5	1.0	1.0	1.5	2.0	1.3	2.4	1.5	2.7	2.0

PAG305	WATERSHED PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares the students

- To provide the technical know-how of analyzing the degradation of soil and water resources and implementation of the measures for soil and water conservation.
- To provide the technical, economical and sociological understanding of a watershed.
- To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management.
- To ensure the proper use of all available resources of a watershed for optimum production with minimum hazards to natural resources.
- To relate interdisciplinary topics such as the use of public policies, regulations, and management tools to effectively manage water resources for a sustainable future.

UNIT-I INTRODUCTION 9

Watershed – Definition - concept - Objectives – Land capability classification -priority watersheds - land resource regions in India

UNIT-II WATERSHED PLANNING 9

Planning principles – collection of data – present land use Preparation of watershed development plan - Estimation of costs and benefits - Financial plan – selection of implementation agency Monitoring and evaluation system.

UNIT-III WATERSHED MANAGEMENT 9

Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands -In-situ & Ex-situ moisture conservation principle and practices.

UNIT-IV WATERSHED DEVELOPMENT PROGRAMME 9

River Valley Project (RVP) - Hill Area Development Programme (HADP) - National

Watershed Development Programme for Rainfed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Role of NGOs in watershed development.

UNIT-V GIS FOR WATERSHED MANAGEMENT 9

Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To apply the knowledge of overall concepts of watershed which would help to comprehend and analyze for better management.
2. To analyze public policies and practices of watershed planning.
3. To assess the impact of watershed planning through case studies.
4. To develop control and mitigation techniques for watershed problems.
5. To access better watershed management plan for applications of Remote Sensing and GIS.

TEXTBOOKS:

1. Rajvir Singh, *Watershed Planning and Management*, Yash Publishing House, New Delhi, 2016.
2. R. Suresh, Watershed Planning and Management, Standard Publishers Distributors, New Delhi, 2020.
3. J.V.S. Murty and J. Jha, Watershed Management, New Age International Publishers, New Delhi, Revised Edition 2022.
4. S.C. Sharma, *Watershed Management and Planning*, Katson Publishing House, New Delhi, 2021.
5. K.N. Tiwari, *Watershed Management*, Kushal Publications & Distributors, Cuttack, 2018.
6. Rajvir Singh, Watershed Planning and Management, Yash Publishing House, New Delhi, 2016.

REFERENCE BOOKS:

1. USDA Natural Resources Conservation Service, *National Watershed Program*

Manual, USDA NRCS, Washington, D.C., 2024.

2. California Department of Water Resources, *Watershed Management Resource Management Strategy*, California DWR, Sacramento, 2024.
3. A.M. Michael, *Irrigation: Theory and Practice* (Relevant chapters on watershed hydrology and planning), Vikas Publishing House, New Delhi, Revised Edition 2017.
4. D.K. Das, *Introductory Soil Science* (Chapters on soil and water conservation), Kalyani Publishers, New Delhi, 2020.
5. New York State Department of Environmental Conservation, *Watershed Management: Hudson River Estuary Program*, NYSDEC, Albany, 2025

PAG305	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	-	-	-	2	3	1	3	-	-	-	2	3	-	2	1
CO2	2	-	-	-	3	3	2	3	-	-	1	1	3	-	3	2
CO3	1	-	2	3	-	2	1	2	-	-	-	-	-	2	2	1
CO4	3	2	1	-	-	-	3	2	1	2	-	3	3	-	2	3
CO5	-	-	-	-	3	3	2	2	-	-	2	2	-	3	-	2
Average	2.3	2.0	1.5	3.0	2.7	2.8	1.8	2.4	1.0	2.0	1.5	2.0	3.0	2.5	2.3	1.8

PAG306	CLIMATE CHANGE AND ADAPTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares the students

- To know the basics, importance of global warming.
- To know the concept of mitigation measures against global warming.
- To learn about the global warming and climate change.
- To analyse linkages between climate change adaptation and development planning.
- To identify international initiatives which support countries to plan for climate change.

UNIT-I EARTH'S CLIMATE SYSTEM 9

Role of ozone in environment - ozone layer - ozone depleting gases - Green House Effect, Radiative effects of Greenhouse Gases - Hydrological Cycle - Green House Gases and Global Warming – Carbon Cycle.

UNIT-II ATMOSPHERE AND ITS COMPONENTS 9

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

UNIT-III IMPACTS 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 and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT-IV OBSERVED CHANGES AND ITS CAUSES 9

Climate change and Carbon credits- CDM- Initiatives in India - Kyoto Protocol

Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks –The Montreal Protocol – UNFCCC– IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India.

UNIT-V CLIMATE CHANGE AND MITIGATION MEASURES 9

Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To demonstrate an understanding of how the threats and opportunities of predicted climate change will influence specific sectors at global and regional scale.
2. To critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts.
3. To understand the scientific insights underlying the assessment reports of the IPCC.
4. To critically evaluate with a focus on impacts, adaptation and mitigation.
5. To analyse different climate change scenarios and their implications.

TEXTBOOKS:

1. P. Rao, “Climate Change”, University Science Press (An Imprint of Laxmi Publications), New Delhi, 2010.
2. K.S. Valdiya, “Environmental Geology – Ecology, Resource and Hazard Management”, McGraw-Hill Education, New Delhi, 2013.
3. B.J. Alloway and D.C. Ayres, “Chemical Principles of Environmental Pollution”,

2nd Edition, Blackie Academic & Professional (Springer), London, 1997.

4. R. Murugesan, “Climate Change: Facts, Impacts and Adaptation Strategies”, MJP Publishers, Chennai, 2018.
5. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (Eds.), “Climate Change 2007: Impacts, Adaptation and Vulnerability”, Contribution of Working Group II to the Fourth Assessment Report of the IPCC, Cambridge University Press, Cambridge, 2007
6. P. Rao, “Climate Change”, University Science Press (An Imprint of Laxmi Publications), New Delhi, 2010.

REFERENCE BOOKS:

1. IPCC, *“Climate Change 2021: The Physical Science Basis”*, Contribution of Working Group I to the Sixth Assessment Report of the IPCC, Cambridge University Press, Cambridge, 2021.
2. OECD, *“Climate Change Adaptation: Policies and Practices for Coastal Cities”*, Organisation for Economic Co-operation and Development, Paris, 2010.
3. UNEP, *“Climate Change Adaptation Technologies for Water: A Practitioner’s Guide to Adaptation Technologies in Water Sector”*, United Nations Environment Programme, Nairobi, 2014.
4. World Bank, *“Climate Change and Agriculture: A Review of Impacts and Adaptations”*, Agriculture and Rural Development Department, World Bank Publications, Washington D.C., 2010.
5. FAO, *“Climate-Smart Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation”*, Food and Agriculture Organization of the United Nations, Rome, 2013.
6. N.H. Ravindranath and J. Sathaye, *“Climate Change and Developing Countries”*, Kluwer Academic Publishers (Springer), Dordrecht, 2

PAG306	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	2	2	-	-	-	-	-	-	2	1	-
CO2	-	-	-	-	2	2	2	-	-	-	-	1	1	-	2	1
CO3	-	2	-	-	2	2	2	-	-	-	-	2	2	-	2	1
CO4	-	2	-	2	-	1	1	-	-	-	-	2	2	-	1	2

CO5	2	2	1	2	-	2	2	-	-	-	-	2	2	1	2	2
Average	2.0	2.0	1.0	2.0	2.0	1.8	1.8	-	-	-	-	1.8	1.8	1.5	1.6	1.5

VERTICAL IV

PAG401	PRINCIPLES OF AGRICULTURALECONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand the concepts of agricultural economics.
- To study about the market demand in agriculture.
- To understand about the production and capital in agriculture.
- To study about the concepts of supply and market.
- To study about the macro economics and finance in agriculture.

UNIT-I INTRODUCTION TO AGRICULTURAL ECONOMICS 9

Economics – Definition and Nature & Scope of Economics – Divisions of Economics- Economic systems – Definitions and characteristics - capital economy – socialist economy – Mixed economy

UNIT-II DEMAND 9

Demand –individual demand – market demand – demand schedule – demand curve – Law of demand and factors affecting it-Elasticity of demand – price, income and cross elasticities – estimation – point and arc elasticity - Giffen Good – normal and inferior goods – substitutes and complementary goods

UNIT-III PRODUCTION AND CAPITAL 9

Production – factors of production – land & characteristics; Labour – quantity and quality of labour- - division of labour – efficiency of labour - Malthusian-.Capital - characteristics - capital formation; Organization of business firms – types and characteristics - Concept of shares & debenture.

UNIT-IV SUPPLY AND MARKET 9

Supply-Law of diminishing marginal return – its application to agriculture - Cost concepts – short run & long run cost curves - optimum level of production-Graphical derivation of supply from cost curve - - supply schedule – supply curve – Law of supply – elasticity of supply-Market and its structure - perfectly competitive market and derivation of equilibrium price – Definition and characteristics of Imperfectly competitive markets-Factor pricing ; rent - Ricardian rent-economic rent – Quasi –rent; Wage– marginal productivity theory of wage; Interest - Liquidity preference theory; Profit – Risk-bearing theory of profit.

UNIT-V MACRO ECONOMICS AND FINANCE 9

Macro economics – Concepts of - Gross National Product (GNP) - Gross Domestic Product (GDP) - Net National Product (NNP) - Percapita income-Money – Definition & functions of money; inflation –consequences & control- Public finance - public revenue - public expenditure; taxation - principles of taxation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To Understand the concepts of agricultural economics.
2. To Apply the market demand in agriculture.
3. To Apply the production and capital in agriculture.
4. To Apply the concepts of supply and market in agriculture.
5. To Understand the macro economics and finance in agriculture.

TEXTBOOKS:

1. Andrew Barkley, Paul W. Barkley “Principles of Agricultural Economics”, Taylor and Francis, 2023.
2. Deepak Kumar and Sunil Phougat, “Principles of Agricultural Economics”, Academic Publication, 2023.
3. S. Subba Reddy, P. Raghu Ram, T.V. Neelakanta Sastry and I. Bhavani Devi, “Agricultural Economics”, Oxford, 2019.
4. Adler Bryant, “Principles of Agricultural Economics”, Syrawood Publishing House, 2018.
5. Latika Sharma, S.K. Acharya, L.L. Somani and Harshita Maloo, “Principles of Agricultural Economics” 2015.

REFERENCE BOOKS:

1. Edwin Griswold Nourse, “Agricultural Economics, a Selection of Materials in

Which Economic Principles are Applied to the Practice of Agriculture", Legare Street Press, 2022.

2. Raphael Herman Tuck, "An Introduction to the Principles of Agricultural Economics", Hassell Street Press, 2021.

3. Praveen Kumar Verma and Santhosh Kumar Nag, "Fundamentals of Agricultural Economics", Jaya Publishing House, 2019.

4. E. Case Karl, C. Fair Ray and E. Oster Sharon, "Principles of Economics", Pearson Education, 2017.

5. N. Gregory Mankiw, "Principles of Macroeconomics", Cengage Learning India Pvt. Ltd, 2015.

PAG401	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	-	-	1	1	-	-	-	3	3	3	2	1	2	2
CO2	1	1	-	-	1	1	-	-	-	3	3	3	2	1	1	2
CO3	1	1	-	-	1	1	-	-	-	2	3	3	2	1	1	2
CO4	1	2	-	-	3	1	-	-	-	2	3	3	2	1	1	2
CO5	1	2	-	-	3	1	-	-	-	2	3	3	2	1	2	1
Average	1.0	1.4	-	-	1.8	1.0	-	-	-	2.4	3.0	3.0	2.0	1.0	1.4	1.8

PAG402	AGRICULTURAL EXTENSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To develop expertise on different concepts and issues of educational technology in extension.
- To know the evolution of extension system in organisational structure, salientfeatures and functioning.
- To develop expertise knowledge and skills on Gender Studies in Agricultural Development.
- To develop expertise knowledge in approaches to projects and issues inextension.
- To have well-balanced cognitive, affective and psychomotor aspects with community.

UNIT-I EXTENSION EDUCATION 9

Extension Education - Types - their characteristics - Agricultural extension-Concepts - objectives and principles - Pioneering extension effects and their implications in Indian agricultural extension.

UNIT-II EXTENSION SYSTEMS ANALYSIS 9

Analysis of extension systems of ICAR and SAU – State Departments Extension system and NGOs – Role of Extension in Agricultural University.

UNIT-III AGRICULTURAL DEVELOPMENT PROGRAMMES 9

Objectives and salient features - Intensive Agriculture Development Programmes (IADP) - High Yielding Variety Programme (HYVP) - Institution Village Linkage Programme (IVLP) - Water Shed Development Programme (WDP) - National Agricultural Technology Project (NATP) - Agricultural Technology Management and Assessment (ATMA) - Agricultural Technology Information Center.

UNIT-IV POVERTY ALLEVIATION PROGRAMMES 9

Swarnjayanti Gram SwarozgarYojana (SGSY) - SampoornaGrameenRozgarYojana (SGRY) -PradhanMantri Gram SadakYojana (PMGSY), -Desert Development Programme (DDP), The Council for Advancement of People's Action and Rural

Technology (CAPART) – Employment Generation Programmes – NREGP, Women Development Programmes – ICDS, MSY, RMK, Problems in Rural Development.

UNIT-V APPROACHES IN EXTENSION 9

Decentralized Decision Making - Bottom-up Planning -Farming System Approach - Farming Situation Based Extension - Market– Led – Extension - Farm Field School – ATIC - Kisan Call Centres – KVK - NAIP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand about extension eduction and its application in agriculture.
2. To know the extension system functioning of various organizational structures.
3. To analyse and compare different agricultural development programmes.
4. To understand the importance of poverty alleviation and government initiatives towards it.
5. To learn about different approaches to implement agricultural extensionactivities.

TEXTBOOKS:

1. Sagar Mondal. “Fundamentals of Agricultural Extension Education”, Kalyani Publishers, 2017.
2. Ganesan R, Iqbal IM & Anandaraja N, “Reaching the Unreached: Basics of Extension Education”, Associated Publishing Company, 2nd Edition, 2022.
3. M. V. Srinivasa Reddy, “Fundamentals of Agricultural Extension Education”, Brillion Publishing, 2021.
4. Ravindra Dohley, Anjula Bhartiya, Sarita Paradkar, Nitin Dohle, “Textbook of Agricultural Extension: Theories to Practical Implementation”, Notion Press, 2022.
5. Ray G.L. “Extension Communication and Management”, Kalyani Publishers, 2023.

REFERENCE BOOKS:

1. S.R. Padma & M. Jegadeesan, “Fundamentals of Agricultural Extension Education and Rural Development”, NIPA, 2023.
2. Sapna Jarial, “A Comprehensive Handbook For Agricultural Extension”, NIPA, 2023.

3. Ajay Kumar Prusty, “Advanced Trends in Agricultural Extension”,Volume 7, Integrated Publications, 2023.
4. Sudhanshu, Pushpendra Singh Gurjar, Ashish Kumar Pandey, Ankit Tiwari, Abhishek Mishra, “Handbooks of Agricultural Extension and Education”, P.K. Publishers & Distributors, 2023.
5. Shyam Ranjan Kumar Singh & Uttam Kumar Tripathi , “Advances in Agricultural Extension”, Volume 17 , AkiNik Publications, 2023.

PAG402	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	2	2	-	-	-	-	2	1	1	2	1	1	2
CO2	1	-	-	-	2	-	-	-	2	-	1	-	2	-	-	1
CO3	1	-	-	-	3	-	-	-	-	-	2	1	2	-	1	1
CO4	1	-	1	-	2	-	-	-	1	1	-	2	1	-	-	-
CO5	2	-	-	2	2	-	-	-	-	2	1	1	2	1	1	2
Average	1.4	-	1.0	2.0	2.2	-	-	-	1.5	1.7	1.3	1.3	1.8	1.0	1.0	1.5

PAG403	AGRI BUSINESS MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce the importance of Agri-business management, its characteristics and principles.
- To introduce the students about Agriculture – Business Origination like staffing, directing, supervision and motivation.
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.
- To impart knowledge about the Agriculture financing regarding the acquiring capital budget analysis and financial management.
- To learn about market promotion and human resources.

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 physical facilities and managing quality. Agro-inputs and products inventory management - raw material procurement, inventory types, and costs. Marketing management- Marketing environment, marketing mix - Agricultural input marketing firms.

UNIT-IV AGRICULTURAL BUSINESS FINANCE 9

Forms of agri-business organizations - Role of lead bank in agribusiness finance –

Financial management. Acquiring capital- Budget analysis. Concepts and Determinants - Business project scheduling of raw material procurement - production management - launching products (branding, placement) - Input marketing promotion activities.

UNIT-V MARKET PROMOTION AND HUMAN RESOURCES 9

Agricultural products - marketing promotion activities - product pricing methods. District Industries Centre - Consumer survey - Agricultural inputs retailing - Market potential assessment - types of distribution channels - Return on Investment - Personnel management. Recruitment, selection and training - Technology in Agri Business.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Understand the concepts and fundamentals of management with reference to agribusiness.
2. Gain knowledge about organization and functioning of different institutions involved in agriculture marketing.
3. Understand the different concepts of inventory management of agricultural inputs.
4. Expose students to various concepts of financing Agri Business.
5. Have the knowledge of marketing agricultural products and the techniques involved.

TEXTBOOKS:

1. Freddie L. Barnard, Jay T. Akridge, Frank J. Dooley, John C. Foltz, “Agribusiness Management”, Routledge, 6th Edition,2021.
2. Smita Diwase, “Indian Agriculture and Agribusiness Management”, Krishi resource Management Network, 3rd Edition, 2017.
3. Peter L Nuthall, "Farm Business Management: The Fundamentals of Good Practice", CABI Publisher, 2016.
4. R. K. Sharma, "Agribusiness Management and Trade", Scientific Publishers, 2016.
5. Julian Roche, “Agribusiness: An International Perspective " Routledge, 2019.

REFERENCE BOOKS:

1. Chandra Prasanna, “Projects: Preparation, Appraisal, Budgeting and Implementation”, Tata McGraw Hill Publications, 9th Edition, 2017.
2. Philip Kotler., “Marketing Management. Analysis, Planning and Control”, Prentice Hall Inc., 15th Edition, 2016.
3. Rao V.S.P. and Narayana P.S., “Principles and Practices of Management”, Konark Publishing Private Limited, 9th Edition, 2022.
4. Tripathy P.C. and Reddy, P.N., “Principles of Management”, Tata McGraw Hill Publications, 7th Edition, 2021.
5. Freddie L. Barnard, John Foltz, Elizabeth A. Yeager, Brady Brewer, “Agribusiness Management”, Taylor & Francis, 2020.

PAG403	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	-	1	-	-	2	1	1	-	-	2	1	1	1	-
CO2	-	2	1	2	1	3	3	1	-	-	1	2	1	1	1	-
CO3	2	3	3	3	3	1	2	-	-	2	2	2	2	2	2	-
CO4	-	3	3	1	1	2	1	-	1	-	3	2	2	2	2	-
CO5	2	1	3	2	3	2	3	2	1	2	2	2	3	3	3	-
Average	2.0	2.3	2.5	1.8	2.0	2.0	2.2	1.3	1.0	2.0	2.0	2.0	1.8	1.8	1.8	-

PAG404	SYSTEMS ANALYSIS IN AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce the students to the application of system concepts.
- To study the importance of linear programming for crop planning and scheduling.
- To understand the simulation for reservoir.
- To understand the concepts of dynamic programming.
- To study about the application of optimization techniques.

UNIT-I SYSTEM CONCEPTS 9

Definition, classification, and characteristics of systems – Scope and steps in systems engineering – Need for systems approach to water resources and irrigation.

UNIT-II LINEAR PROGRAMMING 9

Introduction to operations research – Linear programming, problem formulation, graphical solution, solution by simplex method – Sensitivity analysis, application to design and operation of reservoir, single and multipurpose development plans – Irrigation water allocation- Cropping pattern optimization.

UNIT-III SIMULATION 9

Basic principles and concepts – Random variate and random process – Monte Carlo techniques – Model development – Inputs and outputs – Single and multipurpose reservoir simulation models – Deterministic and stochastic simulation – Irrigation Scheduling.

UNIT-IV DYNAMIC PROGRAMMING 9

Bellman's optimality criteria, problem formulation and solutions – Application to design and operation of reservoirs, Single and multipurpose reservoir development plans – Applications in Irrigation management.

UNIT-V OPTIMIZATION TECHNIQUES 9

Integer and parametric linear programming – Applications to Irrigation water management- Goal programming models with applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand practical knowledge on specialized in different water resources and irrigation system.
2. To apply the Linear programming for crop planning and scheduling.
3. To apply the Dynamic Programming for reservoir release for irrigation management.
4. To design a reservoir irrigation system simulation model for efficient water management
5. To evaluate the application of optimization techniques used to address thesocio-technical aspects irrigation water management.

TEXTBOOKS:

1. I obert M. Peart and W. David Shoup “Agricultural Systems Modeling and Simulation”, CRC press, 2019.
2. aslam Pk, “Role of Optimization Techniques in Agriculture”, Grin Verlag, 2018.
3. ohn H. Hargreaves and Mark G. Kibblewhite "Introduction to Agricultural System Models", 2017.
4. I aurie E. Drinkwater, Diana Friedman and Louise Buck, “Systems Research for Agriculture”, 2016.
5. ohn W. Satzinger, Robert B. Jackson, and Stephen D. Burd “Systems Analysis and Design in a Changing World”, Course Technology Inc, 2015.

REFERENCE BOOKS:

1.

ric Bentley, “Concepts and Applications in Agricultural Engineering”, Discovery International, 2023.

2.

. Panneerselvam, “Operations Research”, PHI Learning, 2023.

3.

nubhav Pratap Singh, Sanjay Kumar Padaliya and Anand Chauhan, “Introduction of Linear Programming Problems”, Walnut Publication, 2022.

4.

bhijit Gosavi, “Simulation-Based Optimization”, Springer, 2016.

5.

ohn H. Hargreaves and Z. K. Ludwig "Modeling Agricultural Systems: Applications to Field Research", 2016.

PAG404	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	1	3	1	2	2	3	1	3	3	2	2	1	2	1
CO2	2	3	2	2	1	2	2	2	1	2	2	1	2	2	1	2
CO3	3	3	3	2	1	2	2	2	3	2	2	1	3	2	1	2
CO4	3	2	3	3	3	3	2	1	3	1	3	3	3	3	1	2
CO5	3	3	3	3	3	3	2	1	2	1	3	3	3	3	2	1
Average	2.4	2.4	2.4	2.6	1.8	2.4	2.0	1.8	2.0	1.8	2.6	2.0	2.6	2.2	1.4	1.6

PAG405	IOT APPLICATIONS IN AGRICULTURAL INDUSTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To study the fundamentals about IoT.
- To study about IoT Access technologies.
- To study the design methodology and different IoT hardware platforms.
- To study the basics of IoT Data Analytics and supporting services.
- To study about various IoT case studies and Agricultural applications.

UNIT-I FUNDAMENTAL OF IOT 9

Evolution of Internet of Things – Enabling Technologies, M2M Communication, IoTWorld Forum (IoTWF) standardized architecture – Simplified IoT Architecture, CoreIoT Functional Stack, Fog – Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT-II IoT PROTOCOLS 9

S- IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN – Network Layer: IP versions, – Constrained Nodes and Constrained Networks,6LoWPAN, Application Transport Methods:SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT-III DESIGN AND DEVELOPMENT 9

Design Methodology – Embedded computing logic, Microcontroller, System on Chips– IoT system building blocks IoT Platform overview: Overview of IoT supported –Hardware platforms such as: Raspberry pi, Arduino Board details.

UNIT-IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Introduction, Structured Versus Unstructured Data – Data in Motion versus Data at Rest, IoT Data Analytics Challenges – Data Acquiring, Organizing in IoT/M2M – Computing Using a Cloud Platform for IoT/M2M Applications/Services – Everything as a service and Cloud Service Models.

UNIT-V CASE STUDIES/AGRICULTURAL APPLICATIONS 9

IoT applications in home – infrastructures, buildings, Farms, Industries –Home appliances – other IoT Agricultural equipments – Industry concepts.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Understand the basics of IoT.
2. Implement the state of the Architecture of an IoT.
3. Understand design methodology and hardware platforms involved in IoT.
4. Understand how to analyze and organize the data.
5. Compare IOT Applications in Agriculture & real world.

TEXTBOOKS:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete,Rob Barton and Jerome Henry, Cisco Press, 2017.
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.
3. Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Education.

REFERENCE BOOKS:

1. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence",Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
2. Recipes to Begin, Expand, and Enhance Your Projects, 2nd edition, Michael Margolis, Arduino Cookbook and O'Reilly Media,2011.

PAG405	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	3	-	2	1	3	3	-	1	-	2	2	3	2	2	2
CO2	3	2	-	2	1	2	1	-	1	-	2	2	3	3	2	2
CO3	3	2	-	2	-	3	3	1	2	-	2	2	2	2	2	2
CO4	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2
CO5	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2
Average	1.8	1.8	2.0	2.0	1.0	2.4	2.2	1.0	1.2	-	2.0	2.0	2.4	2.2	2.0	2.0

PAG406	AUTOMATION IN AGRICULTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To study about evolution of Automation.
- To study trends and modelling.
- To Study about time sensor technologies.
- To study about sensors and CAD models.
- To study about grain beverages processing.

UNIT-I INTRODUCTION **9**

The Fourth Industrial Revolution and agriculture - Changes in agriculture - Production of agricultural products - product distribution – consumption - Agricultural robots - Precision agriculture.

UNIT-II TRENDS OF ENGINEERING SYSTEMS EVOLUTION AND AGRICULTURAL TECHNOLOGY **9**

Trends in the agriculture technology field - trend of increasing coordination - Trend of elimination of increasing dynamicity - human involvement - Technology forecasting using systematic creativity methods.

UNIT-III REVIEW OF VARIABLE-RATE SPRAYER APPLICATIONS BASED ON REAL- TIME SENSOR TECHNOLOGIES **9**

Infrared sensor-based detection technology - Ultrasonic sensor-based detection technology - LIDAR sensor-based detection technology - Computer stereo vision-based detection technology - Advanced data fusion application technique and future directions.

UNIT-IV ROBOTIC HARVESTING OF FRUITING VEGETABLES **9**

Overview of the simulation environment - Image processing, publishing and subscription - Simulation scene and objects – Sensors - CAD models - Communication protocol and user interface - Low-cost microcontroller boards opened up DIY’s way.

UNIT-V AUTOMATION OF INTEGRATED SYSTEM FOR GRAIN BEVERAGES PROCESSING **9**

Automation of Integrated System for Grain Beverages Processing - . Unit operations- The present status of grain beverages production - Materials and methods - Designplan of the automation - Components of automatic system - Case study on the introduction of an UECS in a greenhouse used for tomato production.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Obtain knowledge on evolution of Automation.
2. Obtain knowledge on recent trends in technology.
3. Obtain knowledge on the time sensor technologies.
4. Obtain knowledge on sensors and CAD models.
5. Obtain knowledge on Grain beverages processing.

TEXTBOOKS:

1. Qin Zhang 2020. Agriculture Automation and Control, Delhi 6.
2. Minzan Li, Chenghai Yang, Qin Zhang 2022. Soil and Crop Sensing for Precision Crop Production, New Delhi.
3. Stavros G. VougioukasQin Zhang 2022. Advanced Automation for TreeFruit Orchards and Vineyards CBS Publishers and Distributers, Delhi.
4. “Future Farming: Advancing Agriculture with Artificial Intelligence”, Skyhorse publishers, 2023
5. “Automation and Robotics in Agriculture”, Arcler Education Inc.,2020

REFERENCE BOOKS:

1. Yanbo HuangQin Zhang 2022 Agricultural Cybernetics Tata McGraw-Hill pub., New Delhi.
2. Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi.
3. “Robotics and automation for improving agriculture”, Burleigh Dodds Science Publishing, 2019
4. Hazem Shawky Fouda, Alexandria University, “Automation And Robotics In Agriculture, Delve Publishing, 2021

5. Ayman Aly El-Naggar, "Fundamentals of Automation and Industrial Control Systems Using Plc", LAP Lambert Academic Publishing, 2021

PAG406	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	2	3	1	3	-	-	-	2	3	-	2	1
CO2	2	-	-	-	3	3	2	3	-	-	1	1	3	-	3	1
CO3	1	-	-	2	3	-	2	1	2	-	-	-	-	2	2	1
CO4	3	2	-	1	-	-	3	2	1	2	-	3	3	-	2	3
CO5	1	-	-	-	3	3	2	2	-	-	2	2	-	3	-	2
Average	2.0	2.0	-	1.5	2.8	3.0	2.0	2.2	1.5	2.0	1.5	2.0	3.0	2.5	2.3	1.6

VERTICAL V

PAG501	INTEGRATED FARMING SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To improve the student skills in the area of farming system research and optimization methodology to design individual integrated farming system in scientific manner.
- To expose the students to different components and various models of IFSused for cultivation.
- To introduce the concept of improving Livestock production by implementingIFS components.
- To understand in-depth knowledge of various IFS components thereby increasing crop production.
- To expose the students to agribusiness opportunities through the knowledge ofIntegrated Farming System.

UNIT-I INTRODUCTION OF FARMING SYSTEM 9

Farming system – introduction – scope of farming system – importance – concept – principles of farming system - Types of farming systems – Advantages and limitations - suitability – factors affecting the farming system

UNIT-II INTEGRATED FARMING SYSTEM 9

Integrated farming system-historical background - objectives and characteristics advantages of IFS – Components of IFS - Integrated Farming System in Wetland – IFS in garden land –- IFS in dryland and fallow land.

UNIT-III LIVESTOCK PRODUCTION IN IFS 9

IFS With Goats and Sheep – housing and feeding management – deworming – Young stock management - Dairy Farming in IFS - Fodder production in IFS - IFS With poultry rearing – Duck farming – Rabbit farming – Piggery

UNIT-IV IFS COMPONENTS 9

Agroforestry – definition – types of agroforestry system – benefits of agroforestry

System – Aquaculture – Fish cum agriculture and horticulture – Beekeeping – types

and cast of bees – care and management in beekeeping – Sericulture - Mulberry cultivation – Silkworm rearing – Organic farming – Azolla – Small scale nursery.

UNIT-V RESOURCE RECYCLING IN IFS 9

Resource recycling in wetland IFS - Resource flow in crop + dairy + biogas + spawn+ silviculture In IFS - Biogas production through IFS – Resource recycling in crop + goat IFS - Uses and features of biogas - Structure and function of Dheenabandhu Gas plant - Vermicompost - Preparation of vermicompost from farm residue – Mushroom production in IFS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the fundamental concepts and principles of Farming system, types and Factors.
2. Understand the objectives and characteristics of Integrated Farming System.
3. Understand the Livestock production in Integrated Farming System.
4. Understand the different components of Integrated Farming System.
5. Understand the concept of resource recycling in Integrated Farming System.

TEXTBOOKS:

1. Sohan Singh Walia , Tamanpreet Kaur. 2023. Basics of Integrated Farming Systems. Springer Singapore. ISBN: 978-981-99-6555-7
2. Shikhar Verma, Jyotiprakash Mishra,Sweekruta Mohapatra, Mausmi Rastogi, Vikash Singh. 2023. “A Textbook of Integrated Farming Systems for Sustainable Agriculture”. B P International. ISBN No: 978-81-19039-07-4
3. H.M. Jayadeva and B. K. Ramachandrappa. 2021. “Integrated Farming Systems”. BRILLION Publishing. ISBN No: 978-9390757855.
4. Dileep Kumar, Deepak Chaturvedi, R.K. Yadav, Sankar Lal, Harjindra Singh. 2021. Integrated Farming System for Sustainable Production. Satish Serial Publishing House. ISBN: 978-9353870423

REFERENCE BOOKS:

1. Hina Ashraf Waiz, Lokesh Gautam. 2023. Integrated Livestock Farming Systems. New India Publishing Agency. ISBN: 978-8119103164.
2. E. Somasundaram, D. Udhaya Nandhini, M. Meyyappan. 2022. Principles of Organic Farming. Press. ISBN: 978-1000533699
3. Panda.S.C. Cropping and farming systems. Agrobios (India) Jodhpur. 2011.
4. S. Krishnaprabu. “Recent Advances in Integrated Farming System”. Satish Serial Publishing House.2020.
5. Balasubramaniyan, P. and Palaniappan, SP. “Principles and Practices of Agronomy” Agrobios. 2001.

PAG501	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	3	3	3	1	3	-	3	1	3	1	2	2	1	3
CO2	-	-	2	1	1	1	3	1	1	2	3	1	3	2	1	3
CO3	-	-	2	2	1	1	3	3	1	3	2	2	3	1	3	-
CO4	-	1	1	2	2	3	3	2	-	2	3	-	2	1	2	3
CO5	2	3	1	-	3	1	3	1	2	2	-	-	3	1	3	1
Average	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5

PAG502	ORGANIC FARMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To quantify the organic resources of integrated organic farming system (IOFS) components.
- To assess the total productivity of the system.
- To work out the economics of organic farming system.
- To gain knowledge on Organic Farming for Sustainable agriculture.
- To expose the students to the concept of Organic Farming.

UNIT - I ORGANIC FARMING PRACTICES - INTRODUCTION 9

Organic farming / organic farming concept and development-Principles of Organic Farming-Need of organic farming-Steps of Organic Farming-Basic steps - Successful Organic Transition-Organic Farming Vs Conventional Farming-Crop Rotation

UNIT - II COMPOSTING TECHNIQUES 9

Compost –Vermi composts -Coir Compost-Sugarcane Trash Composting –Composting of poultry wastes Crop Residue Composting-Recycling of Farm Waste-Soil nourishment and Plant Growth Promotion

UNIT - III ORGANIC INPUTS AND TECHNIQUES 9

Green Manures and green leaf manure- Organic Fertilizers & Manures- Biofertilizers Organic Special Inputs-Panchagavya-Preparations-Beneficial effect on commercial crops-Panchagavya for animal health-Dasagavya

UNIT - IV ORGANIC PLANT PROTECTION 9

Pest, Disease & Weed Management - Conventional- Integrated - Organic - Managing Pests and Diseases - Strategies in organic farming - Prevention (indirect method) - Protection (direct method).

UNIT - V ORGANIC CERTIFICATION 9

Guidelines for Organic Certification -Procedures for Organic Certification -Organic Certification Agencies -Grower Group Certification for Organic Agriculture-TNOCD -Accreditation of TNOCD -APEDA -NPOP Standards -Indian Society for Certification of Organic Products (ISCOP) -National Center of Organic Farming (NCOF)

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. To the completion of the course, the students will be able to understand the concepts of Organic farming and sustainable agriculture.
2. To the Students will gain knowledge on organic farming and Overview of Organic Farming in India.
3. To the students will be able to understand Microbial Inoculations in Organic Farming.
4. To the students can design Sustainable agriculture.
5. To the students will be understand Organic Regulation and Certification Procedure.

TEXTBOOKS:

1. S.P. Palaniappan & K. Annadurai “Organic Farming: Theory and Practice”, Scientific Publishers (India).2022.
2. Dilip Nandwani “Organic Farming for Sustainable Agriculture”, Springer, 2016.
3. Jeyabalan Sangeetha, Kasem Soytong, Devarajan Thangadurai, Abdel Rahman Mohammad Al-Tawaha, “Organic Farming for Sustainable Development”, Apple Academic Press, 2022.
4. Rahul Kumar, Jitendra Kumar, Dr. Uma, Mahesh Kumar Singh and Monu Kumar “Manual on Organic Farming”, Integrated Publications, 2021.
5. P.L.Maliwal “Principles Of Organic Farming” Scientific Publishers, 2022

REFERENCE BOOKS:

1. Khalid Rehman Hakeem, Gowhar Hamid Dar, Mohammad Aneesul Mehmood, Rouf Ahmad Bhat, “Microbiota and Biofertilizers A Sustainable Continuum for Plant and Soil Health”, Springer, 2021.

2. S. Krishnaprabu ,"Organic Farming and Farming Systems for Sustainable Agriculture", Satish Serial Publishing House ,2020

3. Latha, E, "Organic Farming for Sustainable Agriculture" Narendra Publishing House, 2022.

4. S.P. Palaniappan & K. Annadurai, "Organic Farming Theory and Practice" 2nd Edition, Scientific Publishers, 2022.

5. R. Sathya Priya, N. Jagathjothi, M. Yuvaraj, N. Suganthi Satish, "Organic Farming Principles & Practices", Satish Serial Publishing House, 2024.

PAG502	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
CO3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
CO4	3	2	-	-	3	2	-	-	-	-	-	3	2	-	-	3
CO5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
Average	2.3	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	2.0	2.3	2.7	2.0	2.7

PAG503	SOIL FERTILITY AND FERTILIZERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To gain theoretical as well as practical knowledge on different aspects of soil fertility and fertilizer.
- To use like essential nutrient elements, chemistry and transformation of nutrient elements and their management.
- To understand the use of biofertilizers in soil.
- To understand the application of manures and fertilizers.
- To use the essential micronutrients in soil.

UNIT-I INTRODUCTION TO SOIL FERTILITY AND PRODUCTIVITY 9

Soil fertility and productivity - factors affecting - features of good soil management- problems of supply and availability of nutrients - relation between nutrient supply and crop growth - organic farming - basic concepts and definitions

UNIT-II ESSENTIAL PLANT NUTRIENTS 9

Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms- transformation and dynamics of major plant nutrients- Preparation and use of farmyard manure- compost, green manures, vermicompost

UNIT-III BIOFERTILIZERS 9

Biofertilizers and other organic concentrates their composition - availability and crop responses- recycling of organic wastes and residue management - Commercial fertilizers - composition, relative fertilizer value and cost; crop response to different nutrients - residual effects and fertilizer use efficiency - fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

UNIT-IV MANURES AND FERTILIZERS APPLICATION 9

Time and methods of manures and fertilizers application - foliar application and its concept - relative performance of organic and inorganic manures - economics of fertilizer use - integrated nutrient management - use of vermincompost and residue wastes in crops.

UNIT-V MICRONUTRIENTS **9**

Micronutrients – critical limits in soils and plants - factors affecting their availability and correction of their deficiencies in plants - role of chelates in nutrient availability.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To gain theoretical as well as practical knowledge on different aspects of soil fertility and fertilizer.
2. To use like essential nutrient elements, chemistry and transformation of nutrient elements and their management.
3. To understand the use of biofertilizers in soil.
4. To understand the application of manures and fertilizers.
5. To use the essential micronutrients in soil.

TEXTBOOKS:

1. Havlin JL, Beaton JD, Tisdale SL & Nelson WL “Soil Fertility and Fertilizers”, 7th Ed. Prentice Hall, 2006.
2. Prasad R & Power JF “Soil Fertility Management for Sustainable Agriculture”, CRC Press, 1997.
3. Yawalkar KS, Agrawal JP & Bokde S “Manures and Fertilizers”, Agri-Horti Publication, 2000.
4. John L. Havlin, Samuel L. Tisdale, and Werner L. Nelson “Soil Fertility and Fertilizers” Pearson, 2013
5. Allen V. Barker and David J. Pilbeam “Handbook of Plant Nutrition” Taylor & Francis, 2006.

REFERENCE BOOKS:

1. Brady NC & Weil R.R “The Nature and Properties of Soil” 13th Ed. Pearson Edu, 2002.
2. Fageria NK, Baligar VC & Jones CA. “Growth and Mineral Nutrition of Field Crops” Marcel Dekker, 1991.
3. Horst Marschner "Mineral Nutrition of Higher Plants" Academic Press, 2011.

4. "Nutrient Management for Sustainable Crop Production in Asia" International Rice Research Institute (IRRI).
5. Alfred R. Conklin "Introduction to Soil Chemistry: Analysis and Instrumentation" Wiley, 2014.

PAG503	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	1	1	1	1	2	-	-	-	-	1	1	1	1	1
CO2	1	1	2	1	3	1	2	-	-	-	-	2	1	1	1	2
CO3	2	1	2	2	3	2	2	-	1	-	-	2	2	2	2	2
CO4	2	1	2	2	3	2	2	-	1	-	-	2	2	2	2	2
CO5	3	1	2	2	3	2	2	-	1	-	-	2	2	2	2	2
Average	1.8	1.0	1.8	1.6	2.6	1.6	2.0	-	1.0	-	-	1.8	1.6	1.6	1.6	1.8

PAG504	LANDSCAPE ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand the basic concept of the landscape architecture.
- To learn the principles and components of landscape architecture.
- To know the types and tools of landscape gardening
- To grasp the knowledge regarding gardening and green house
- To introduce the concept of landscape ecology.

UNIT-I INTRODUCTION TO LANDSCAPE ARCHITECTURE 9

Ancient Indian traditions- siting of structures- complexes and cities - symbolic meanings and sacred value attributed to natural landscapes - Traditional landscapes such as ghats: gardens, kunds, sacred groves etc. Landscape in myth and poetry.

UNIT-II PRINCIPLES AND ELEMENTS IN LANDSCAPE ARCHITECTURE 9

Principles and elements of landscape designs- Components and features of landscaping - Plant components- Components and features of landscaping - non-plant components-Significance of trees in landscaping- Significance of shrubs in landscaping- Layout of special types of gardens

UNIT-III LANDSCAPE GARDENING 9

Types of vertical greening system- Nursery management of ornamental plants and designs of garden - Elements Propagation of ornamental plants- Graphics and symbols in landscape gardening- Layout of rock garden and gravel garden- Roof gardening- Paved Garden- Tools and implements used in landscape design & Marshor Bog Garden

UNIT-IV LAYOUT OF GARDENING AND GREENHOUSE 9

Layout of different styles of gardens & Landscaping of places of public importance - Layout of informal gardens & Gardening of public places - Layout of formal types ofgardens & designing of greenhouse, conservatory and Lathe house - Lawn

and lawn making & Hanging containers - TERRARIUM requirement and Maintenance & Bonsai making- Fresh flower arrangements,Dry flower technology & Dry flower arrangement – Interiorscaping &Establishment and maintenance of lawns.

UNIT-V LANDSCAPE ECOLOGY 9

Introduction to landscape ecology – formation of various landforms – landforms and landscape process – pattern and structure of landscapes– concepts of patch, corridor and matrix – landscape dynamics and function – topological and chorological process within landscape

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To acquire knowledge regarding the basic concepts of landscape architecture.
2. To gain knowledge regarding the principles and components of landscape architecture.
3. To understand the various types and tools of landscape gardening.
4. To brief knowledge on layout of gardening and greenhouse.
5. To learn the concept of landscape ecology.

TEXTBOOKS:

1. Tim Waterman, The Fundamentals of Landscape Architecture, Bloomsbury Visual Arts, 2020.
2. Joshua Zeunert, Landscape Architecture and Environmental Sustainability, Fairchild Books; Illustrated edition, 2017.
3. Ed Hutchison, Drawing for Landscape Architecture, Thames and Hudson Ltd; Illustrated edition 2019.
4. Mohammad Shaheer, Geeta Wahi Dua and Adit Pal, Landscape Architecture in India: A Reader Reprint Edition, 2024.
5. Rachel Tennant, Nicola Garmory, Clare Winsch, Professional Practice for Landscape Architects, Routledge, 2015.

REFERENCE BOOKS:

1. Norman K. Booth; James E. Hiss , Residential Landscape Architecture: Desigr

Process for the Private Residence, New York : Pearson, 2018 .

2. Landscape Institute, Guidelines for Landscape and Visual Impact Assessment, Routledge. 2013.
3. Galen D. Newman and Zixu Qiao, Landscape Architecture For Sea Level Rise: Innovative Global Solutions. 2022.
4. Paul Hensey, Construction Detailing for Landscape and Garden Design, Routledge, 2016.
5. Steven L. Cantor, Professional and Practical Considerations for Landscape Design, 2020.

PAG504	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	2	-	1	1	-	-	-	2	1	1	-	2	-	2
CO2	-	2	-	2	-	-	2	-	1	-	-	2	1	-	-	2
CO3	2	-	2	-	1	-	-	1	-	1	-	1	-	1	2	-
CO4	-	1	-	-	3	1	3	-	3	1	-	1	3	-	-	1
CO5	1	-	2	1	-	2	-	-	-	2	-	1	-	2	-	2
Average	1.7	1.5	2.0	1.5	1.7	1.3	2.5	1.0	2.0	1.5	1.0	1.2	2.0	1.7	2.0	1.8

PAG505	POST HARVEST TECHNOLOGY OF SEEDS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To improve the student skills in the area of post harvest handling of seeds todesign machineries for seed processing in scientific manner
- To expose the various storage procedures, methods of drying and equipments for drying.
- To understand the seed certification standards and field inspection procedures.
- To learn the seed treatment methods and packaging techniques.
- To expose the students about laws and legislation for seed certification.

UNIT-I SEED PROCESSING AND CLEANING EQUIPMENTS 9

Seed processing-Introduction, Principles- equipment and their functions- scalper, debearder, scarifier, huller, Seed Extractor- Brinjal, Tomato, Chilli, Sunflower seed sheller, Pulse Dehuller, Air screen seed cleaner, Seed grader Indented cylinder cum grader, Grain seed scalper, Double seed cleaner- Adjustments for efficiency-specific gravity separator, indented cylinder, velvet-spiral-disc separators, colour sorter, delinting machines, seed blending.

UNIT-II SEED STORAGE AND DRYING 9

Seed storage- Storage methods and structures- MAP-Underground storage structures-Bamboo structures-sanitation Storage problems of recalcitrant seeds and their conservation-Seed drying methods – importance- factors-changes during storage-moisture equilibrium, safe seed moisture content- Methods to minimize the loss of seed vigour and viability

UNIT-III SEED CERTIFICATION AND INSPECTION 9

Seed Certification- history, concept, objectives- agency/organization, NSCA-legal status, phases of seed certification- Certification Standards - crop standards, seed standards; Seed certification programmes. Field Inspection -genetic purity evaluation (grow-out tests); post harvest inspection- seed sampling, testing, labelling, tagging

UNIT-IV SEED TREATMENT AND PACKAGING 9

Seed treatments-methods, formulations and equipments, slurry seed treater, mist o mastic seed treater-Seed priming: physiological and biochemical basis, types of priming technology, film coating and pelleting, seed tapes, seed mats, seed colouring, biopriming-Packaging: principles, practices and materials; bagging and labelling.

UNIT-V SEED LAWS AND LEGISLATION 9

Salient features of national seed policies, role of various sectors/agencies in efficient seed marketing-quality control and assurance programme-Responsibilities of seed companies and dealers under Seed Act-EXIM policies for seed trade-NSC, SSC-seed bank.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the fundamental concepts of post-harvest technology and properties of seeds, seed cleaning procedures of agricultural and horticultural crops.
2. Understand the concept and theory of drying and various dryers.
3. Understand the principles of storage, packaging.
4. Understand seed treatment process,seed inspection and certification procedures.
5. Understand the principles of seed law and legislation.

TEXTBOOKS:

1. Dhirendra Khare & M.S. Bhale. 2024. Seed Technology. Scientific Publishers. 2nd edition. ISBN: 9788172338831
2. Sujit Kumar Yadav, Shaurya Singh, Srijan Yadav, Arun Kumar. 2024. Text Book on Principles of Seed Science and Technology. Brillion Publishing. ISBN:9788197229879.
3. Shiv Kumar Payasi, Deepak Katkani. 2021. Seed Technology. Brillion Publishing. ISBN: 9789390757725 e-ISBN: 9789390757800.
4. R.L. Agarwal. 2018. Seed Technology Oxford & IBH Publishing Co Pvt.Ltd; 2nd edition (28 February 2018). ISBN: 978-8120409941

REFERENCE BOOKS:

1. Amarjit Basra. 2023. Handbook of Seed Science and Technology. ISBN 9780815351443. CRC Press.
2. Malavika Dadlani, Devendra K. Yadava. “Seed Science and Technology: Biology, Production, Quality”. Springer Singapore. 2023.
3. K.Vanagamudi. 2021. Seed science and Technology. New India Publishing House. ISBN: 9789383305117.
4. Lokesh Gour, Devidas patel, Laxmi lal somani. 2020. Textbook of seed science and technology. Publisher: Agrotech Publishing Academy. ISBN: 978-81-940691-7-1
5. P S Shukla and Birendra Prasad. 2016. Advances in Seed Science and Technology. Verlag: Biotech Books, ISBN 10: 8176223522 / ISBN 13: 9788176223522

PAG505	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	3	3	3	1	3	-	3	1	3	1	2	2	1	3
CO2	-	-	2	1	1	1	3	1	1	2	3	1	3	2	1	3
CO3	-	-	2	2	1	1	3	3	1	3	2	2	3	1	3	-
CO4	-	1	1	2	2	3	3	2	-	2	3	-	2	1	2	3
CO5	2	3	1	-	3	1	3	1	2	2	-	-	3	1	3	1
Average	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5

PAG506	INTELLECTUAL PROPERTY RIGHTS IN AGRICULTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To understand and make the students aware of their rights for the protection oftheir invention done in their project work.
- To provide the knowledge about the patents, copyrights, industrial design, plant and geographical indications.
- To expose the students about IPR and its laws and Policy.
- To study about the amended patent act on agriculture industry.

UNIT-I INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS 9

Introduction, Types of Intellectual Property Rights-patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT-II PATENTS 9

Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT-III PLANT VARIETY-TRADITIONAL KNOWLEDGE– GEOGRAPHICAL INDICATIONS 9

Plant variety- Justification-criteria. UPOV act- PVPFRA-National Biodiversity Authority (NBA) & Convention on Biological diversity CBD). Traditional knowledge-Concept, protection of traditional knowledge - Traditional knowledge digital library (TKDL)-Geographical Indications.

UNIT-IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing,

licensing of basic types of IPR, clauses of IPR. IPR Policy - Effectiveness of TRIPS and patent policy.

UNIT-V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY **9**

International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the fundamental concepts and principles of IPR.
2. Understand and get the knowledge of plagiarism in their innovations whichcan be questioned legally.
3. Understand the concepts of plant variety protection, Geographical indicationsand traditional Knowledge.
4. Understand the Policies and enforcement related to IPR
5. Understand the International conventions and Treaties of IPR.

TEXTBOOKS:

1. Hitesh Kumar. 2024. Protecting Agricultural Innovations: The Role of Intellectual Property Rights. Nipa Genx Electronic Resources & Solutions Pvt Ltd. ISBN: 9789395763844.
2. N. Ramachandran (Author), S.P. Singh (Author), S.K. Jinddal. 2019. Intellectual Property Rights in Agricultural Research. International Books and Periodicals Supply Service.
3. Let ha Devi G, Mukund A. Kataktalware, Atul P. Kolte. “Intellectual Property Rights in Agricultural Research”. Sathish Serial Publishing House, New Delhi. 2019.
4. Ka lyan Sarma, Dibyajyoti Talukdar. “Textbook of Intellectual Property inAgriculture”. Sathish Serial Publishing House, New Delhi. 2019.

5. Chandan Roy. 2018. “The Role of Intellectual Property Rights in Agriculture and Allied Sciences”. Apple Academic Press; India. 1st edition (31 July 2018)

REFERENCE BOOKS:

1. Juan Antonio Vives Vallés. 2024. Intellectual Property In Agriculture. Plant Breeders’ Rights and Geographical Indications: Towards a comprehensive approach to Intellectual Property in Agriculture.
2. Soumya Mukherjee, Piyali Mukherjee, Tariq Aftab. 2023. Crop Sustainability and Intellectual Property Rights. Apple Academic Press.
3. Brad Sherman. 2020. Intellectual Property and Agriculture. Critical Concepts in Intellectual Property Law series. Edward Elgar Publishing Ltd
4. N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar. 2017. Intellectual Property Rights” Edu creation Publishing, New Delhi.
5. Phundan Singh. 2009. IPR& Plant Breeders Rights. ISBN: 9788183990295

PAG506	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	1	2	3	3	3	1	3	-	3	1	3	1	2	2	1	3
CO2	-	-	2	1	1	1	3	1	1	2	3	1	3	2	1	3
CO3	-	-	2	2	1	1	3	3	1	3	2	2	3	1	3	-
CO4	-	1	1	2	2	3	3	2	-	2	3	-	2	1	2	3
CO5	2	3	1	-	3	1	3	1	2	2	-	-	3	1	3	1
Average	1.5	2.0	1.8	2.0	2.0	1.4	3.0	1.8	1.8	2.0	2.8	1.3	2.6	1.4	2.0	2.5

VERTICAL VI

PAG601	WASTE AND BY-PRODUCT UTILIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares the students

- To impart knowledge to students on various methods of agricultural waste management for eco-friendly energy and manure production.
- To introduce the students about the composting and various methods.
- To insist the importance of agricultural waste management.
- To impart knowledge on effectively utilizing the agricultural waste.
- To impart the knowledge about producing the Bio products from Agricultural waste.

UNIT-I INTRODUCTION 9

Availability of different types of agriculture wastes - its overall characteristics - classification of agro wastes based on their characteristics- its recycling and utilization potential - current constraints in collection and handling of agricultural wastes – its environmental impact.

UNIT-II COMPOSTING 9

Definition- Solid waste suitable for composting – Methods of composting –vermi composting – Mineralization process in composting - Biochemistry of composting– Factors involved – Infrastructure required – maturity parameters – value addition – application methods.

UNIT-III BIOMASS BRIQUETTING 9

Definition – potential agro residues and their characteristics for briquetting – fundamental aspects and technologies involved in briquetting – economic analysis of briquetting –setting up of briquetting plant- appliances for biomass briquettes.

UNIT-IV BIOCHAR PRODUCTION 9

Definition - characteristics of agro wastes suitable for Biochar production – Methods of Biochar production – fast and slow pyrolysis – characteristics of Biochar – role of Biocharin soil nutrition and carbon sequestration.

UNIT-V BIOGAS AND BIO ETHANOL PRODUCTION 9

Screening of suitable lingo cellulosic substrate for biogas production -determination of bio-energy potential of agro-waste by estimating total solids - volatile solids – Calorific value- per cent total carbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion – types of digesters – factors affecting – nutrient value and utilization of biogas slurry. Ethanol production from lingo cellulosic wastes -Processing of Biomass to Ethanol – pre-treatment – fermentation – distillation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand various eco-friendly methods for agricultural waste management.
2. To gain knowledge about vermicomposting.
3. To evaluate the nutritive value and energy production potential of agro wastes.
4. To gain knowledge about biochar product.
5. To develop the process of biogas and bio ethanol production.

TEXTBOOKS:

1. Bhat, R. A., Hakeem, K. R., Qadri, H., & Dervash, M. A. (2021*).* Agricultural Waste: Threats and Technologies for Sustainable Management. Springer. – Discusses threats from agri-waste and sustainable techniques including composting, biogas, and biochar.
2. Ok, Y. S., Tsang, D. C. W., Bolan, N. S., & Novak, J. M. (2020). Biochar from Biomass and Waste: Fundamentals and Applications. Elsevier– Covers biochar production, properties, and soil applications.
3. Viggi, C. C., Aulenta, F., & Colantonio, V. (2019). Biomass to Bioenergy Innovations and Sustainability. Elsevier– Explores bioenergy technologies such as

anaerobic

digestion and ethanol production.

4. Kumar, S., & Bharti, A. (2022). Composting and Vermicomposting Technologies for Organic Waste Management. Springer– Modern composting technologies including infrastructure, process, and maturity indicators.
5. Tariq, R., Rehman, A., & Ali, M. (2023). Biowaste Valorization for Sustainable Agriculture. Wiley-Blackwell– Techniques to convert biowaste into biofertilizers, compost, biogas, and ethanol.

REFERENCE BOOKS:

1. Kumar, A., & Singh, J. (2020). Biomass Briquetting and Utilization: Fundamentals and Technologies. CRC Press– Covers raw materials, processing, and economics of briquetting systems.
2. Sahu, A., & Yadav, A. (2021). Anaerobic Digestion of Agricultural Waste: Recent Advances. Springer– Updated information on biogas production using modern digesters and substrates.
3. Vassilev, S. V., Baxter, D., & Vassileva, C. G. (2019). Agro-Biomass: Properties, Pretreatment, and Applications. Elsevier– Properties of agro-waste and suitable pre-treatment for fuel and energy.
4. Chowdhury, M. A., & Ahmed, S. (2024). Waste Biorefinery Approaches for Agro-Waste to Bioethanol Conversion. Wiley– Ethanol production from lignocellulosic residues using recent biorefinery technologies.
5. Zhao, B., & Wang, H. (2023). Recent Developments in Compost and Soil Amendment from Organic Waste. Elsevier– Discusses composting processes and its effects on soil health and carbon sequestration.

PAG604	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	2	-	1	-	3	-	2	-	-	-	3	2	2	3
CO2	2	-	-	-	2	-	1	-	3	2	-	-	2	2	3	2
CO3	2	3	2	-	-	-	-	-	2	2	-	-	2	1	3	2
CO4	2	-	2	3	2	-	-	-	2	-	-	-	2	-	2	1
CO5	2	2	-	-	2	-	2	-	3	-	-	-	3	2	-	1

Average	2.0	2.5	2.0	3.0	1.8	-	2.0	-	2.4	2.0	-	-	2.4	1.8	2.5	1.8

PAG602	BIOMASS MANAGEMENT FOR FODDER AND ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the fundamental knowledge of biomass management for fodder and energy.
- To study the biomass resource and management.
- To understand the concepts of mulch seeder, paddy straw chopper-cum-loader.
- To gain knowledge on mulching and composting.
- To expose the students to the concept of biomass management.

UNIT - I INTRODUCTION TO BIOMASS RESOURCE AND MANAGEMENT 9

Introduction to biomass management- Biomass resource assessment management techniques/supply chains- Processing of paddy straw, densification - extrusion process- Briquettes and cubes.

UNIT - II BALING-CLASSIFICATION, USES 9

Bailing, surface mulch and soil incorporation - Residue management for surface mulch and soil incorporation

UNIT - III MULCH SEEDER, PADDY STRAW CHOPPER-CUM-LOADER 9

Mulch seeder, chopper-cum-Loader, Baler for collection of straw Paddy Straw- Paddy Straw choppers and spreaders- Paddy Straw choppers and spreaders as an attachment to combine Harvester.

UNIT - IV PROCESSING OF STRAW/ FODDER FOR ANIMAL USE 9

Baler for collection of straw - Processing and uses of straw for animal use and cushioning material - Agricultural and horticultural use of paddy straw - Paddy straw - Cushioning material for fruits and vegetables.

UNIT - V MULCHING AND COMPOSTING 9

Mulching and Composting -Paper and cardboard manufacturing from paddy straw-Straw as a fuel.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

1. To gain Knowledge and skills on bio energy source technology.
2. To Understanding of important of biomass in agriculture fields.
3. To gain Knowledge on alcohol and ethanol production and energy and environment management.
4. To develop Skill about residue management in agriculture fields.
5. To The students will be understand storage methods of fruits and vegetables.

TEXTBOOKS:

1. N. L. Panwar, Er. M. R. Patel, Er. Nakum Divyang Kumar, “Biomass Management for Fodder and Energy”, New India Publishing Agency, 2023.
2. Heather Moore Niver, “Baling Equipment (Let's Learn About Farm Machines)”, Enslow Pub Inc, 2020.
3. Cecilia Pinto McCarthy, “The Science of Biomass Energy (Science of Renewable Energy)” Reference point Press, 2018.
4. P. C. Saseendran, K.S. Anil, T.N. Jagdish Kumar, “Fodder Production and Conservation”, Brillion Publishing, 2023.
5. Jack Blake, “Art of Composting and Mulching”, Independently Published, 2024.

REFERENCE BOOKS:

1. Rajesh Kumar Singhal, Indu, Ayman El Sabagh, Krishna Kumar Dwivedi, Forage Crops in the Bioenergy Revolution, Springer,2025.
2. Pawan Kumar Bharti, “Plant Biomass and Energy Solutions”, Discovery Publishing House Pvt Ltd, 2018.
3. Jingzheng Ren, Bo Zhang, Subramanian Senthilkannan Muthu “Clean Energy Transition via Biomass Resource Utilization”,Springer (2024)
4. Ajalesh B. Nair, Vidya Francis, Nisha Nandakumar “Handbook of Advanced

Biomass Materials for Environmental Applications",Springer (2024)

5. Jingxin Wang "Forest and Biomass Harvest and Logistics"Springer (2022)

PAG602	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	3	2	-	-	2	-	1	-	-	2	-
CO2	1	3	-	2	-	2	2	2	-	-	-	1	2	3	-	2
CO3	1	-	-	2	-	-	3	-	-	2	-	1	-	3	-	-
CO4	3	2	-		3	2	-	-	-	-	-	1	2	-	-	3
CO5	-	-	-	2	-	-	3	3	-	-	2	-	-	-	-	3
Average	1.5	2.5	-	2.0	3.0	2.3	2.5	2.5	-	2.0	2.0	1.0	2.0	3.0	2.0	2.7

PAG603 AGRO - ENERGY ANALYSIS AND ECONOMICS

L	T	P	C
3	0	0	3

OBJECTIVES:

The course prepares

- To understand need to differentiate between conventional, non-conventional & renewable energy sources.
- To recognizing of energy sources and types of energy used in agricultural production and agro-industry.
- To performing of organization and planning of necessary infrastructure studies for establishing of energy management system.
- To understand of relationship between energy consumption and production as for energy efficiency and savings.
- To understand the energy conservation planning and practices.

UNIT-I INTRODUCTION TO AGRO-ENERGY 9

Energy resources on the farm: conventional and non-conventional forms of energy and their use. Heat equivalents and energy coefficients for different agricultural inputs and products.

UNIT-II ENERGY CONSUMPTION AND AUDIT 9

Pattern of energy consumption and their constraints in production of agriculture. Direct and indirect energy. Energy audit of production agriculture, and rural living and scope of conservation

UNIT-III ENERGY ANALYSIS TECHNIQUES 9

Identification of energy efficient machinery systems, energy losses and their management. Energy analysis techniques and methods: energy balance, output and input ratio, resource utilization, conservation of energy sources.

UNIT-IV ENERGY CONSERVATION PLANNING AND PRACTICES 9

Energy conservation planning and practices. Energy forecasting, Energy pricing and incentives for energy conservation

UNIT-V ENERGY ECONOMICS 9

Energy economics, Factors affecting energy economics - Energy modelling.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand need to differentiate between conventional, non-conventional & renewable energy sources.
2. To recognize energy sources and types of energy used in agricultural production and agro-industry.
3. To perform organization and planning of necessary infrastructure studies for establishing of energy management system.
4. To understand relationship between energy consumption and production as for energy efficiency and savings.
5. To understand the energy conservation planning and practices.

TEXTBOOKS:

1. Verma SR, Mittal JP &Surendra Singh “Energy Management and Conservation in Agricultural Production and Food Processing” USG Publ. & Distr., Ludhiana,1994.
2. Rai GD. “Non-conventional Sources of Energy” Khanna Publ, 1998.
3. S.C. Kaushik and Shilpi Aggarwal "Energy Efficiency in Agriculture".
4. Sieglinde Snapp and Barry Pound "Agricultural Systems: Agroecology and Rural Innovation for Development" Elseiver, 2008.
5. Chittaranjan Kole “Handbook of Bioenergy Crop Plants”, Taylor & Francis, 2012.

REFERENCE BOOKS:

1. Kennedy WJ Jr. & Wayne C Turner “Energy Management” Prentice Hall, 1984.
2. Pimental D. “Handbook of Energy Utilization in Agriculture” CRC, 1980.
3. M. Reza Emami and Keshav C. Das “Energy Management in Agriculture”, 2022.
4. Anju Dahiya “Bioenergy: Biomass to Biofuels” 2014.
5. R. Praveen Kumar and S. Uma Maheshwari “Agricultural Biomass Based Potential Materials for Bio-Energy”, 2020.

PAG605	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	2	1	-	-	1	1	-	1	1	2	2	1
CO2	3	2	2	1	2	1	-	-	1	1	-	1	1	2	2	1
CO3	3	2	2	1	2	1	-	-	2	1	-	1	1	2	2	1
CO4	3	2	2	1	2	1	-	-	2	1	-	1	2	2	2	2
CO5	3	2	2	1	2	1	-	-	1	1	-	1	2	2	2	2
Average	3.0	2.0	2.0	1.0	2.0	1.0	-	-	1.4	1.0	-	1.0	1.4	2.0	2.0	1.4

PEE105	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To understand the concepts of basic needs of energy management
2. To understand the concepts of Energy management on various electrical equipments and cogeneration
3. To understand the Concept of lighting systems
4. To understand the concepts of Metering for Energy Management
5. To understand the concepts of Economic Analysis and Models.

UNIT-I INTRODUCTION 9

Basics of Energy – Need for energy management –Commercial and non commercial energy - Final energy consumption - Energy accounting - Energy monitoring, targeting and reporting - Energy audit process.

UNIT-II ENERGY MANAGEMENT FOR MOTORS ANDCOGENERATION 9

Energy management for electric motors – Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration –Prime Movers for cogeneration Electrical interconnection.

UNIT-III LIGHTING SYSTEMS 9

Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Occupancy sensors - Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

UNIT-IV METERING FOR ENERGY MANAGEMENT 9

Metering for energy management – Units of measure – Typical cost factors - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens –Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

UNIT-V ECONOMIC ANALYSIS AND MODELS 9

Economic analysis – Economic models - Time value of money - Utility rate structures– Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Explain the fundamentals of the energy audit process and its significance.
2. Describe the principles of energy management through cogeneration techniques.
3. Illustrate the methods of energy conservation and management in lighting systems.
4. Analyze energy efficiency practices for various electrical equipment and metering systems.
5. Interpret economic analysis techniques and strategies for effective load management.

TEXTBOOKS

1. Ashok Kumar L. & Gokul Ganesan, Energy Audit and Management: Concept, Methodologies, Procedures, and Case Studies, CRC Press, 2023.

REFERENCE BOOKS

1. Albert Thumann, Terry Niehus, William J. Younger, "Handbook of Energy Audits", CRC Press, 9th Edition, 2020.
2. Y. P. Abbi, "Handbook on Energy Audit and Environment Management", TERI Press, 1st Edition, 2016.

CO - PO and CO - PSO MAPPING

PEE105	PROGRAM OUTCOMES												PSO'			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	-	-	2	-	3	-	-	1	-	-	-	-	-	-
CO2	1	-	3	-	1	-	-	-	1	-	-	-	-	-	-	-
CO3	-	2	-	3		1		-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	1	-	-	-	-	-	-	-	-
CO5	-	2	-	-	1	-	-	3	2	-	-	-	-	-	-	-
Average	1.5	1.7	3.0	3.0	1.3	1.0	3.0	2.0	1.5	1.0	-	-	-	-	-	-

PEE603	DESIGN AND MODELLING OF RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To impart knowledge on the following topics

1. To review the renewable energy systems and technology
2. To learn the Single-phase grid-connected photovoltaic systems and three-phase photovoltaic systems
3. To learn the inverter for PV systems
4. To illustrate the small wind energy systems
5. To simulate the Doubly fed induction generator based WECS

UNIT-I **RENEWABLE ENERGY SYSTEMS: TECHNOLOGY OVERVIEW AND PERSPECTIVES** **9**

Introduction- Demands for Grid-Connected PV Systems-Power Converter Technology for Single-Phase PV Systems, Transformer less AC-Module Inverters (Module- Integrated PV Converters, Transformer less Single-Stage String Inverters, DC-Module Converters in Transformer less Double-Stage PV Systems

UNIT-II **SINGLE-PHASE GRID-CONNECTED PHOTOVOLTAICSYSTEMS** **9**

Introduction- Demands for Grid-Connected PV Systems-Power Converter Technology for Single-Phase PV Systems, Transformer less AC-Module Inverters (Module- Integrated PV Converters, Transformer less Single-Stage String Inverters, DC-Module Converters in Transformer less Double-Stage PV Systems

UNIT-III **THREE-PHASE PHOTOVOLTAIC SYSTEMS: STRUCTURES,TOPOLOGIES** **9**

Introduction-PV Inverter Structures, Three-Phase PV Inverter Topologies- -Control Building Blocks for PV Inverters, Modulation Strategies for Three-Phase PV Inverters, Implementation of the Modulation Strategies., Grid Synchronization, Implementation of the PLLs for Grid Synchronization, Current Control, Implementation of the Current Controllers, Maximum Power Point Tracking.

UNIT-IV BLDC MOTOR CONTROL 9

Introduction-Generator Selection for Small-Scale Wind Energy Systems- Turbine Selection for Wind Energy- Self-Excited Induction Generators for Small Wind Energy Applications- Permanent Magnet Synchronous Generators for Small Wind Power Applications- Grid-Tied Small Wind Turbine Systems-Magnus Turbine–Based Wind Energy System.

UNIT-V SRM MOTOR CONTROL 9

Introduction – modelling of induction machine in machine variable form and arbitrary reference frame, modelling of Doubly-fed Induction Generator.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of this course, learners will be able to:

1. Review the perspectives of renewable energy systems
2. Integrate photovoltaic systems with grid.
3. Analyze inverter for PV systems.
4. Create the working of small wind power systems
5. Analyze the features of induction machine and doubly fed induction machine

TEXT BOOKS

1. Ahmad Azar, Nashwa Kamal, "Design, Analysis and Applications of Renewable

Energy Systems",Academic Press, First Edition, 2021.

2. Nabil Derbel, Quanmin Zhu “Modeling, Identification and Control Methods in Renewable Energy Systems" , Springer, First Edition, 2019.

REFERENCE BOOKS

1. Power Conversion and Control of Wind Energy Systems, Bin Wu, Wiley-IEEE, 1st Edition,2011.
2. Wind Electrical Systems, S.N. Bhadra, Oxford, 7th Impression,2005.
3. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, IET, 2nd Edition,2014.
4. Renewable Energy Devices and Systems with Simulations in MATLAB and

ANSYS, Frede Blaabjerg, Dan M. Ionel, CRC press,1st Edition,2017.

5. Wu, Bin. Power Conversion and Control of Wind Energy Systems, 1st Edition, Wiley-IEEE, 2011.
6. Nabil Derbel, Quanmin Zhu “Modeling, Identification and Control Methods in Renewable Energy Systems" , Springer, First Edition, 2019

CO - PO and CO - PSO MAPPING

	PROGRAM OUTCOMES												PSO’s			
PEE603	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	2.0	3.0	2.8	2.0	0	0	0	0	0	0	0	-	-	-	-

PEE606	SOLAR AND WIND ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge on solar energy systems, wind energy systems and its applications.
- To make students understand the fundamental theory governing solar thermal and photovoltaic devices
- To understand the processes of generation of wind, its potential and energy extraction.
- To know about different PV panel configurations and its characteristics
- To understand use of solar energy for different applications like cooking, desalination, space heating etc.

UNIT-I SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS 9

Solar energy - Introduction-Solar constant- Solar Radiation at the Earth's surface- measurements of solar radiation-pyronometer- pyrheliometer-sunshine recorder- – Solar collectors - Flat plate collectors - - collector efficiency - absorber plate – types - selective surfaces. Solar water heaters - types- their performance. Solar driers – types – heat transfer - performance of solar dryers – agro industrial applications.

UNIT-II SOLAR CONCENTRATING COLLECTORS 9

Concentrating collectors – types – reflectors - solar thermal power stations – principle and applications - Solar energy storage systems – thermal - sensible and latent heat, chemical, electrical, electro-magnetic energy storage – Solar distillation – application - Solar stills - types - Solar pond - performance – characteristics - applications – Solar refrigeration.

UNIT-III SOLAR PV TECHNOLOGY 9

Solar photovoltaic technology –introduction – solar cell basics – Types of solar cells and modules – encapsulation – Design of solar PV system – load estimation - batteries – invertors – operation - system controls. Standalone and grid connected systems - PV powered water pumping - Hybrid system - Solar technologies in green buildings.

UNIT-IV WIND ENERGY 9

Nature of the wind – power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment - wind power laws - velocity and power duration curves - Betz limit - site selection.

UNIT-V TYPES OF WIND POWER AND ITS APPLICATIONS 9

Wind energy conversion devices - classification, characteristics, applications – Design of horizontal axis wind mill rotor diameter - Wind energy storage - wind farms – wheeling and banking - testing and certification procedures. Water pumping - Hybrid systems –Wind mill safety and environmental aspects

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Understand the concepts of solar and wind energy resources.
- Understand the applications of solar and wind energy systems.
- Acquired skills on the choice of energy conversion technique forspecific applications.
- Identify pros and cons of energy resources.
- Understand the operation of a wind farm and economics of power generation.

TEXTBOOKS

1. Rai., G.D., “Solar Energy Utilization”, Khanna publishers, New Delhi,2002.
2. More, H.S and Maheshwari R.C., “Wind Energy Utilization in India”, CIAE Publication – Bhopal, 1982.
3. Solanki, C.S. “Renewable Energy Technologies: A Practical guide for beginners”, PHI learning Pvt. Ltd, New Delhi. 2008.

REFERENCE BOOKS

1. Solanki, C.S., “Solar Photovoltaic Technology and Systems”, PHI learning Pvt. Ltd., New Delhi, 2013.
2. Rai. G.D., “Non-Conventional Sources of Energy”, Khanna Publishers, New Delhi, 2002.
3. Rajput. R.K.,“Non- Conventional Energy Sources and Utilization”, S. Chand & Company Pvt. Ltd, New Delhi, 2013.

CO - PO and CO - PSO MAPPING

PEE606	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	1	-	2	-		1	-	-	-	-	3	2	-	-	-	-
CO2	1	1	2	-	2	3	-	-	-	-	-	1	-	-	-	-
CO3	2	3	1	1	-	2	3	-	-	-	-	3	-	-	-	-
CO4	-	-	1	-	-	2	-	-	-	-	1	2	-	-	-	-
CO5	3	1	1	2	-	-	2	-	-	-	3	1	-	-	-	-
Average	1.7	1.6	1.4	1.5	2	2	2.5	-	-	-	2.3	1.8	-	-	-	-

OPEN ELECTIVE

OCS101	IoT AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamentals about IoT.
- To study about IoT Access technologies.
- To study the design methodology and different IoT hardware platforms.
- To study the basics of IoT Data Analytics and supporting services.
- To study about various IoT case studies and industrial applications.

UNIT- I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT- II IoT PROTOCOLS 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks,6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT- III DESIGN AND DEVELOPMENT 9

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details.

UNIT- IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M, Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

UNIT- V CASE STUDIES / INDUSTRIAL APPLICATIONS 9

IoT applications in home, infrastructures, buildings, security, Industries, Home

appliances, other IoT electronic equipments, Industry 4.0 concepts.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the basics of IoT.
2. Implement the state of the Architecture of an IoT
3. Understand design methodology and hardware platforms involved in IoT.
4. Understand how to analyze and organize the data.
5. Compare IOT Applications in Industrial & realworld.

TEXTBOOKS:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017(unit 1,2,3,)
2. Internet of Things - A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015 (unit 5)
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education(unit 4)

REFERENCE BOOKS:

1. The Internet of Things - Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
2. “From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence”,Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O"Reilly Media,2011

OCS101	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	2				2			1	2	-	-	-
CO2	3	3	3	3									-	2	-	-
CO3	3	3	3		3		2	1		2			-	-	1	-
CO4	3	3	3	3	3						2		-	-	2	-
CO5	3	3	3	3	2	3	2			3	2	1	-	2	-	2
Average	**3**	**3**	**3**	**3**	**2.5**	**3**	**2**	**1**		**2.5**	**2**	**1**	**2**	**2**	**1.5**	**2**

OCS102	MACHINE LEARNING WITH R	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for machine learning for various problem solving.
- To study the various supervised, semi-supervised and unsupervised learning algorithms inmachine learning.
- To understand the latest trends in machine learning.
- To understand , analyze and organize the data using clustering methods.
- To design appropriate machine learning algorithms for problem solving.

UNIT- I INTRODUCTION 9

Machine learning -Examples of Machine Learning applications-Learning Associations- Classification-Regression-Unsupervised Learning-Reinforcement Learning-Supervised learning: Learning a class from Examples-Regression-Model Selection and Generalization. Case Study: Familiarity with R tool and Python programming language and libraries.

UNIT- II CONCEPT LEARNING AND DECISION-TREE LEARNING 9

Concept Learning - Concept learning Task - Concept Learning as search -Finding a maximally specific hypothesis - Version Spaces and Candidate elimination Algorithm -Inductive Bias Decision Tree Learning - Decision Tree representation - Problems for Decision Tree Learning - Hypothesis Search space - Inductive Bias in Decision Tree Learning - Issues in Decision Tree Learning.Case Study: Implementation of decision tree algorithm for problems in Retail Domain.

UNIT- III MULTILAYER PERCEPTRONS AND DEEP LEARNING 9

The Perceptron-Training a Perceptron-Learning Boolean Functions-Multilayer Perceptrons- MLP as Universal Approximator Back propagation Algorithm-Training Procedures Convolution Networks -The Convolution Operation-Pooling-Convolution and Pooling as an infinitely strong prior -Variants of the Basic Convolution Function -Structured Outputs -Data Types -Efficient Convolution Algorithms -Random and Unsupervised features.Case Study: Implementation of Back propagation algorithm for problems in financial domain.

UNIT- IV CLUSTERING 9

Similarity-Based Clustering-Unsupervised learning problems-Hierarchical Agglomerative Clustering (HAC)-Single-link, completelink, group-average similarity-k-Means and Mixtures of Gaussians-Flat clusteringk-Means algorithms-Mixture of Gaussian modelEM-algorithm for mixture of Gaussian model. CaseStudy: Implementation of clustering algorithm for problems in financial/insurance/health care domain.

UNIT- V REINFORCEMENT LEARNING 9

Introduction - learning task - Q learning - The Q function - Algorithm for Q learning - convergence- experimentation strategies - updating sequence -Non deterministic rewards and actions - Temporal difference learning -Generalizing from examples - relationship to dynamic programming Case Study: Implementation of Q learning algorithm/reinforcement learning for problems in automotive domain/games.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Understand the basics ideas and objective of machine learning
2. Understand the problem of over fitting in machine learning.
3. Transfer concrete problems to machine learning problems and select appropriate models to solve them.
4. Understand how to analyze and organize the data using clustering methods.
5. Understand reinforcement learning algorithms and experiment strategies.

TEXTBOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, September 2014, ISBN 978-0-262-02818-9.(Units 1,3(Multilayer Perceptrons) & 4)
2. Mitchell, Tom, "Machine Learning", New York, McGraw-Hill, First Edition, 2003. (Units 2,5)

REFERENCE BOOKS:

1. Ian GoodFellow,Yoshua Bengio,Aaron Courville ,"Deep Learning",MIT Press Book (Unit 3 - Convolutional Networks),Nov. 2016

2. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC 2009.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press (MA) 2012.

OCS102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
CO2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
CO3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
CO4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
CO5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
Average	**1.2**	**1**	**1.3**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1.6**	**2**

OCS103	TAMIL COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Tamil grammar and programming basics for Tamil computing.
- To understand the various types of Tamil Computing applications.
- To make the students understand the use of Tamil computing tools and Resources.
- To strengthen the students' ability to carry out the Computational Linguistics in Tamil computing.
- To understand the concepts of Tamil text processing using open – Tamil python library.

UNIT- I TAMIL GRAMMAR 9

Introduction to Computational Linguistics-Grammars-Alphabets: Classification & Properties - Words: classification and components - Sentences: Structures and word ordering.

UNIT- II PROGRAMMING BASICS FOR TAMIL COMPUTING 9

History of Tamil Computing - Standards & Fonts - UNICODE - Object Oriented Tamil Computing - Tamil text processing using open-tamil python library.

UNIT- III COMPUTATIONAL LINGUISTICS 9

Basic linguistics - Phonology - Phonology computing - lexicography - syntax - semantics - pragmatics- Regular languages-and their limitations-Finite-state automata.

UNIT- IV TAMIL COMPUTING TOOLS & RESOURCES 9

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Ontologies.

UNIT- V TAMIL COMPUTING APPLICATIONS 9

Machine Translation -Information retrieval & Extraction - Question Answering - Text Summarization- Automatic Indexing - Text Mining - Conceptual Search.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Explain classification of Tamil grammar and properties.
2. Adopt a suitable process for tamil computing tools.
3. Analyze the different types of computational linguistics such as phonology, Morphology, lexicography.
4. Perform and analyze the Tamil computing applications.
5. Analyze and process the Tamil python library.

TEXTBOOKS:

1. The Oxford Handbook of Computational Linguistics, Edited by RuslanMitkov, Oxford University Press, 2014.
2. Tamil Computing ,Dr.R.Ponnusamy, Allied Publishers private limited, 2024

REFERENCE BOOKS:

1. Translation - Theory and Application, Valarmathi, International Institute of Tamil Studies, First Edition, 2001.
2. Tholkaappiyam - Thodariyal, Shanmugam, International Institute of Tamil Studies, First Edition, 2004.
3. J.E.Hopcroft, R.Motwani and J.D Ullman, - Introduction to Automata Theory, Languages and Computations, ThirdEdition, Pearson Education, 2013.
4. Natural language processing and computational linguistics, Bhargav SrinivasaDesikan Packt Publishing, first edition 2018.
5. The Phonology and morphology of tamil chrisdas Prathima, 2016.
6. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in

OCS103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
CO2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
CO3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
CO4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
CO5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
Average	**1.2**	**1**	**1.3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1.6**	**2**

OCY101	CYBER FORENSIC AND INVESTIGATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Principles of digital evidence handling and forensic investigation techniques.
- Proficiency in using forensic tools for imaging, data recovery, and analysis.
- Understanding legal and ethical considerations in cyber investigations.
- Incident response planning and execution for cyber incidents.
- Documentation and reporting of forensic findings for stakeholders and legal purposes.

UNIT- I INTRODUCTION TO CYBER FORENSICS 9

Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services.

UNIT- II COMPUTER FORENSICS EVIDENCE AND CAPTURE 9

Data Recovery – Evidence Collection and Data SeizurE - Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.

UNIT- III COMPUTER FORENSIC ANALYSIS 9

Discover of Electronic EvidencE- Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of theMilitary – Tactics of Terrorist and Rogues – Tactics of Private Companies.

UNIT- IV INVESTIGATION 9

Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime- Identity Theft and Identity Fraud – Organized Crime & Terrorism –Avenues Prosecution and Government Efforts – Applying the First Amendment to Computer Related Crime-The Fourth Amendment and other Legal Issues.

UNIT- V COMPUTER FORENSIC INVESTIGATION CASES 9

Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To demonstrate proficiency in using forensic tools and techniques for digital evidence analysis.
2. To critically evaluate and interpret digital artifacts to reconstruct cyber incident timelines.
3. To apply legal and ethical principles to ensure compliance in cyber forensic investigations.
4. To formulate and implement incident response strategies to mitigate cyber threats effectively.
5. To prepare clear and comprehensive forensic reports and presentations for stakeholders.

TEXTBOOKS:

1. Marjie T. Britz, "Computer Forensics and Cyber Crime: Introduction to Digital Evidence," Pearson, 3rd Edition, 2021. (CHAPTERS 3 – 13). (UNIT IV – V)
2. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Cengage Learning, 2nd Edition, 2005. (CHAPTERS 1 – 18). (UNIT I – IV)

REFERENCE BOOKS:

1. Mark L. Merkow, "Information Security: Principles and Practices," Pearson, 4th Edition, 2020.
2. MariE-Helen Maras, “Computer Forensics: Cybercriminals, Laws, and Evidence”, Jones & Bartlett Learning; 2nd Edition, 2014.
3. Chad Steel, “Windows Forensics”, Wiley, 1st Edition, 2006.
4. Majid Yar, “Cybercrime and Society”, SAGE Publications Ltd, Hardcover,2nd Edition, 2013.
5. Robert M Slade, “Software Forensics: Collecting Evidence from the Scene of a Digital Crime”, Tata McGraw Hill, Paperback, 1st Edition, 2004.

OCY101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	-	3	-	3	-		-	-	-	-	-	-	-	2	-	-
CO3	3	-	2		-	3	-	-	-	-	-	-	-	-	3	-
CO4	2	-	2		-	-	-	-	-	-	-	-	-	2		-
CO5	3	-	-	2	-	2	-	-	-	-	-	-	-	-	2	-
Average	2.7	2.5	2	2.5	-	2.5	-	-	-	-	-	-	3	2	2.5	-

OCY102	SOCIAL MEDIA SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Understand Social Media Platforms: Learn how popular social media platforms work.
- To Identify Security Risks: Recognize threats and vulnerabilities on social media.
- To Privacy and Data Protection: Protect personal information on social media.
- To Legal and Ethical Issues: Understand legal and ethical issues in social media.
- To Security Best Practices: Apply methods to secure social media accounts.

UNIT- I INTRODUCTION TO SOCIAL MEDIA SECURITY 9

Social Media Platforms-Communication Impact-Cybersecurity Basics-Security Threats-User Awareness-Breach Case Studies-Data Collection-Security Features-Future Trends.

UNIT- II PRIVACY AND ACCOUNT SECURITY 9

Privacy Settings-Strong Passwords-Two-Factor Authentication (2FA)-Geotagging Risks Personal Information- Third-Party Apps-Account Takeover-Encryption Role-Safe Posting.

UNIT- III THREATS AND ATTACKS 9

Social Engineering-Cybercriminal Tactics-Suspicious Activity-Malware Links-Hacking Cases-Suspicious Content-Security Tests-Insider Threats -Threat Intelligence.

UNIT- IV LEGAL AND ETHICAL ISSUES 9

International Laws-Intellectual Property-Privacy Policies-Ethical Data Use-User Responsibilities-Legal Disputes- Freedom of Speech-Compliance Requirements-RegulationFuture.

UNIT- V ONLINE REPUTATION AND POLICIES 9

Reputation Strategies-Brand Impact-Crisis Management-Corporate

Communication-Social Media Policies- Governance Role-Monitoring Tools-Employee Training-Cybersecurity Integration.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To Understand Social Media Platforms.
2. To Identify Security Threats.
3. To Protect Privacy and Apply best practices to protect personal information on social media.
4. To Address Legal and Ethical Issues.
5. To Apply Security Measures and Use tools and techniques to secure social media.

TEXTBOOKS:
1. Michael J. K. Lee, "Social Media Security: Leveraging Social Networking to Defend
2. Against Cyber Threats," Elsevier, 1st Edition, 2019.
3. "Social Media Security: Leveraging Social Networking While Mitigating Risk" by Michael Cross.
REFERENCE BOOKS:
1. Sanjay Purighalla, "Cybersecurity and Social Media," CRC Press, 1st Edition, 2021.
2. "Phishing Dark Waters: The Offensive and Defensive Sides of Malicious Emails" byChristopher Hadnagy and Michele Fincher.
3. The Ethical Hack: A Framework for Business Value Penetration Testing" by James S. Tiller.

OCY102	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	1	2	-	3	-	-	-	-	-	-	-	-	3	-	2	-
CO2	-	1	-	2	-	-	-	-	-	-	-	-	3	-	1	-
CO3	-	-	1	2	3	-	-	-	-	-	-	-	3	-	1	-
CO4	-	1	-	2	-	-	-	-	-	-	-	-	3	-	2	-
CO5	1	1	-	2	2	-	-	-	-	-	-	-	3	1	2	-
Average	**1**	**1.2**	**1**	**2.2**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1.6**	**-**

OEC101	INTRODUCTION TO 5G COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution of wireless networks.
- To learn the various features of 5G.
- To get acquainted with the fundamentals of EPC.
- To study the processes associated with 5G architecture.
- To explore the spectrum sharing and spectrum trading.
- To assess the security features in 5G networks.

UNIT- I EVOLUTION OF WIRELESS NETWORKS 9

Networks evolution: 1G, 2G, 3G, 4G, Evolution of radio access networks, Need for 5G. 4G versus 5G, Next Generation Core (NG-Core), visualized Evolved Packet Core (vEPC).

UNIT- II 5G CONCEPTS AND CHALLENGES 9

Fundamentals of 5G technologies, Overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT- III NETWORK ARCHITECTURE AND THE PROCESSES 9

5G architecture and core, Network slicing, Multi access edge computing (MEC) Visualization of 5G components, End-to-end system architecture, Service continuity, Relation to EPC, and Edge computing.

UNIT- IV PROTOCOLS AND SPECTRUM MANAGEMENT 9

5G protocols: 5G NAS, NGAP, GTP-U, IP Sec and GRE, Mobility management, Command and control, Spectrum sharing and Spectrum trading, Cognitive radio based on 5G.

UNIT- V SECURITY IN 5G NETWORKS 9

Security features in 5G networks, Network domain security, User domain security, Flow based QoS framework, Mitigating the threats in 5G.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Emphasize the basic theory of evolution of communication techniques
2. Apply the concepts of 4G communication
3. Assess the need for 5G communication Techniques
4. Comprehend architecture and protocols for 5G communication
5. Understand the principles of dynamic spectrum management
6. Analyze the security aspects in 5G networks

TEXT BOOKS:

1. 5G Core networks: Powering Digitalization, Stephen Rommer, Academic Press, 2019.
2. An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.

REFERENCE BOOKS:

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material
2. 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019

OEC101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	2	-	2	-	-	-	-	-	3	2	2	-	-
CO2	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
CO3	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
CO4	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
CO5	3	3	3	2	-	2	-	-	-	-	-	2	2	-	-	-
CO6	3	2	3	2	-	2	-	-	-	-	-	2	2	2	-	-
Average	3	3	3	2	-	2	-	-	-	-	-	2	2	2	-	-

OEC102	INTRODUCTION TO INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand basic industrial processes and its reference architecture.
- To perceive the knowledge of networks and programming of IIOT.
- To study the role of sensors, actuators and communication protocols used for interfacing.
- To introduce and familiarize the industry 4.0.
- To master security in IIOT.
- To study application of IIOT in various fields

UNIT- I INTRODUCTION TO INDUSTRIAL IoT AND ITS ARCHITECTURE 9

IoT Introduction, Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain – Implementation View point – Architectural Topology – Three Tier Topology – Data Management.

UNIT- II NETWORKING AND PROGRAMMING OF IIoT 9

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication. Industrial IoT- Layers: IIoT Communication, IIoT Networking. Industrial IoT: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop.

UNIT- III SENSOR AND INTERFACING 9

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, and M2M.

UNIT- IV COMPUTATION IN IIoT AND SECURITY 9

SDN in IIoT, Data Center Networks, Industrial IoT: Security and Fog Computing-

Cloud Computing in IIoT, Industrial IoT Application Domains: Factories and Assembly Line, Food Industry.

UNIT- V IIoT APPLICATIONS 9

Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security: AR and VR safety applications, Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Interpret basic industrial processes and its reference architecture.
2. Comprehend to the modern networking technologies and programming of IIOT.
3. Illustrate the sensors, actuators and communication protocols used for interfacing.
4. Analyze the concepts and gain insights into Industry 4.0.
5. Handle real time security issues in IIOT.
6. Realize the importance of IIoT applications in real time.
7. Create numerous IOT applications with the physical world of humans and real life problem solving.

TEXT BOOKS:

1. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.2020
2. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2017
3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B.Rawart(Springer)

REFERENCE BOOKS:

1. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
2. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”,1st Edition, VPT, 2014
3. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to

Connecting Everything", 1st Edition, Apress Publications, 2013

4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key, applications and Protocols", Wiley, 2012
5. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.

OEC102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	1	-	-	-	-	-	-	-	-	3	1	2	-	-
CO2	1	-	1	-	-	-	-	-	-	-	-	2	2	2	-	-
CO3	2	3	3	3	-	-	-	-	-	-	-	2	2	3	-	-
CO4	1	-	2	-	-	-	-	-	-	-	-	2	2	2	-	-
CO5	2	1	3	2	-	-	-	-	-	-	-	2	3	2	-	-
CO6	2	3	3	2	-	-	-	-	-	-	-	2	3	2	-	-
Average	2	3	3	2	-	-	-	-	-	-	-	2	2	2	-	-

OEC103	ARDUINO PROGRAMMING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution of IoT boards.
- To program Arduino to control lights, motors and other devices.
- To learn Arduino's architecture, including inputs and connectors for add-on devices.
- To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.
- To explore various options in programming Arduino boards.
- To test, debug, and deploy the Arduino to solve real world problems.

UNIT- I INTRODUCTION TO SENSORS 9

Transducers, Classification, Roles of sensors in IoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators.

UNIT- II ARDUINO GPIOs and APIs 9

Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, APIs / Packages- Quark SOC processor.

UNIT- III ARDUINO INTERFACES 9

Sensor with Arduino- Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal - Reading various sensor data on serial monitor and LCD Display.

UNIT- IV PROGRAMMING IN ARDUINO IoT DEVICE 9

Preparing the development environment (Arduino IDE), Exploring the Arduino language syntax, Coding, compiling, and uploading to the microcontroller, Working with Arduino Communication Modules: Bluetooth Modules, Wi-Fi Modules and I2C and SPI.

UNIT- V PROGRAMMING ESP 8266 MODULE 9

ESP8266 Wi-Fi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor, Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via Thing Speak.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Understand the basics of sensors, its functioning.
2. Execute basic and advanced assembly language programs.
3. Learn the ways to interface I/O devices with processor for task sharing.
4. Evoke the basics of co-processor and its ways to handle float values by its instruction set.
5. Recognize the functionality of micro controller, latest version processors and its applications.
6. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyse the results.

TEXTBOOKS:

1. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, 2nd Edition, McGraw-Hill Education, 2017.
2. Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 1 st edition,McGraw Hill Education, 2015

REFERENCE BOOKS:

1. Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Automation 2014.
2. Schwartz, Marco. Internet of things with arduino cookbook, 1st edition, Packt Publishing Ltd, 2016.
3. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 1st edition, Packt Publishing Ltd, 2015

OEC103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	2	-	-	-	-	-	-	-	3	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-	-
CO6	3	2	3	2	-	-	-	-	-	-	-	2	2	2	-	-
Average	3	3	3	2	-	-	-	-	-	-	-	2	2	2	-	-

OMD101	INTRODUCTION TO FOOD PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- To learn about the shelf life of food products.
- To gain knowledge on the storage of food products.
- To know about the thermal and non-thermal processing methods of food.
- To design different types of Dryers and methods to prevent food wastage.
- To understand the Food Hygiene methods and its importance.

UNIT- I FOOD PROCESSING AND ITS IMPORTANCE 9

Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT- II METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods. Retort pouch packing, Aseptic packaging.

UNIT- III THERMAL METHODS AND NON-THERMAL METHODS 9

Newer methods of thermal processing- batch and continuous - In container sterilization canning - application of infra-red microwaves - ohmic heating - control of water activity - preservation by concentration and dehydration - osmotic methods. Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

UNIT- IV DRYING PROCESS FOR TYPICAL FOODS & FOOD WASTES IN VARIOUS PROCESSES **9**

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages. Waste disposal-solid and liquid waste, rodent and insect control, use of pesticides, ETP, selecting and installing necessary equipment.

UNIT- V FOOD HYGIENE **9**

Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

1. Aware of the different methods applied to preserving foods.
2. Explain the food handling and storage processes.
3. Analyze the thermal and non-thermal processing methods.
4. Explore the drying process of foods.
5. Understand Food Hazards, Adulteration, and Safety in handling and procurement & Microbial considerations and sanitation.

TEXTBOOKS:

1. Karnal, Marcus and D.B. Lund “Physical Principles of Food preservation”. Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles

and Practice".Surbhi Publications, 2001.

3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

REFERENCE BOOKS:

1. Shafiur M Rahman, "Handbook of Food Preservation", Second Edition, CRC Press, 2007
2. Zeuthen Peter, Bogh-Sorensen Leif, "Food Preservation Techniques", Wood Head Publishing, Cambridge, England, 2005.
3. Ranganna S, "Handbook of Canning and Aseptic Packaging", Tata McGraw-Hill, 2000.

OMD101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	3	-	1	1	-	-	-	-	-	-	1		
CO2	2	3	1	2	-	-	-	2	-	-	-	2	-	1		
CO3	3	2	1	2	-	1	1	-	-	-	-	2	-	1		
CO4	3	2	1	2	-	1	1	-	-	-	-	2	-	1		
CO5	3	1	2	-	-	1	1	-	-	-	-	2	-	1		
Average	**3**	**2**	**1.3**	**2.3**	**-**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**1**		

OMD102	INTRODUCTION TO BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explore the characteristics of electrode configuration.
- To study the characteristics of Bio signals.
- To explain the necessity of bio amplifiers in biomedical signal processing.
- To analyze the different techniques used for measurement of non-electrical bio-parameters.
- To understand the biochemical measurement techniques and sensors.

UNIT- I ELECTRODE CONFIGURATIONS 9

Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non- polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT- II BIOSIGNAL CHARACTERISTICS 9

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT- III BIOAMPLIFIERS 9

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

UNIT- IV MEASUREMENT OF BIO SIGNALS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements.

UNIT- V BIOCHEMICAL MEASUREMENTS 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Illustrate the origin of various biological signals and their characteristics.
2. Apply knowledge of bio signal characteristics.
3. Gain knowledge on various amplifiers involved in monitoring bio signals.
4. Identify appropriate instruments and methods for each physiological parameter.
5. Examine the biochemical measurement techniques.

TEXTBOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. John Enderle, Susan Blanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, second edition, Academic Press,2005.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.

OMD102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-	-
CO4	3	2	1	1	-	-	-	-	-	-	1	-	2	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	1	-	2	1	-	-
Average	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**1**	-	-

OEE101	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the Indian and global energy scenario.
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT- I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.

UNIT- II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT- III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics – Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT- IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers – Cogeneration – Carbonization – Pyrolysis - Biogas plants – Digesters – Biodiesel production – Ethanol production - Applications.

UNIT- V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Discuss the Indian and global energy scenario.
2. Describe the various solar energy technologies and its applications.
3. Explain the various wind energy technologies.
4. Explore the various bio-energy technologies.
5. Discuss the ocean and geothermal technologies

TEXTBOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 :9390385636.
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 8120344707.

REFERENCE BOOKS:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.

OEE101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
CO2	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
CO3	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
CO4	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
CO5	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-
Average	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-

OEE102	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

At the end of the course, the student is expected to

- Acquire knowledge in the field of energy conservation and management.
- Study the various measures for energy conservation in electrical devices both static & rotating machineries
- Analyze the energy efficiency in thermal utilities
- Know the concept of compressed air system and improve the efficiency.
- Understand and analyze of Energy Economics.

UNIT- I INTRODUCTION 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data –Environmental aspects associated with energy utilization – Energy conservation and its importance - need for energy management – Energy accounting -Energy monitoring, targeting and reporting- Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers.

UNIT- II ELECTRICAL SYSTEMS 9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors automatic power factor controllers - transformer losses - Electric motors: motor efficiency - factors affecting motor performance - energy saving opportunities with energy efficient motors – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination. Lighting System: Light source, choice of lighting, luminance requirements – ballast - energy efficient lighting controls - energy conservation avenues.

UNIT- III THERMAL SYSTEMS 9

Introduction to fuels- Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System:

Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss.

UNIT- IV COMPRESSED AIR SYSTEM 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – Diesel Generating System - methods adopted for effecting ENCON – economics of ENCON adoption in all the utilities.

UNIT- V ECONOMICS 9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept**.**

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

1. Acquire knowledge in the field of energy conservation and management process.
2. Learn the various measures for energy conservation in electrical devices.
3. Design the effective thermal utility system.
4. Improve the efficiency in compressed air system.
5. Suggest methodologies for Energy Economics.

TEXTBOOKS:

1. Mehmet Kanoğlu, Yunus A. Çengel, ‘Energy Efficiency and Management for Engineers’, 1st Edition, McGraw-Hill Education, 2020.
2. D Moncef Krati, “Energy Audit of Building Systems: An Engineering Approach”, Second Edition, CRC Press, 2016.
3. Sonal Desai, ‘Handbook of Energy Audit’, McGraw Hill Education (India) Private Limited,2015.

REFERENCE BOOKS:

1. Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits',American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
2. Charles M. Gottschalk, 'Industrial Energy Conservation', Wiley, 1996.

OEE102	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	1	1		1		3				2			1			
CO2			2		1				2			1	1	2		
CO3		1		3		2							1			
CO4	3					3		2			2		1			
CO5		2		3	2		1	2				2	2			
Average	**2**	**1.3**	**2**	**2.3**	**1.5**	**2.6**	**1**	**2**	**2**	**2**	**2**	**1.5**	**1.2**	**2**		

OEE103	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures.
- To acquire the knowledge on modelling, sizing of batteries.
- To understand the working principle, construction and characteristics of various motors.
- To provide knowledge about various power converters and control.
- To understand the Hybrid and Electric vehicles.

UNIT- I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency-. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.

UNIT- II ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra-capacitors. Battery Management System.

UNIT- III MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT- IV POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and

TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes.

UNIT- V HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles – Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the operation and architecture of electric and hybrid vehicles.
2. Identify various energy source options like battery and fuel cell.
3. Select suitable electric motor for applications in hybrid and electric vehicles.
4. Explain the role of power electronics in hybrid and electric vehicles
5. Analyze the energy and design requirement for hybrid and electric vehicles.

TEXTBOOKS:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003.
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRCPress,2005.

REFERENCE BOOKS:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “ John Wiley & Sons,2003
2. Lino Guzzella, “ Vehicle Propulsion System” Springer Publications, 2005
3. Ron HodKinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2005.

OEE103	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	3	2	3	2					1	1	2		2	
CO2	3	3	3	2	3	2						1		1		1
CO3	3	3	3	2	3	2	3					2	2			1
CO4	3	3	3	2	3	2					1	1				
CO5	3	3	3	2	3	2	2				1	1	1			
Average	**3**	**3**	**3**	**2**	**3**	**2**	**2.5**				**1**	**1.2**	**1.6**	**1**	**2**	**1**

OEI101	FUNDAMENTALS OF ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

UNIT-I INTRODUCTION TO ROBOTICS 9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT-II DRIVE SYSTEMS AND GRIPPERS 9

Pneumatic Drives-Hydraulic Drives-Electrical Drives- Fundamental features and Applications of A.C & D.C. Servo Motors, Stepper Motors, Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Selection and Design Considerations

UNIT-III SENSORS FOR ROBOT 9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors.

UNIT-IV KINEMATICS AND PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and

Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Programming Types-Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT-V IMPLEMENTATION OF ROBOTS 9

RGV, AGV; Implementation of Robots in Industries -Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

TEXTBOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.

REFERENCE BOOKS

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb.S.R., “Robotics Technology and Flexible Automation”, Tata McGraw Hill Book Co. 1994.
3. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”,McGraw Hill Book Co., 1987.

5. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.

OEI101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	1	1				1					1	1	1	
CO2	2	3	1	2					1	1			2	2	3	
CO3	2	3	2	3		3	2	1	2	1		1	2	2	1	
CO4	2	1			1										1	
CO5	2	1	3	1	3	2	2	1			2	2	1	2	1	
Average	**2.2**	**1.8**	**1.8**	**1.8**	**2.0**	**2.5**	**2.0**	**1.0**	**1.5**	**1.0**	**2.0**	**1.5**	**1.5**	**1.8**	**1.4**	**-**

OEI102	SENSORS FOR ENGINEERING APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To know the various stimuli that are to be measured in real life instrumentation.
- To select the rightprocess or phenomena of the sensor.
- To aware of the various sensors available for measurement and control applications.

UNIT-I INTRODUCTION TO SENSORS 9

What is a sensor and what is a transducer? Electrical sensor – need for sensors in the modern world. Different fields of sensors based on the stimuli - various schematics for active and passive sensors. General characteristics and specifications of sensors - Implications of specifications uses of sensors - measurement of stimuli - block diagram of sensor system. Brief description of each block.

UNIT-II TRANSDUCERS 9

Sensors for mechanical systems or mechanical sensors - Displacement - acceleration and force - flow of fluids - level indicators - pressure in fluids - stress in solids. Typical sensors - wire and film strain gauges, animometers, piezo electric and magnetostrictive accelerometers, potentiometric sensors, LVDT.

UNIT-III TEMPERATURE SENSORS 9

Thermal sensors – temperature – temperature difference – heat quantity. Thermometers for different situation – thermocouples thermistors – color pyrometry. Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor- Radiation detectors: radiation intensity, particle counter – Gieger Muller courter (gas based), Hallide radiation detectors.

UNIT-IV MAGNETIC SENSORS 9

Introduction- magnetic field, magnetic flux density – magneto resistors, Hall sensors, super conduction squids. Acoustic or sonic sensors: Intensity of sound, frequency of sound in various media, various forms of microphones, piezo electric sensors.

UNIT-V ELECTRICAL SENSORS 9

Introduction- conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. High frequency sensors like microwave frequency sensors, wavelength measuring sensors. MEMs and MEM based sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Appreciate the operation of various measuring and control instruments which they encounter in their respective fields.
- Visualize the sensors and the measuring systems when they have to work in areas of interdisciplinary nature.
- Also think of sensors and sensors systems when for a new situation they encounter in their career
- Identify and select the right process or phenomena on which the sensor should depend on.
- Know various stimuli that are to be measured in real life instrumentation.

TEXTBOOKS

1. Doebelin, “Measurement Systems: Application and Design”, McGraw Hill Kogakusha Ltd.
2. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim “Microsensors, MEMS and Smart Devices”,New York: Wiley, 2001.
3. Henry Bolte, “Sensors – A Comprehensive Sensors”, John Wiley.

OEI102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	2	1	1	1	3	1	2	1	1	2		2	
CO2	2		2	2			1									
CO3	2	2				1	1					1	1	2		
CO4	3	3	3	3	1			3	1	2						
CO5	2	1	2	1	1	1	1	2	1	1	1	1	2	2	2	
Average	2.4	2.0	2.3	2.0	1.0	1.0	1.0	2.7	1.0	1.7	1.0	1.0	1.7	2.0	2.0	0

OIT101	MULTIMEDIA TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Provide a comprehensive understanding of multimedia concepts and components.
- Equip students with the knowledge to design and handle multimedia systems and files.
- Develop skills in multimedia authoring, hypermedia messaging, and user interface design.
- Introduce augmented reality techniques and their integration with existing development environments.
- Explore virtual reality techniques and their applications in creating immersive experiences.

UNIT- I INTRODUCTION TO MULTIMEDIA 9

Multimedia - Multimedia system architecture − Evolving technologies for multimedia -Components of multimedia – Multimedia Hardware and Software-Web and Internet multimedia applications –Data Representation: Text, Images, Audio, Video - Transition from conventional media to digital media.

UNIT- II MULTIMEDIA SYSTEM DESIGN & FILE HANDLING 9

Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases- Compression and decompression− Data and file format standards − Multimedia I/O technologies − Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.

UNIT- III HYPERMEDIA 9

Multimedia authoring and user interface - Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems. CASE STUDY: Blender graphics and Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures.

UNIT- IV AUGMENTED REALITY 9

Working with AR techniques, compatibility with the environment, system architecture, AR terminology, application areas of AR, Integration of AR toolkits with

existing IDE's (Unity-Vuforia, Visual Studio, Netbeans, intellij IDEA, Android, iOS), connectivity of smart devices with AR.

UNIT- V VIRTUAL REALITY 9

Integration of VR techniques, Contents objects and scale, Gaze Based Control, Handy Interactables, IDE setup with package files, concepts and features of VR, VR project example**.**

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

1. Understand and explain the fundamental concepts of multimedia and its components.
2. Design and handle multimedia systems and files.
3. Develop and manage hypermedia content and applications.
4. Apply augmented reality techniques and integrate AR toolkits with various IDEs.
5. Develop virtual reality content and understand its applications and features.

TEXTBOOKS:

1. Multimedia: Making It Work (8th Edition) by Tay Vaughan and Fundamentals of Multimedia by Ze-Nian Li and Mark S. Drew Publisher, Unit 1, 2.
2. Yvonne, B., & Alistair, G. (1997). Multimedia and Hypertext: The Internet and Beyond. MIT Press. Unit 3
3. Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice," Addison-Wesley Professional, 2016. Unit 4
4. Understanding Virtual Reality: Interface, Application, and Design (2nd Edition) by William R. Sherman and Alan B. Craig Publisher: Morgan Kaufmann, Unit 5.

REFERENCE BOOKS:

1. Li, Z., Drew, M., & Liu, J. (2004). Fundamentals of Multimedia. Pearson. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", PHI, 1998.
2. Furht, B. (Ed.). (1998). Handbook of Multimedia Computing. CRC Press.
3. Billinghurst, M., Clark, A., & Lee, G. (2015). A Survey of Augmented Reality**.** Foundations and Trends® in Human–Computer Interaction, 8(2-3), 73-272.

4. Sherman, W. R., & Craig, A. B. (2018). Understanding Virtual Reality: Interface, Application, and Design (2nd ed.). Morgan Kaufmann.

List of Open Source Software/ Learning website:

1. Tay Vaughan, "Multimedia: Making It Work," Tata McGraw-Hill, 2008.
2. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia," Pearson Education, 2004.
3. Gaurav Bhatnagar and Shikha Mehta, "Introduction to Multimedia Systems," Cambridge University Press, 2000.
4. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile," O'Reilly Media, 2015.

OIT101	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	1	-	1	1	-	-	-	2	3	1	3	2	1	-
CO2	1	-	2	-	3	3	-	-	-	3	3	1	1	-	2	-
CO3	3	2	2	-	2	1	1	1	1	1	1	1	3	2	2	-
CO4	3	3	3	-	2	1	1	1	1	1	1	1	3	3	3	-
CO5	3	3	3	-	3	1	1	1	1	1	1	1	3	3	3	-
Average	**2.6**	**2.4**	**2.4**	**-**	**2.2**	**1.4**	**1.0**	**1.0**	**1.0**	**1.6**	**1.8**	**1.0**	**2.6**	**2.0**	**2.3**	**-**

OIT102	3D PRINTING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop CAD models for 3D printing.
- To import and export CAD data and generate. STL file.
- To select a specific material for the given application.
- To select a 3D printing process for an application.
- To produce a product using 3D printing or Additive Manufacturing (AM).

UNIT- I 3D PRINTING (ADDITIVE MANUFACTURING) 9

Introduction, The Generic AM Process, Classification of AM Process, Advantages, Additive V/s Conventional Manufacturing processes, Applications- the Benefits of AM.

UNIT- II CAD FOR ADDITIVE MANUFACTURING 9

Steps in Additive Manufacturing-Variation from one AM Machine to another-Application Areas That Don't Involve Conventional CAD Modeling-CAD Tools for AM -Preparation of CAD Models: The STL File, Steps in Additive Manufacturing-Variation from one AM Machine to another-Application Areas That Don't Involve Conventional CAD Modeling-CAD Tools for AM -Preparation of CAD Models: The STL File, STL File Format, Binary/ASCII, Creating STL Files from a CAD System - Problems with STL Files.

UNIT- III ADDITIVE MANUFACTURING TECHNIQUES 9

Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process, Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, Defence, Automotive, Construction, Food Processing, Machine Tools.

UNIT- IV MATERIALS 9

Polymers, Metals, Non-Metals, Ceramics. Various forms of raw material – Liquid, Solid, Wire, Powder;Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT- V ADDITIVE MANUFACTURING EQUIPMENT AND POST PROCESSING **9**

Process equipment- design and process parameters, Governing bonding mechanism, Common faults and troubleshooting, Process design, Post processing: requirement and techniques, Product quality, Inspection and testing, Defects and their causes.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Develop CAD models for 3D printing.
2. Import and Export CAD data and generate. STL file.
3. Select a specific material for the given application.
4. Select a 3D printing process for an application.
5. Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXTBOOKS:

1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1. (Unit I & II)
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126. (Unit II to V)

REFERENCE BOOKS:

1. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
2. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”,World Scientific, 2017.
3. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer SeriesIn Material Science, 2013.
4. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”,Kulwer Academic Press, 2001.
5. Zhiqiang Fan And Frank Liou, “Numerical Modelling of the Additive Manufacturing (AM)Processes of Titanium Alloy”, InTech, 2012.

OIT102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	2	3	-	2	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	-	3	2	-	-	-	-	-	2	-	-	-	3	2
CO5	-	-	2	3	2	-	-	-	-	-	-	-	-	-	2	1
Average	**2**	**2**	**2.2**	**2.6**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**2.6**	**1.6**

OIT103	WEB FRAMEWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Design static web page using Markup languages.
- Design and implement web pages using style sheets.
- Implement with java script web applications with dynamic web pages.
- Understand working of Web servers and Design Methodologies with MVC Architecture.
- Develop web applications using XML.

UNIT- I INTRODUCTION TO WEB FRAMEWORKS 9

Basics of web development – Overview of web frameworks - MVC architecture - Popular web frameworks: Django, Flask, Ruby on Rails, Laravel, Express.js - Benefits of using web frameworks

UNIT- II CLIENT- SIDE FRAMEWORKS 9

Introduction to client-side frameworks - React.js: Components, JSX, State and Props, Lifecycle Methods - Angular: Modules, Components, Services, Directives, Data Binding - Vue.js: Vue instance, Templates, Components, Vue Router

UNIT- III SERVER - SIDE FRAMEWORKS 9

Introduction to server-side frameworks - Django: Models, Views, Templates, Forms, Admin Interface - Flask: Routing, Templates, WTForms, SQLAlchemy - Node.js with Express.js:Middleware, Routing, Templating, REST APIs

UNIT- IV DATABASE INTEGRATION 9

Database fundamentals - SQL vs NoSQL databases - ORM (Object-Relational Mapping) concepts - Integrating databases with Django (using Django ORM) - Integrating databases with Flask (using SQLAlchemy) - Integrating databases with Node.js using Mongoose for MongoDB

UNIT- V FULL-STACK DEVELOPMENT 9

Overview of full-stack development - RESTful APIs and Web Services - Authentication and Authorization - Deployment and Hosting - Case Studies:

Building a full-stack application with React and Django/Node.js.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Understand the fundamental concepts and architecture of web frameworks.
2. Develop web applications using client-side frameworks.
3. Build dynamic server-side applications with popular server-side frameworks.
4. Integrate databases and manage data within web applications.
5. Implement full-stack web applications combining client side and server-side technologies.

TEXTBOOKS:

1. "Web Development with Node and Express: Leveraging the JavaScript Stack" by Ethan Brown Unit 1,3,4,5
2. "Django for Beginners: Build websites with Python and Django" by William S. Vincent Unit 1,3,5
3. "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux" by Kirupa Chinnathambi Unit 2,5

REFERENCE BOOKS:

1. **"**Flask Web Development: Developing Web Applications with Python" by Miguel Grinberg Unit 3,4
2. "Pro Angular 9: Build Powerful and Dynamic Web Apps" by Adam Freeman Unit 2
3. "Full-Stack Vue.js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel" by Anthony Gore Unit 1,5

OIT103	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	2	2	3	-	-	-	-	2	1	2	3	2	2	-
CO2	2	3	3	2	3	-	-	-	2	3	2	2	3	2	3	-
CO3	2	3	3	3	3	-	-	-	2	2	2	2	3	2	3	-
CO4	2	2	3	2	3	-	-	-	2	2	1	2	3	3	3	-
CO5	2	3	3	3	3	-	-	-	2	3	3	2	3	3	3	-
Average	**2.2**	**2.6**	**2.8**	**2.4**	**3**	**-**	**-**	**-**	**1.6**	**2.4**	**1.8**	**2**	**3**	**2.4**	**2.8**	**-**

OAD101	FOUNDATION OF DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT- I INTRODUCTION **9**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.

UNIT- II DATA MANIPULATION **9**

Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance.

UNIT- III MACHINE LEARNING **9**

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis.

UNIT- IV DATA VISUALIZATION **9**

Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

UNIT- V HANDLING LARGE DATA 9

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Gain knowledge on data science process.
2. Perform data manipulation functions using Numpy and Pandas.
3. Understand different types of machine learning approaches.
4. Perform data visualization using tools.
5. Handle large volumes of data in practical scenarios.

TEXTBOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCE BOOKS:

1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014

OAD101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	3	2	-	-	-	3	1	3	2	-	-	-	-
CO2	2	2	2	3	3	-	-	-	2	2	3	2	-	-	-	-
CO3	3	3	3	3	2	-	-	-	2	3	1	1	-	-	-	-
CO4	2	3	2	3	2	-	-	-	3	3	3	3	-	-	-	-
CO5	2	3	2	2	3	-	-	-	3	3	1	3	-	-	-	-
Average	**2.4**	**2.8**	**1.3**	**2.8**	**2.4**	**-**	**-**	**-**	**2.6**	**2.4**	**2.2**	**2.2**	-	-	-	-

OAD102	OPEN SOURCE SOFTWARE TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of open source software.
- To understand about open source databases.
- To understand about the open source programming languages.
- To understand and apply the concepts in python language.
- To understand the real world problems using case studies.

UNIT- I INTRODUCTION 9

Introduction to Open sources – Need of Open Sources – Advantages of Open Sources–Application of Open Sources. Open source operating systems: LINUX: Introduction –General Overview – Kernel Mode and user mode – Process – Advanced Concepts –Scheduling – Personalities – Cloning – Signals – Development with Linux.

UNIT- II OPEN SOURCE DATABASE 9

MySQL: Introduction – Setting up account – Starting, terminating and writing your ownSQL programs – Record selection Technology – Working with strings – Date and Time– Sorting Query Results – Generating Summary – Working with metadata – Usingsequences – MySQL and Web.

UNIT- III OPEN SOURCE PROGRAMMING LANGUAGES 9

PHP: Introduction – Programming in web environment – variables – constants –data;types – operators – Statements – Functions – Arrays – OOP – String Manipulation and regular expression – File handling and data storage – PHP and SQL database – PHP and LDAP – PHP Connectivity – Sending and receiving E-mails – Debugging and error handling – Security – Templates.

UNIT- IV PYTHON 9

Syntax and Style – Python Objects – Numbers – Sequences – Strings – Lists and Tuples – Dictionaries – Conditionals and Loops – Files – Input and

Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.

UNIT- V CASE STUDIES 9

Apache, BSD, Linux, Mozilla (Firefox), Wikipedia, Joomla, GCC, Open Office.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Explain the basic concepts of open source softwares.
2. Excel in open source databases.
3. Understand about open source programming languages.
4. Apply the concepts using python.
5. Understand the real world problems using the case studies.

TEXTBOOKS:

1. Remy Card, Eric Dumas and Frank Mevel, “The Linux Kernel Book”, Wiley Publications, 2003.
2. Steve Suchring, “MySQL Bible”, John Wiley, 2002 .
3. Kailash Vadera, Bhavyesh Gandhi, “Open Source Technology”, Laxmi Publications Pvt Ltd 2012, 1st Edition.

REFERENCE BOOKS:

1. Rasmus Lerdorf and Levin Tatroe, “Programming PHP”, O’Reilly, 2002.
2. Wesley J. Chun, “Core Phython Programming”, Prentice Hall, 2001.
3. Martin C. Brown, “Perl: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
4. Steven Holzner, “PHP: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
5. Vikram Vaswani, “MYSQL: The Complete Reference”, 2nd Edition, Tata McGraw- Hill Publishing Company Limited, Indian Reprint 2009.
6. Fadi P. Deek and James A. M. McHugh, “Open Source: Technology and Policy”, Cambridge Universities Press 2007.

OAD102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-
Average	**2.0**	**-**	**1.6**	**-**	**1.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	-	-	-

OME101	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
- To study the Vapour absorption and air refrigeration systems.
- To learn the psychrometric properties and processes.
- To study the air conditioning systems and load estimation.

UNIT- I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT- II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT- III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic Vortex and Pulse tube refrigeration systems.

UNIT- IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT- V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Explain the basic concepts of Refrigeration
2. Explain the Vapor compression Refrigeration systems and to solve problems
3. Discuss the various types of Refrigeration systems
4. Calculate the Psychrometric properties and its use in psychrometric processes
5. Explain the concepts of Air conditioning and to solve problems

TEXTBOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010
2. Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi | 10 February 2019

REFERENCE BOOKS:

1. ASHRAE Hand book, Fundamentals, 2010
2. JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007

OME101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
CO2	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
CO3	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
CO4	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
CO5	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-
Average	2	1	1	1	-	-	2	-	1	-	-	1	2	2	-	-

OME102	ADVANCED MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To describe the concepts of various metal casting processes.
2. To demonstrate the concepts of various metal joining processes.
3. To describe unconventional machining processes
4. To demonstrate thermal and electrical based processes.
5. To describe the chemical and electrochemical-based process parameters, their influence on performance, and their application.

UNIT- I METAL CASTING 9

Casting terminology, pattern material, allowance; Pattern types: Single piece, split, gated; Core prints, moulding sand properties, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - Stir casting; Defects in Sand casting

UNIT- II JOINING PROCESSES 9

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding. brazing, soldering and adhesive bonding; Weld defects: types, causes and cure.

UNIT- III MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining - (AJM, WJM, AWJM and USM) - Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT- IV THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipment - Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits- Tool Wear –Dielectric – Flushing – Applications. Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Working Principles – Equipment –Types – Beam control techniques – Applications.

UNIT- V CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant – techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- Equipment -Surface Roughness and MRR Electrical circuit -Process Parameters ECG and ECH – Applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Understand the various metal casting processes.
2. Understand the various metal joining techniques.
3. Describe the unconventional machining processes and the mechanical processes.
4. Understand the thermal and electrical-based processes.
5. Understand the chemical and electrochemical-based process parameters, their influence on performance, and their application.

TEXTBOOKS:

1. Serope Kalpakjian, Steven R.Schmid, “Manufacturing Engineering and
2. P.N. Rao, “Manufacturing Technology: Foundry, Forming and Welding – Volume 1”, Tata McGraw-Hill Publishing Limited, 2019.

REFERENCE BOOKS:

1. P.C. Sharma, “A text book of Production Technology (Manufacturing Processes)”, S. Chand and Company, 8th Edition 2014.

2. S.Gowri, P.Hariharan, and A.Suresh Babu, “Manufacturing Technology 1”, Pearson Education, 2020.

E- RESOURCES:

https://archive.nptel.ac.in/courses/112/107/112107219

https://archive.nptel.ac.in/courses/112/105/112105212

OME102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
CO2	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
CO3	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
CO4	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
CO5	2	-	1	-	1	-	1	-	1	1	-	1	1	1	-	-
Average	2	-	1	-	1	-	1	-	1	1	-	1	1	2	-	-

OME103	MATERIAL TESTING AND CHARACTERIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is:

- To describe the phase structure of metals/alloys.
- To demonstrate the heat treatment process employed for various materials.
- To describe the classification of ferrous and nonferrous alloys.
- To describe the Practical exposure towards microstructure of Engineering Materials.
- To demonstrate the Mechanical testing tools for engineering materials.

UNIT- I BINARY PHASE DIAGRAM 9

Solid solutions: Substitutional and interstitial – Compound – Phase diagram: Classification - Phase reactions with an example: Isomorphous, eutectic, eutectoid, peritectic and peritectoid, Iron – Iron carbide diagram.

UNIT- II HEAT TREATMENT PROCESSES 9

Full, stress relief, recrystallization and spherodizing annealing – normalizing, hardening and tempering of steel –phase transformation - Isothermal transformation (TTT) diagram for Eutectoid Steel – cooling curves - CCR –Hardenability - Jominy end quench test – Austempering - martempering. Case hardening - carburizing, nitriding, cyaniding, carbo- nitriding, flame and induction hardening

UNIT- III FERROUS ALLOYS 9

Classification, properties, microstructure, processing and applications of low, medium & high carbon steel & FG, SG, White, Malleable cast iron – effect of alloying elements on steel (Cr, Mo, V, Ti, Ni & W) - stainless steel and tool steels - HSLA steel & Maraging steels – Die steel, Wear of Metals - BIS Specification.

UNIT- IV NON-FERROUS ALLOYS 9

Properties, Composition, Applications: Copper and its alloys - Brass, Bronze and Cupronickel – Aluminium and its alloys – Duralumin- Bearing alloys. Nickel and Titanium base alloys – Metals for low and high temperature applications-

BIS Specification.

UNIT- V MECHANICAL TESTING 9

Mechanical properties - stress - strain curve for ferrous and non-ferrous alloys - Mechanism of plastic deformation, slip and twinning – Fracture: types – Griffith theory - Material testing: Tensile, compression and shear loads –Hardness tests: Brinell, Rockwell and Vickers - Impact test: Izod and Charpy - Fatigue and creep tests - fracture toughness tests - Characterization techniques: Optical, SEM, XRD.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To recall the phase reactions of various metals and alloys.
2. To have great exposure in the heat treatment processes and know their purpose in engineering applications
3. To have knowledge in the classification, properties and applications of various ferrous alloys.
4. To classification and application of various nonferrous alloy materials.
5. To Identify the various mechanical properties for the ferrous and nonferrous alloys using modern testing facilities.

TEXTBOOKS:

1. Jindal. U.C “Material science and Metallurgy”, Pearson New Delhi, 2015.
2. Selvakumar N, “Engineering Metallurgy and Nanotechnology” Scitech, Publications (India) Pvt. Ltd., 2018.

REFERENCE BOOKS:

1. Raghavan.V, “Materials Science and Engineering”, Prentice-Hall, 6th Edition, 2015.
2. William D Callister and David G. Rethwisch, “Material Science and Engineering: An Introduction”, John Wiley, 10th Edition, 2018.

E- RESOURCES:

https://nptel.ac.in/courses/112108150

https://www.digimat.in/nptel/courses/video/113107078/L01.html

OME103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
CO2	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
CO3	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
CO4	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
CO5	3	1	3	1	-	-	-	-	-	-	-	1	1	1	-	-
Average	**3**	**1**	**3**	**1**	-	-	-	-	-	-	-	**2**	**1**	**1**	-	-

OME104	HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- At the end of the course the student shall be able to understand the type, nature of hazardous wastes.
- To study the hazardous wastes management.
- To study the biomedical waste management.
- To study the radioactive waste management.
- To study the E-Waste Management.

UNIT- I INTRODUCTION 9

Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste - Physical and biological routes of transport of hazardous substances.

UNIT- II HAZARDOUS WASTES MANAGEMENT 9

Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment technologies-Physical, chemical and thermal treatment of hazardous waste–Solidification- Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste landfills-Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques.

UNIT- III BIOMEDICAL WASTE MANAGEMENT 9

Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources–Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection – disposal-Infection control Practices.

UNIT- IV RADIOACTIVE WASTE MANAGEMENT 9

Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes-Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB.

UNIT- V E-WASTE MANAGEMENT 9

Regulatory aspects of E-l Waste management, Waste characteristics- Generation -- Collection - Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e-waste management.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Gain the knowledge of the type, nature hazardous wastes.
2. Ability to plan minimization of hazardous wastes.
3. Ability to handle the bio medical Waste.
4. Ability to handle the radioactive waste.
5. Ability to handle the E- Waste Management.

TEXTBOOKS:

1. Hazardous waste management CharlesA.Wentz.Second edition 1995.McGraw Hill nternational.
2. Hazardous waste management Michael D. La Gerga, PhilipL Buckingham, Jeffrey C. Evans, Second edition 2010.Waveland Press.

REFERENCE BOOKS:

1. Basic Hazardous waste management, “William C.Blackman.Jr”, Third Edition, 2001, Lewis Publishers
2. Integrated solid waste management George Techobanoglous, Hilary Theisen & Sammuel A.Vigil.

OME104	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
CO2	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
CO3	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
CO4	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
CO5	2	1	1	-	-	-	3	-	1	-	-	1	1	2	-	-
Average	**2**	**1**	**1**	-	-	-	**3**	-	**1**	-	-	**1**	**1**	**2**	-	-

OME105	AUTOMOTIVE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The intention and purpose of this course is to study the basics of electronics, emission controls and its Importance in automobiles.
- To study the Ignition and Injection system in Automobiles
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
- To study the various blocks of mechatronics control units used for control of fuel, ignition and exhaust systems.
- To learn about different types of chassis and mechatronics safety systems in automobile.

UNIT- I INTRODUCTION 9

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT- II IGNITION AND INJECTION SYSTEMS 9

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT- III SENSOR AND ACTUATORS IN AUTOMOTIVES 9

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT- IV ENGINE CONTROL SYSTEMS 9

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles

UNIT- V CHASSIS AND SAFETY SYSTEMS 9

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of air bag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

1. Know the importance of emission standards in automobiles.
2. Understand the electronic fuel injection and ignition components and their function.
3. Choose and use sensors and equipment for measuring mechanical quantities temperature and appropriate actuators.
4. Diagnose electronic engine control systems problems with appropriate diagnostic tools.
5. Analyze the chassis and vehicle safety system.

TEXTBOOKS:

1. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2017.
2. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 7th edition, 2019.

REFERENCE BOOKS:

1. Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication,4th edition, 2000.
2. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

OME105	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
CO2	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
CO3	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
CO4	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
CO5	3	2	1	1	1	-	-	-	-	-	1	1	1	2	-	-
Average	**3**	**2**	**1**	**1**	**1**	-	-	-	-	-	**1**	**1**	**1**	**2**	-	-

OPH101	ADVANCED FUNCTIONAL MATERIALS	L	T	P	C
	(B.E/B.Tech Common to all branches)	3	0	0	3

OBJECTIVES:

- To understand the sensors and actuators
- To facilitate the knowledge about photoactive functional soft materials
- To enrich the idea of Functional magnetic materials
- To explore bio mimics, bionics and biomineralization
- To enhance the fundamental knowledge about Energy Functional materials and molecular Electronics

UNIT- I FUNCTIONAL MATERIALS FOR SENSORS AND ACTUATORS 9

Introduction of sensors - differences between transducers, Sensors and Actuators- Conducting polymers sensor materials- Conducting polymer FET sensor - Chemi resistive sensor. Introduction of actuators and its working principle - Electrochromic and Electroactive Polymer actuators: Wet and Dry Electroactive polymer actuators (EAP).

UNIT- II PHOTOACTIVE FUNCTIONAL SOFT MATERIALS 9

Introduction - soft materials-photo thermal effect-photo isomerisation-photo switches - opto fluidics. micro soft robotics-light driven micro pumps and micro mixers – Photo acutuation. Photo tunable photonic crystals-photo patterning and alignment. Optical control in a chiral photo magnet.

UNIT- III FUNCTIONAL MAGNETIC MATERIALS 9

Magneto caloric effect-magnetic cooling and heating-Magneto caloric materials for heat pumping applications. Soft magnetic wires for sensor applications-Magnetic bistability and domain wall propagation. slow magnetic relaxation-magnetic molecular materials - single molecule magnets-single ion magnets - single chain magnets - molecular spin qubits.

UNIT- IV ENERGY MATERIALS AND MOLECULAR ELECTRONICS 9

Electro chemical capacitor - super capacitors for energy storage - single junction solar cell-Tandem solar cell - Dye sensitized solar cells – Quantum dot solar cell - Organic solar cells – Semiconductor nanostructures. Superconductors for energy storage systems and transportation. Organic electronics- Organic LED – spintronics - dilute magnetic semiconductors.

UNIT- V BIO-INSPIRED MATERIALS 9

Bio-inspired materials, Classification, Biomimics, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid,'Bionics' - Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization-En route to Nanotechnology; Biometals – bioceramics- bio synthetic polymers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. The students will gain knowledge on the basics of conducting polymer sensors, actuators and FET sensors.
2. The students will have adequate knowledge on the soft materials, and micro soft robotics.
3. The students will have knowledge on the concepts Magneto caloric effect, magnetic cooling and heating.
4. The students will understand the basics of Bio-inspired materials and Bio-inspired Information Technologies
5. The students will get knowledge on electro chemical capacitor and spintronics.

TEXTBOOKS:

1. Hasse Fredriksson, KTH Stockholm, Sweden and Ulla Åkerlind University of Stockholm, Sweden 'Physics of Functional Materials'John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, 2008.

2. S Banerjee, A.K. Tyagi, 'Functional Materials- Preparation, Processing and Applications' Elsevier , 2011.
3. Chander Prakash, Sunpreet Singh, J. Paulo Davim, 'Functional and Smart Materials',CRC Press ,2020.
4. Arcady Zhukov, 'Novel Functional Magnetic Materials- Fundamentals and Applications',Springer International Publishing, 2016.
5. Insup Noh, 'Biomimetic Medical Materials- From Nanotechnology to 3D Bioprinting', Springer Singapore, 2018.

REFERENCE BOOKS:

1. Quan Li , 'Photoactive Functional Soft Materials Preparation, Properties, and Applications'Wiley-VCH ,2019.
2. Hee-Gweon Woo, Hong Li, 'Advanced Functional Materials', Springer , 2011.
3. Rupitsch, Johann, S., Piezoelectric Sensors and Actuators. Springer-Verlag Berlin Heidelberg, 2018.
4. G. Arthanareeswaran, Pei Sean Goh, S. A. Gokula Krishnan , 'Functional Polymers and Nanomaterials for Emerging Membrane Applications',CRC Press ,2023.

OPH101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	2	-	-	1	1	-	-	-	-	1	-	-	-	-
CO2	3	2	2	1	2	1	1	-	-	-		1	-	-	-	-
CO3	3	2	1	1	2	1	1	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
CO5	3	2	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Average	3	1.8	1.6	1	1.5	1	1	-	-	-	-	1	-	-	-	-

OCH101	NANOMATERIALS AND APPLICATIONS	L	T	P	C
	(Common to all branches)	3	0	0	3

OBJECTIVES:

- To make the students familiar with the properties and applications of nanomaterials.
- To acquaint the student with the synthesis of nanomaterials by different methods.
- To provide knowledge on the different characterisation techniques employed to characterise the nanomaterials.
- To inculcate the students on the knowledge of nanocomposites, biodegradable polymer-based nanocomposites, and clay polymer nanocomposites.
- To enlighten the needs and utilization of nanomaterials in various fields such as energy, water treatment process, agriculture, electronics, medicine, engineering and Information technology.

UNIT- I PROPERTIES OF NANOMATERIALS 9

Definition – importance of nano structured materials - size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials. Surface area - band gap energy and its applications. Photochemistry and electrochemistry of nanomaterials –ionic properties of nanomaterials- Nanocatalysis. Green Materials – biomaterials, biopolymers and bioplastics.

UNIT- II SYNTHESIS OF NANOMATERIALS 9

Bottom-up and top-down approach to obtain nanomaterials. Chemical methods: co-precipitation methods, sol-gel technique, photochemical synthesis. Physical methods: high energy ball milling, PVD methods, gas phase condensation and magnetron sputtering.

UNIT- III STRUCTURAL CHARACTERISTICS 9

Introduction, principles, instrumentation and applications of powder X-ray diffraction, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, nanoindentation, small angle X-ray and neutron scattering and BET analysis method.

UNIT- IV NANOCOMPOSITES 9

Introduction, the importance of nanocomposites, binary and ternary nanocomposites. Synthesis, properties and applications of metal-metal oxide and metal oxide-metal oxide nanocomposites, biodegradable polymer-based nanocomposites, thermoplastic nanocomposites, nylon-6 nanocomposites, clay polymer nanocomposites.

UNIT- V APPLICATIONS OF NANOMATERIALS 9

Introduction, applications of nanomaterials in renewable energy generation, drug delivery, cosmetics, tissue engineering, bioinformatics, nanomedicine, molecular motors, bioelectronics & spintronics, textiles, cosmetics, agriculture & food technology, high integrated circuits, information technology, defence and aerospace. Practice of nanoparticles for environmental remediation and water treatment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

1. Evaluate and understand the different types of nanomaterials and their properties.
2. Understand the proper methods for synthesizing nanomaterials.
3. Recommend the characterization techniques for various nanomaterials.
4. Illustrate the functioning and properties of nanocomposites and their interference.
5. Develop a more profound knowledge on the applications of nanomaterials in various fields.

TEXTBOOKS:

1. C. N. R. Rao, Achim Muller, Anthony K. Cheetham, “The Chemistry of Nanomaterials: Synthesis, Properties and Applications”, 2nd Edition Wiley-VCH, Germany, 2006.
2. Geoffrey A. Ozin, Andre C. Arsenault, Ludovico Cademartiri, Chad A. Mirkin, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2nd Edition, United Kingdom, 2008.

3. Azamal Husen, Khwaja Salahuddin Siddiqi, “Advances in Smart Nanomaterials and their Applications (Micro and Nano Technologies)”, 1st Edition, Elsevier, Netherlands, 2023.

REFERENCE BOOKS:

1. William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3rd Edition, CRC Taylor and Francis, United Kingdom, 2012.
2. G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, London, 2004.
3. N. Kumar, “Concise concepts of nanoscience and nanomaterials”, Scientific publishers, New Delhi, 2019.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, Hyderabad, 2018.
5. Korada, Viswanatha Sharma, Hamid, Nor Hisham, Engineering Applications of Nanotechnology: From Energy to Drug Delivery, Springer, United States, 2017.

OCH101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO4	2	1	1	1	-	1	-	1	-	-	-	1	-	-	-	-
CO5	2	1	1	1	1	1	-	1	-	-	-	1	-	-	-	-
Average	**2**	**0.6**	**0.8**	**0.4**	**0.2**	**0.2**	**-**	**0.2**	**-**	**-**	**-**	**0.8**	**-**	**-**	**-**	**-**

VERTICAL I: FINTECH AND BLOCKCHAIN

BAM101 FINANCIAL MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES

1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of finance.
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy.
5. To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT 9

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of Money-Risk and return concepts**.**

UNIT II SOURCES OF FINANCE 9

Long term sources of Finance-Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits etc.

UNIT III INVESTMENT DECISIONS 9

Investment Decisions: Capital budgeting – Need and Importance –Techniques of Capital Budgeting - Payback - ARR – NPV – IRR – Profitability Index. Cost of Capital - Cost of Specific Sources of Capital- Equity -Preferred Stock - Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION 9

Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy.

UNIT V WORKING CAPITAL DECISION 9

Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital - Working capital operating cycle. Cash Management: Motives for holding cash – Objectives and Strategies of Cash

Management. Receivables Management: Objectives - Credit policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will have an understanding on Time value of money and role of a finance manager.
2. Students will be able to analyze the various avenues available to generate long term funds for investments through capital markets and other sources.
3. Students will be able to apply various techniques for Investment decisions.
4. Students will be able to choose the right approach for financing and dividend decisions to solve business issues.
5. Students will be able to analyze the requirement and management of working capital.

REFERENCES

1. M.Y. Khan and P.K. Jain Financial Management, text, problems and cases Tata McGraw Hill, 8th edition 2017.
2. I.M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018.
3. Prasanna Chandra, Financial Management – Theory and Practice, 9th edition, Tata McGraw Hill, 2017.
4. Rajiv Srivastava and Anil MisraFinancial Management, Oxford University Press, 2011.
5. Parasuraman, N.R Financial Management: a step-by-step approach, 2nd edition; Cengage Learning India Pvt. Ltd., 2019.

BAM102 FUNDAMENTALS OF INVESTMENT L T P C

3 0 0 3

COURSE OBJECTIVES

1. To describe the investment environment and understand the factors influencing investment decisions.
2. To explain the methods of valuing bonds and equities.
3. To examine various approaches used in the valuation of securities.
4. To understand the principles of portfolio construction and the role of diversification in creating efficient portfolios.
5. To discuss the mechanisms of investor protection in India, including regulatory frameworks and investor rights.

UNIT I THE INVESTMENT ENVIRONMENT 9

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II FIXED INCOME SECURITIES 9

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating. Yield Measures: Current Yield, Yield to Maturity (YTM), Yield to Call (YTC) Money Market Instruments (Treasury Bills, Certificates of Deposit, Commercial Paper). Credit Rating Agencies in India (CRISIL, ICRA, CARE, India Ratings)

UNIT III APPROACHES TO EQUITY ANALYSIS 9

Introduction to Fundamental Analysis, Technical, Analyze macroeconomic indicators: GDP, interest rates, inflation, etc. Sector and industry analysis (Porter's Five Forces). Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES 9

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT V INVESTOR PROTECTION 9

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism. Concept of Fair Disclosure and Transparency. Sustainable Investing and ESG.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand basic investment concepts and their significance, and analyze various investment avenues including stocks, bonds, mutual funds, real estate, commodities, and financial derivatives.
2. Students will evaluate risk and return profiles of different investment options using appropriate tools and techniques, and interpret market trends and economic indicators to make informed investment decisions.
3. Students will be able to apply principles of portfolio construction and management to optimize investment returns.
4. Students can able to develop a long-term investment strategy aligned with financial goals and risk appetite.
5. Students can able to explain the regulatory framework for investor protection in India and the principles of sustainable and ethical investing.

REFERENCES

1. Pinto, J. E., Henry, E., Robinson, T. R., & Stowe, J. D. Equity Asset Valuation (4th edition). Wiley India 2023.
2. Chandra, P. Fundamentals of Investment (Revised ed.). McGraw-Hill Education 2022.
3. Mishkin, F. S., & Eakins, S. G. Financial Markets and Institutions (9th ed., Indian adaptation by Aparna Pujari 2021.
4. Sundaresan, S. Fixed Income Securities (4th ed.). McGraw-Hill Education 2021.
5. Graham, B., & Dodd, D. Security Analysis (7th ed.). McGraw-Hill Education 2020.

BAM103 BANKING, FINANCIAL SERVICES AND INSURANCE L T P C
3 0 0 3

COURSE OBJECTIVES

1. To understand the Banking system in India.
2. To grasp how banks, raise their sources and how they deploy it.
3. To understand the development in banking technology.
4. To understand the financial services in India.
5. To understand the insurance Industry in India.

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM 9

Overview of Banking system–Structure– Functions–Banking system in India –Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS / PRODUCTS 9

Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY 9

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT IV FINANCIAL SERVICES 9

Introduction – Need for Financial Services – Financial Services Market in India – NBFC –– Leasing and Hire Purchase –– mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking

UNIT V INSURANCE 9

Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim

TOTAL :45 PERIODS

COURSE OUTCOMES

1. Students will be able to identify and describe the roles and interrelationship of institutions in the banking, financial services, and insurance sectors.
2. Students will understand key functions such as deposits, loans, credit creation, and payment systems in both commercial and central banking.
3. Students will analyze various products such as savings accounts, fixed deposits, mutual funds, credit cards, and insurance policies.
4. Students will demonstrate an understanding of the regulatory environment, including acts, guidelines, and the roles of RBI, SEBI, IRDAI, etc.
5. Students will assess the impact of digital banking, and e-insurance services on customer experience and operational efficiency.

REFERENCES

1. Padmalatha Suresh and Justin Paul, “Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Meera Sharma, “Management of Financial Institutions – with emphasis on Bank and Risk Management”, PHI Learning Pvt. Ltd., New Delhi 2010.
3. Peter S.Rose and Sylvia C. and Hudgins,“Bank Management and Financial Services”, Tata McGraw Hill, New Delhi, 2017.
4. Indian Financial System M. Y. Khan, McGraw Hill Education, 2019 10th Edition.
5. Financial Markets and Institutions, L. M. Bhole & Jitendra Mahakud, McGraw Hill Education, 2021 6th Edition.

BAM104	FINTECH PERSONAL FINANCE AND PAYMENTS	L T P C 3 0 0 3

COURSE OBJECTIVES

1. To introduce the foundational concepts of Financial Technology (FinTech) and its applications in personal finance, inclusive finance, and digital financial services.
2. To familiarize students with digital payment systems and cryptocurrencies**,** including their underlying technologies, security concerns, and legal frameworks.
3. To provide insights into InsurTech innovations**,** focusing on the integration of AI, ML, and IoT in risk management, underwriting, and fraud detection in insurance.
4. To enable understanding of peer-to-peer lending models and crowdfunding ecosystems, with a focus on digital infrastructure and financing solutions for SMEs and MSMEs.
5. To develop awareness of global and domestic FinTech regulations, and the emergence of RegTech as a tool for ensuring regulatory compliance and fraud monitoring using AI.

UNIT I INTRODUCTION TO FINTECH AND DIGITAL FINANCE 9

Overview of FinTech: Definition, scope, applications. History of Financial Innovation and Digitization. Alternative Finance: Crowdfunding – Types (Charity, Equity), platforms. Introduction to Initial Coin Offering (ICO). Role of FinTech in personal finance and inclusive finance.

UNIT II DIGITAL PAYMENTS AND CRYPTOCURRENCIES 9

Introduction to Cryptocurrencies: Bitcoin and Applications. Types of Cryptocurrencies and Digital Wallets. Basics of Blockchain Technology. National Payment Systems: Real-Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Unified Payments Interface (UPI). Digital Payments: Smart Cards, Mobile Payments, Payment Gateways, Virtual Currencies. Legal, Security, Privacy, and Ethical Issues in Digital Transactions.

UNIT III INSURTECH AND DIGITAL INSURANCE INNOVATIONS 9

Introduction to InsurTech. Role of (Artificial Intelligence (AI), Machine Language (ML), and Internet of Things (IoT) in insurance services. Risk Modelling, Fraud Detection. Innovations in Claims Processing and Underwriting. Impact on traditional insurance business models.

UNIT IV P2P LENDING AND FINANCIAL INCLUSION 9

Peer-to-Peer (P2P) and Marketplace Lending. Architecture and Technology Platforms. Crowdfunding Unicorns and Business Models. Financing for SME/MSME – Opportunities, Challenges, and FinTech Solutions.

UNIT V FINTECH REGULATIONS AND REGTECH 9

Global and Indian FinTech Regulations. Legal and Regulatory Risks. RegTech: Definition, Evolution. RegTech Ecosystem – Institutions, Startups, Regulators. Role of AI in Compliance and Fraud Monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to explain the fundamentals of cryptocurrencies, digital wallets, blockchain and payment systems such as UPI, RTGS, and IMPS, along with related security and regulatory aspects.
2. Students will describe the evolution of digital finance and analyze alternative finance models like crowdfunding and Initial Coin Offerings (ICO).
3. Students will evaluate the role of AI, ML, and IoT in InsurTech applications such as underwriting, claims processing, risk modeling, and fraud detection.
4. Students will analyze P2P lending and crowdfunding platforms, infrastructure, and innovations for SME/MSME financing.
5. Students will interpret FinTech regulations and assess the role of RegTech and AI in ensuring compliance and detecting fraud.

REFERENCES

1. Swanson, Seth Fintech for Beginners*:* Understanding and Utilizing the Power of Technology. Create Space Independent Publishing Platform 2016.
2. Tanda, Alessandra & Schena, Cristiana-Maria FinTech, BigTech and Banks: Digitalisation and Its Impact on Banking Business Models*.* Springer 2019.
3. Diedrich, Henning Ethereum : Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations*.* Wildfire Publishing 2016.
4. William, Jacob Fin Tech: The Beginner's Guide to Financial Technology*.* Create Space Independent Publishing Platform 2016.
5. Indian Institute of Banking and Finance (IIBF) Digital Banking. Taxmann Publications 2016.

BAM105 INTRODUCTION TO FINTECH LT P C

3 0 0 3

COURSE OBJECTIVES

1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION 9

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY 9

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY 9

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On- Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE 9

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH 9

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to understand and describe the historical phases of FinTech.
2. Students can able to recognize how FinTech is revolutionizing payments, lending, wealth tech, insurance, and emerging sectors across different regions.
3. Students can able to understand the nuances of fintech in wealth management industry.
4. Students can able to compare major FinTech hubs and understand strategic collaborations between traditional financial institutions and tech firms.
5. Students will understand the future of fintech.

REFERENCES

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
5. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications,2020

VERTICAL 2: ENTREPRENEURSHIP

BAM201 FOUNDATIONS OF ENTREPRENERUSHIP LT P C

3 0 0 3

COURSE OBJECTIVES

1. To develop and strengthen the entrepreneurial quality and motivation of learners.
2. To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
4. To empower the learners to run a Technology driven business efficiently and effectively.
5. To cultivate entrepreneurial skills, increase awareness of entrepreneurship, and foster a culture of innovation and job creation.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurship- Definition, Need, Scope -Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Barriers to Entrepreneurship– Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVRIONMENT 9

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological- Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration

UNITIII FUNDAMENTALS OF TECHNOPRENEURSHIP 9

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts-Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends- Managing Techno Stress – Eustress and Distress – Coping Strategies of Techno Stress.

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP 9

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies.

UNIT V EMERGING TRENDS IN ENTREPRENERUSHIP 9

Effective Business Management Strategies for Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be able to learn the basics of Entrepreneurship.
2. Students can understand the business ownership patterns and environment.
3. Students can understand the Job opportunites in Industries relating to Technopreneurship.
4. Students will learn about applications of technopreneurship and successful technopreneurs.
5. Students will acquaint with the recent and emerging trends in entrepreneurship.

REFERENCES

1. S.S. Khanka, “Entrepreneurial Development” S. Chand & Co.Ltd.Ram Nagar New Delhi, 2021.
2. Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning.
3. Daniel Mankani. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall 2003.
4. Edward Elgar. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub 2007.
5. Lang,J.TheHigh-TechEntrepreneur'sHandbook,Ft.com 2002.

BAM 202 TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS **LT P C 3 0 0 3**

COURSE OBJECTIVES

1. To develop and strengthen the Leadership qualities and motivation of learners.
2. To impart the Leadership skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of Team Building in managing Technology oriented businesses.
4. To empower the learners to build robust teams for running and leading a business efficiently and effectively.
5. To emphasize the importance of ethics and values in leadership practices.

UNIT I INTRODUCTION TO MANAGING TEAMS 9

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development – Enhancing teamwork within a group-Team Coaching-Team Decision Making-Virtual Teams-Self Directed Work Teams (SDWTs) -Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS 9

Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High- Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP 9

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation – Effective Communication in Leadership - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS 9

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory –

Transactional and Transformational Leadership - Charismatic Leadership – Change Management - Role of Ethics and Values in Organisational Leadership.

UNIT V LEADERSHIP EFFECTIVENESS 9

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership – Motivation and Employee Engagement - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership**.**

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of managing teams for business.
2. students will understand developing effective teams for business management.
3. Students will understand the fundamentals of leadership for running a business.
4. Students will learn about the importance of leadership for business development.
5. Students will acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES

1. "Leadership and Team Building" by Uday Kumar Haldar, First Edition, Oxford University Press, New Delhi 2010.
2. "The Five Dysfunctions of a Team: A Leadership Fable" by Patrick Lencioni, 20th Anniversary Edition, Jossey-Bass 2002.
3. Hughes, R.L, Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. 2019.
4. Katzenback, J.R., Smith,D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, 2015.
5. Haldar, U.K., Leadership and Team Building, Oxford University Press, 2010.

BAM 203 CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP L T P C
3 0 0 3

COURSE OBJECTIVES

1. To develop the creativity skills among the learners.
2. To impart the knowledge of creative intelligence essential for entrepreneurs.
3. To impart the knowledge of Innovation in Industries.
4. To know the applications of innovation in entrepreneurship.
5. To develop innovative business models for business.

UNIT I CREATIVITY 9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology - Creative Personality and Motivation - Creativity Training.

UNIT II CREATIVE INTELLIGENCE 9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION 9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation- Inbound and Outbound Ideation-Product Innovation and Process- Technological, Organizational Innovation – Indicators Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system

UNIT IV INNOVATION AND ENTREPRENEURSHIP 9

Innovation and Entrepreneurship: Entrepreneurial Mindset, Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding -

Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit

UNIT V INNOVATIVE BUSINESS MODELS 9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models –Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of creativity for developing Entrepreneurship
2. Students will understand the importance of creative intelligence for business growth
3. Students will understand the advances through Innovation in Industries
4. Students will learn about applications of innovation in building successful ventures
5. Students will acquaint with developing innovative business models to run the business efficiently and effectively

REFERENCES

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand & Sons, 2021.
2. Innovation Management, C.S.G. Krishnama charyulu, R. Lalitha, Himalaya Publishing House, 2nd edition, 2017.
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4. A. Dale Timpe, Creativity, Jaico Publishing House, 2003. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
5. Tidd, J., & Bessant, J. Managing innovation: Integrating technological, market and organizational change. UK: Wiley 2020.

BAM204	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS	L T P C 3 0 0 3

COURSE OBJECTIVES

1. To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
2. To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
3. To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.
4. To consider the various decision areas within marketing and the tools and methods used by marketing managers for making decisions.
5. To appreciate how a marketing perspective is important in your own personal and professional development.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9

Introduction-Market and Marketing – Concepts – Functions of Marketing - Importance of Marketing Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT II MARKETING ENVIRONMENT 9

Introduction-Environmental Scanning- Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT III PRODUCT AND PRICING MANAGEMENT 9

Product-Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding

Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBTUION MANAGEMENT 9

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) – Introduction to Advertising and Sales Promotion –Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

Introduction - Relationship Marketing vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing, E-Marketing or Online Marketing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will have the awareness of marketing management process.
2. Students will understand the marketing environment.
3. Students will acquaint about product and pricing strategies.
4. Students will have the knowledge of promotion and distribution in marketing management.
5. Students can comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House,2016.
2. Marketing Management, Philip Kotler and Kevin Lane Keller, PHI 15th Ed, 2015.
3. Marketing Management-An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India, 5th edition, 2015.
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.

BAM205 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS **L T P C 3 0 0 3**

COURSE OBJECTIVES

1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.
4. To understand the training and compensation practices in Industry
5. To create an awareness on controlling measures followed HR practitioners.

UNIT I INTRODUCTION TO HRM 9

Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting – HR Audit - Challenges in HRM.

UNIT II HUMAN RESOURCE PLANNING 9

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION 9

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources –e Recruitment - Selection Process- Selection techniques -E-Selection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT 9

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices

UNIT V CONTROLLING HUMAN RESOURCES 9

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances

Redressal Methods- Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment – Union - Management Relationship - Recent Trends

TOTAL :45 PERIODS

COURSE OUTCOMES

1. Students will understand the Evolution of HRM and Challenges faced by HR Managers
2. Students will learn about the HR Planning Methods and practices.
3. Students will acquaint about the Recruitment and Selection Techniques followed in Industries.
4. Students will know about the methods of Training and Employee Development.
5. Students will comprehend the techniques of controlling human resources in organisations.

REFERENCES

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e, Pearson, 2015.
2. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
3. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
4. R. Wayne Mondy, Human Resource Management, Pearson, 2015.
5. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012

BAM 206 FINANCING NEW BUSINESS VENTURES L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce the fundamentals of financing entrepreneurial ventures.
2. To understand the structure and avenues for debt and equity financing.
3. To explore government initiatives and institutional frameworks for start-ups.
4. To equip students with practical knowledge of fundraising processes for new ventures.
5. To develop competencies in evaluating financing strategies for new businesses.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE 9

Setting up new Business Ventures – Need - Scope - Startup Ecosystem in India- Franchising - Location Strategy, Registration Process - Legal Requirements- State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT II INTRODUCTION TO VENTURE FINANCING 9

Venture Finance–Definition–Historic Background– Importance – Funding New Ventures- Need–Scope– Types – Cost of Project-Means of Financing -Estimation of Working Capital-Requirement of funds– Mix of Debt and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING 9

Fund for Capital Assets - Term Loans - Leasing and Hire Purchase - Money Market instruments – Bonds, Debentures, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft**.**

UNIT IV SOURCES OF EQUITY FINANCING 9

Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital- Venture Valuation- meaning and Basic Mechanics of Valuation

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES 9

Investor Decision Process - Identifying the appropriate investors- Targeting investors-

Building Investor Relationships-Investor Selection Criteria- Company Creation-Raising Funds-Seed Funding- VC Selection Criteria – Process- Methods- VC Investment Process in India-Recent Trends

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of starting a new business venture.
2. Students can identify various venture financing opportunities
3. Students will understand the sources of debt financing.
4. Students will understand the sources of equity financing.
5. Students will acquaint and Formulate strategies for effective fundraising in real-world scenarios.

REFERENCES

1. Chandra, P. Projects: Planning, analysis, financing, implementation, and review (8th ed.). McGraw Hill Education, 2017.
2. Ramsinghani, M., The business of venture capital: The art of raising a fund, structuring investments, portfolio management, and exits (3rd ed.). Wiley. 2021.
3. Prasanna Chandra, Projects planning, Analysis, Selection, Financing, Implementation and Review, McGraw Hilld Education India Pvt Ltd, New Delhi, 2019.
4. Byers, Thomas. Technology Ventures: From Idea to Enterprise. McGraw – Hill Higher Education, 2014
5. Steven Rogers, Entrepreneurial Finance: Finance and Business Strategies for the Serious Entrepreneur 3e, Tata Mc Graw Hill, 2014.

VERTICAL III: PUBLIC ADMINISTRATION

BAM301	PRINCIPLES OF PUBLIC ADMINISTRATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand the nature, scope and essentials of Public Administration administrative theories and concepts to make sense of administrative practices.
- To evaluate the changing paradigms of Public Administration.
- To understand the synthesizing knowledge of public administration from public perspective.
- To study and explore the approaches of administrative process.
- To cover the principles, practices and the impact of public administration on society.

UNIT - I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning- Nature and Scope of Public Administration, Evolution of Public Administration, Public Administration and Private Administration, Public Administration –Arts, Science or both, Public Administration - relations to other social sciences, Importance of Public Administration.

UNIT - II EMERGING TRENDS IN PUBLIC ADMINISTRATION 9

New Public Administration – Formulating the structure, New Public Management,Globalization and Public Administration, Paradigm Shift from Government to Governance.

UNIT - III ADMINISTRATIVE ORGANIZATIONS 9

Forms of Administrative Organizations –Departments, Public Corporations, Public sector undertakings, Independent Regulatory Commissions, Line and Staff Agencies, Administrative Tribunal.

UNIT - IV APPROACHES AND THEORIES OF PUBLIC ADMINISTRATION 9

Classical Approach, Administrative Approach, Scientific Management Approach, Bureaucratic Approach, Human Relations Approach, Ecological Approach.

UNIT - V PRINCIPLES AND PRACTICES OF PUBLIC ADMINISTRATION 9

Chief Executive - Meaning, Types, Functions & Qualities of Chief Executive, Supervision, Communication - meaning, types of communication & its importance in Public Administration, Centralization & Decentralization, Public Relation, Meaning, Methods & Significance, Decision making - Types, Techniques and Processes, Leadership - Styles –Approaches.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will understand public administration theory and concepts from multiple perspectives.
2. Students will appreciate the nature, scope and dynamics of Public Administration.
3. Students will acquaint with India's development experience and changing role of administration practices.
4. Students will grasp the administrative theories, concepts and principles to make sense of administration in the developing era.
5. Students will demonstrate the integrative knowledge, skills and ethics necessary for

REFERENCE BOOKS:

1. Lakshmi Kanth ,Public Administration by McGraw Hill,2018
2. Rosenbloom David, Public Administration: Understanding Management, Politics, and Law in the Public Sector, McGraw Hill, 2018.
3. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
4. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
5. R.B. Jain: Public Administration in India,21st Century Challenges for Good

BAM302	INDIAN CONSTITUTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To know about the basic structure of Indian Constitution, Fundamental Rights(FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
- To know about the functioning of three wings of the government i.e., executive, legislative and judiciary.
- To know the State Executive s Union territories.
- To know about the Local Administration from Corporation to Village Level.
- To learn the pattern of Election systems and concept of E-Governance.

UNIT - I INTRODUCTION 9

Meaning of the Constitution Law and Constitutionalism - Constituent Assembly. Government of India Act of 1935 and Indian Independence Act of 1947 – Enforcement of COI and its Salient Features – Why Tamilnadu's "Sengol" in Parliament (1947 & 2023)- Samvidhan Divas - The Preamble. The Constitutional amendments in India - National Emergency, President Rule, Financial Emergency - Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT - II THE CENTRE: EXECUTIVE, LEGISLATIVE AND JUDICIARY 9

Meaning of Indian Flag & Ashoka Chakra. Indian Parliament – RS - LS – Power & Functions. Honourable "The President" & "The Vice President", "The Prime Minister" - Power &Functions - Comparison of Indian President with the United States - Central Ministry of Council. The Independence of the Supreme Court - Appointment of Supreme & High Courts Judges (Collegium) - Judicial Review, Judicial Activism, and PIL -, The Lokpal & Lok Ayuktas 2013 – NRC & CAA (Illegal Migrants) - Abrogation of Article 370 in J & K – Need of Uniform Civil Code.

UNIT - III THE STATE GOVERNMENT, UNION TERRITORIES STATE LEGISLATURE 9

Madras Presidency to Tamil Nadu – Tamil Nadu Emblem. State Executives – His Excellency "The Governor" Power & Functions, Chief Minister – Power & Functions, State Cabinet, Members of Legislative Assembly Role. Union Territories – Power &

Functions. Federal System, Centre-State Relations. High Court & Subordinate Courts-Lok Adalat 1982 Vs Arbitration Tribunal.

UNIT - IV LOCAL ADMINISTRATION 9

Corporation – Mayor, Chairman District Administration Head - Role and Importance, Role of Elected Representative – Pachayati Raj: Functions PRI – Grama Sabha. Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy.

UNIT - V ELECTION SYSTEMS AND E-GOVERNANCE 9

Election Commission: Role of Chief Election Commissioner - State Election Commission – One India One Election. National Good Governance Day - Governance and role of Engineers in E-Governance, Need for reformed engineering serving at the Centre and State, E- Courts, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will identify and explore the basic features and modalities about Indian constitution.
2. Students will differentiate and relate the functioning of 3 wings of India.
3. Students will understand the state level executives and state courts
4. Students will identify the role of Mayor and elected representatives of Municipalities
5. Students will know the role of Election Commission apply knowledge and E-governance

REFERENCE BOOKS:

1. BR. Ambedkar, Rupa Publications. The Constitution of India. Rupa Publications. 2024.
2. Singh, M. P. (Ed.). EBC's V. N. Shukla's Constitution of India (14th ed., reprint 2024). Eastern Book Company.
3. Bakshi, P. M The Constitution of India (19th ed.). Universal Law Publishing (LexisNexis) 2023.
4. Babu, D. D. Introduction to the Constitution of India (27th ed.). Lexis Nexis 2024.
5. Sharma, B. K. Introduction to the Constitution of India (11th ed.). PHI Learning 2024.

BAM303	PUBLIC PERSONNEL ADMINISTRATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand the fundamental principles, scope, and evolution of Public Personnel Administration.
- To analyze different types of personnel systems and their relevance in democratic governance.
- To examine the processes of recruitment, training and promotion within the public sector.
- To gain insights into the structure and functioning of All India Services and State Public Service Commissions.
- To evaluate employer-employee relations, wage systems and benefits in the context of public sector employment

UNIT - I INTRODUCTION TO PERSONNEL ADMINISTRATION 9

Meaning, Scope and Importance of Personnel Administration - Evolution of Public Personnel Administration-Personnel Administration vs. Human Resource Management – Challenges in Personnel Administration – Types of Personnel Systems Bureaucratic, Democratic and Representative systems- Emerging Trends in Personnel Administration

UNIT - II PERSONNEL SYSTEMS AND ADMINISTRATIVE ETHICS 9

Generalist Vs Specialist – Comparative Analysis of Personnel Systems – Role of Civil Servants in Policy Implementation - Relationship between Civil Servants and Political Executives - Mechanisms for Promoting Administrative Accountability-Civil Servant's Relationship with Political Executive – Ethics and Integrity in Administration - Mechanisms for Promoting Administrative Accountability

UNIT - III RECRUITMENT, TRAINING AND PROMOTION 9

Recruitment: Direct Recruitment and Recruitment from Within – Methods of Manpower Planning- Training: Objectives and Need –Types of Training: Induction, In-service, Orientation, Refresher - Performance Appraisal and Merit-based Promotion – Promotion

UNIT - IV PUBLIC SERVICE FRAMEWORK IN INDIA 9

All India Services – Structure and Cadre Management – Rules and Regulations Governing Service Conditions – Code of Conduct and Disciplinary Actions –State Public Service Commissions: Functions and Autonomy - UPSC and Its Constitutional Mandate - Reservation Policy in Services - Gender Sensitization and Inclusivity in Services.

UNIT - V EMPLOYEE RELATIONS AND COMPENSATIONS 9

Employer Employee Relations – Wage Theories and Compensation Models – Principles of Pay Fixation -Salary Structures in Indian Civil Services –Salary Structures in Indian Civil Services –Social Security Benefits and Retirement Schemes - Wage and Salary Administration – Allowances and Benefits

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will demonstrate a comprehensive understanding of the nature, scope, and importance of public personnel administration
2. Students will be able to distinguish between bureaucratic, democratic, and representative personnel systems in public administration.
3. Students will apply knowledge of recruitment, training and promotion practices to real-world administrative scenarios.
4. Students will critically analyze the structure and functioning of the All India Services and State Public Service Commissions.
5. Students will evaluate wage and salary administration, allowances and employee relations within the framework of public sector employment.

REFERENCE BOOKS:

1. Public Personnel Administration, 6th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2015.
2. Personnel Management in Government, 7th Ed, by R. Wayne Boss 2016.
3. Human Resource Management in Public Service, 5th Ed, by Richard C. Kearney, Jerrell D. Coggburn 2015.

4. Public Administration: An Introduction, 12th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2019.
5. Public Personnel Management, 4th Ed, by Donald E. Klingner, John Nalbandian 2018

BAM304	ADMINISTRATIVE THEORIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce students to the evolution of administrative thought
- To study the contributions of key administrative thinkers
- To develop an understanding of leadership, governance, and management principles
- To relate classical theories to contemporary administrative practices
- To enhance analytical and critical thinking skills

UNIT - I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration. Public Administration - Introduction, Principles of Organization and Management, Public Policy and Governance, Administrative Structure in India, Ethics and Accountability in Public Administration, Technology and Public Administration, Contemporary Issues in Public Administration.

UNIT - II THEORIES OF ORGANIZATION 9

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory. Introduction to Organizations, Neo-Classical Theories, Modern Theories, Contemporary Approaches, Organization Design and Structure, Leadership and Motivation in Organizations, Applications to Modern Industry and Technology.

UNIT - III ORGANIZATIONAL BEHAVIOUR AND DESIGN 9

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design. Organizational Behaviour - Introduction, Individual Behaviour in Organizations, Group Behaviour and Team Dynamics, Leadership and Power, Conflict and Negotiation, Organizational Culture and Climate, Organizational Change and Development, Contemporary Issues in OB.

UNIT - IV MOTIVATION AND LEADERSHIP 9

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making Motivation - Definition and Importance, Content Theories, Process Theories. Leadership - Meaning, Roles, and Importance of Leadership, Leadership Theories. Decision Making - Nature and Types of Decisions, Decision-Making Process: Steps and Models. Contemporary Perspectives, Applications and Case Studies

UNIT - V ADMINISTRATIVE THINKERS 9

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard. Peter Drucker Introduction to Administrative Thought, Kautilya (Chanakya) - Arthashastra: Concepts of Governance and Statecraft. Woodrow Wilson - The Study of Administration as a discipline. Chester I. Barnard - The Functions of the Executive, Concept of Formal and Informal Organizations, Peter F. Drucker - Management by Objectives (MBO), Comparing Key Contributions: Classical vs Modern Perspectives. Administrative Principles in Startups, Tech Companies, and Government Projects

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will understand foundational ideas of administration
2. Students will be able to analyze different administrative and management theories
3. Students will apply classical principles to modern contexts
4. Students will be able to evaluate the role of leadership and ethics in administration
5. Students will develop problem-solving skills using administrative models

REFERENCE BOOKS:

1. R. K. Sapru – Administrative Theories & Management Thought, 3rd Edition, 2013
2. “Public Administration Theories & Principles” (Vidya R., Rajaram), Kindle 2024 Ed.
3. Fernando Lunenburg & Allen Irby – included in Development of Administrative Theory, SAGE Publications 2022
4. Global Encyclopedia of Public Administration, Public Policy, and Governance. Springer Publications, 2nd Edition, 2020
5. Administrative Theories: Approaches, Concepts and Thinkers in Public Administration, Rakesh Hooja, Ramesh K Arora 2007

BAM305	INDIAN ADMINISTRATIVE SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To understand the historical evolution and constitutional framework of Indian administration.
- To analyze the role and functioning of key constitutional authorities and administrative institutions.
- To explore the structure, functions, and challenges of local governance and grassroots administration.
- To examine the impact of coalition politics and the role of ethics in administrative integrity
- To evaluate the mechanisms for corruption control, including Ombudsman, Lokpal & Lok Ayukta.

UNIT - I INTRODUCTION TO INDIAN ADMINISTRATION 9

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India, Separation of powers and checks & balances in governance

UNIT - II LOCAL GOVERNMENT AND ADMINISTRATION 9

Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government, Role of Smart Cities & Urban Local Bodies in governance

UNIT - III CONSTITUTIONAL AMENDMENTS 9

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992, Implementation challenges and success stories of decentralized governance, Case studies on local governance reforms

UNIT - IV POLITICS AND ETHICS 9

Coalition politics in India, Integrity and Vigilance in Indian Administration, Role of transparency and accountability in governance (RTI Act, Citizen Charters), Ethical dilemmas in civil services and administrative ethics.

UNIT - V TECHNOLOGY IN ADMINISTRATION 9

Corruption–Ombudsman, Lokpal & Lok Ayuktha, Recent anti-corruption measures (Whistle blower Protection Act, Black Money laws), Digital governance and technology-driven transparency in administration

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will gain a comprehensive understanding of India's administrative system, governance structure, and reforms.
2. They will be able to critically assess the functioning of constitutional authorities and their influence on policymaking
3. Learners will develop the ability to analyze local governance models and propose solutions for administrative challenges.
4. They will demonstrate awareness of political dynamics, ethics, and accountability in governance.
5. Graduates will be equipped to evaluate anti-corruption measures and suggest improvements for transparent administration.

REFERENCE BOOKS:

1. S.R. Maheswari : Indian Administration - Orient Black Swan, Sixth edition, 2001
2. In dian Public Administration: Institutions and Issues by Rajni Arora & Ramesh K. Goyal - New Age International Publishers, Fourth edition, 2022
3. Indian Administration - Evolution and Practice by Bidyut Chakrabarty – SAGE Publications India Pvt, Ltd. First edition,2019
4. Khera. S.S : Administration in India – Asia Publishing House, Bombay, First edition,1964
5. Ramesh K. Arora : Indian Public Administration - New Age International Publishers, Fourth edition, 2022

BAM306	PUBLIC POLICY ADMINISTRATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To provide students with a comprehensive understanding of the meaning, nature, scope, and significance of public policy.
- To equip students with knowledge of various approaches to policy analysis and familiarize them with key models such as Dror's Optimal Model.
- To enable students to understand the stages of the policy-making process, including formulation, implementation, and evaluation.
- To analyze the role of institutions, bureaucracy, interest groups, and political parties in the public policy process.
- To introduce students to significant public policies in India, such as the New Economic Policy, Population Policy, Agricultural Policy, and Information Technology Policy.

UNIT - I INTRODUCTION TO PUBLIC POLICY 9

Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration – Importance and relevance of public policy in modern society.

UNIT - II POLICY APPROACHES 9

Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model- Comparison of different approaches.

UNIT - III POLICY FRAMEWORK 9

Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation – Feedback mechanism and Policy change.

UNIT - IV ROLE OF POLITICS IN POLICY FRAMEWORK 9

Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties – Role of Judiciary.

UNIT - V TECHNOLOGY IN POLICY FRAMEWORK 9

Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy – Digital India Initiative.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students can able to know the importance of public policy and its interdisciplinary connections, especially with political science and public administration.
2. Students can able to assess different approaches and models used in policy analysis, including institutional, incremental, systems approaches, and Dror's Optimal Model.
3. Students will understand the stages involved in the policy-making process, from formulation through to evaluation.
4. Students can able to analyze the institutional framework and the roles played by bureaucracy, political parties, and interest groups in policy-making.
5. Students can able to evaluate the key public policies in India, understanding their context, objectives, and impacts.

REFERENCE BOOKS:

1. Anderson, J. E., Moyer, J., & Chichirau, G. Public Policymaking: An Introduction (9th ed.). New Delhi, India: Cengage India 2023.
2. Bardach, E., & Patashnik, E. M. A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving (7th ed.). Washington, DC: CQ Press 2023.
3. Cairney, P. Understanding Public Policy: Theories and Issues (2nd ed.). London: Bloomsbury Academic 2024.
4. Kraft, M. E., & Furlong, S. R. (Public Policy: Politics, Analysis, and Alternatives (8th ed.). Thousand Oaks, CA: CQ Press 2023.
5. Smith, K. B., & Larimer, C. W. The Public Policy Theory Primer (3rd ed.). New York, NY: Routledge 2017.

VERTICAL IV: BUSINESS DATA ANALYTICS

BAM401	STATISTICS FOR MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To apply statistical methods to analyze engineering and management problems.
- To use descriptive statistics and probability theory to summarize, interpret, and present engineering and business data effectively.
- To employ inferential statistical tools such as hypothesis testing, confidence intervals, and regression analysis to solve real-world management and engineering problems.
- To utilize statistical software/tools to perform data analysis and interpret output for strategic planning, quality control, and operational efficiency.
- To develop problem-solving skills by applying statistical reasoning to project management, production processes, and optimization in engineering enterprises.

UNIT - I INTRODUCTION 9

Concepts of Experiment, Event, Sample Space, Basic definitions and addition and multiplication rules for probability, Baye's theorem and random variables, Importance of Statistics in Business and Engineering, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT - II SAMPLING DISTRIBUTION AND ESTIMATION 9

Introduction to Sampling, Population vs. Sample, Concept of a Sampling Distribution, Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters. Confidence Interval for the Mean (Known and Unknown Population Variance)

UNIT - III TESTING OF HYPOTHESIS - PARAMETRIC TESTS 9

Introduction to Hypothesis Testing - Definition and Importance of Hypothesis Testing in Engineering and Business, Basic Concepts: Null Hypothesis (H_0), Alternative Hypothesis (H_1), Type I and Type II Errors, Significance Level (α) and Power of a Test, p-Value: Concept and Interpretation. Parametric Tests for Mean (t-test), Parametric Tests for Proportions (Z-test), Analysis of Variance (ANOVA).

UNIT - IV TESTING OF HYPOTHESIS - NON-PARAMETRIC TESTS 9

Introduction to Non-Parametric Tests, Differences Between Parametric and Non-

Parametric Tests, Sign Test (Concept of the Sign Test for One-Sample Data), Mann-Whitney U Test (Wilcoxon Rank-Sum Test), Wilcoxon Signed-Rank Test (Testing Differences for Paired Data), Kruskal- Wallis H Test (Testing for Differences Between More Than Two Independent Groups), Chi- Square Test for Goodness of Fit (Goodness of Fit Test, Test for Independence, Analyzing Relationships Between Categorical Variables), Friedman Test (Non-Parametric Test for Comparing More Than Two Related Groups).

UNIT - V CORRELATION AND REGRESSION 9

Introduction to Correlation and Regression, Correlation Analysis - Pearson's Correlation Coefficient (r), Spearman's Rank Correlation. Simple Linear Regression - Introduction to Regression Analysis, Simple Linear Model, Multiple Linear Regression, Applications of Correlation and Regression in Engineering - Quality Control and Six Sigma, Reliability Engineering, Optimization Problems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will be able to facilitate objective solutions in business decision making.
2. Students will understand and solve business problems.
3. Students will apply statistical techniques to data sets, and correctly interpret the results.
4. Students will develop skill-set that is in demand in both the research and business environments.
5. Students will be able to apply the statistical techniques in a work setting.

REFERENCE BOOKS:

1. Richard I. Levin, David S. Rubin, Masood H Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2. Fundamentals of Mathematical Statistics, by S.C. Gupta and V.K. Kapoor Revised Edition 2020.
3. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
4. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
5. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.

BAM402	DATA MINING FOR BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To familiarize students with the fundamental principles and scope of datamining and business intelligence.
- To develop an understanding of data preparation and data quality issues in business analytics.
- To explain key datamining techniques such as classification, clustering, and association rule mining from a business view point.
- To expose students to the practical applications of datamining in various business functions.
- To sensitize students to the ethical, strategic and managerial implications of using datamining for decision-making.

UNIT - I INTRODUCTION TO DATAMINING AND BUSINESS INTELLIGENCE **9**

Data Mining – Definition – Purpose – Role in Business Intelligence – Scope – Importance in Managerial Decision-Making – Difference between Data Mining and Business Analytics – Knowledge Discovery in Databases (KDD) – CRISP – DM Methodology – Phases of Data Mining Process – Applications in Business – Benefits and Limitations – Organizational Challenges in Data Mining Implementation.

UNIT - II DATA PREPARATION AND DATA UNDERSTANDING **9**

Types and Sources of Business Data – Structured and Unstructured Data–Importance of Data Quality – Data Cleaning and Handling Missing Values – Data Normalization and Transformation – Exploratory Data Analysis (EDA) – Descriptive Statistics – Frequency Distributions–Data Visualization Techniques–Graphs and Charts–Use of Dashboards for Business Insights – Role of EDA in Business Decision-Making.

UNIT - III CORE DATA MINING TECHNIQUES **9**

Overview of Data Mining Techniques – Classification – Concept and Applications –

Decision Trees – Logistic Regression – Business Use Cases – Clustering – Concept and Business Use –Customer Segmentation – Behavioral Grouping – Association Rule Mining – Market Basket Analysis– Support, Confidence and Lift – Interpretation of Rules – Use in Retail and Marketing–Non- Technical Overview of Techniques.

UNIT - IV FUNCTIONAL APPLICATIONS OF DATA MINING IN BUSINESS 9

Applications in Marketing–Customer Profiling–Targeted Campaigns– Churn Prediction– Applications in Finance – Risk Assessment – Credit Scoring – Fraud Detection – Applications in HR – Employee Attrition – Workforce Analytics – Applications in Operations–Demand Forecasting – Inventory Optimization – Vendor Analysis – Real-Life Business Use Cases – Managerial Interpretation of Results.

UNIT - V MANAGERIAL PERSPECTIVES, ETHICS AND EMERGING TRENDS 9

Managerial Role in Business Intelligence – Framing Business Problems – Interpretation of Data Mining Results – Reporting and Communication of Insights – Ethical Issues – Data Privacy – Consent – Algorithmic Bias – Transparency – Recent Trends – Self–Service BI–Real- Time Analytics – Augmented Intelligence – Role of Managers in Promoting Data-Driven Culture–Challenges and Future Opportunities.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will be able to explain the core concepts and process models used in data mining and business intelligence.
2. Students will recognize the importance of data quality, organization and visualization in deriving insights.
3. Students will be able to interpret the basic logic of classification, clustering, and association rules with practical business examples
4. Students will be able to apply conceptual knowledge of datamining techniques to functional business problems.
5. Students will be able to evaluate the role of ethics, managerial insight and business context in the implementation of data-driven strategies.

REFERENCE BOOKS:

1. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Analytics: Concepts, Techniques, and Applications with XL Miner, 3rd Edition, 2016, Wiley.
2. U Dinesh Kumar, Business Analytics: The Science of Data – Driven Decision Making, 2nd Edition,2020, Wiley India Pvt. Ltd.
3. V. Rameshand K.N. Prasad, Data Mining and Data Warehousing, 2nd Edition,2020, Wiley India Pvt. Ltd.
4. V.P Jain, Data Mining Techniques for Marketing, Sales, and Customer Relationship Management,1st Edition,2016, BPB Publications.
5. Anil Maheshwari, Data Analytics Made Accessible, 2nd Edition, 2017, Amazon Digital Services LLC.

BAM403	HUMAN RESOURCE ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common work force issues and resolving the musing people analytics.
- The learners will be conversant about HR metrics and ready to apply at work settings

UNIT - I INTRODUCTION TO HR ANALYTICS 9

HR analytics - People Analytics: Definition- context - stages of maturity - Human Capital in the Value Chain: impact on business. HR Analytics vs HR Metrics – HR metrics and KPIs.

UNIT - II HR ANALYTICS I: RECRUITMENT 9

Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire- Recruitment to HR cost - Recruitment analysis.

UNIT - III HR ANALYTICS II: TRAINING AND DEVELOPMENT 9

Training & Development Metrics: Percentage of employee trained- Internally and externally trained-Training hours and cost per employee - ROI -Optimising the ROI of HR Programs - Training and Development analysis.

UNIT - IV HR ANALYTICS III: EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics: Talent Retention - Retention index - Voluntary and

involuntary turnover- Turnover by department, grades, performance, and service tenure - Internal hired index - Engagement Survey Analysis. Career Progression Metrics : Promotion index - Rotation index - Career path index - Level wise succession readiness index.

UNIT - V HR ANALYTICS IV: WORK FORCE DIVERSITY AND DEVELOPMENT **9**

Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling- Churn over index - Workforce diversity index - Gender mix - Differently abled index- Revenue per employee – Operating cost per employee - PBT per employee - HR cost per employee- HR budget variance - Compensation to HR cost.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will be conversant about HR metrics and ready to apply at work settings.
2. Students will be able to resolve HR issues using people analytics**.**
3. Students will gain knowledge about analytics of training and development.
4. Students will know about the analytics of employee engagement and career progression
5. Students are competent in the analytics of work force diversity and development

REFERENCE BOOKS:

1. Ferrar, J., & Green, D. Excellence in People Analytics: How to Use Data to Create Value and Drive Business Success (2nd ed.). Kogan Page. 2021.
2. Soundararajan, R., & Singh, K. Winning on HR Analytics: Leveraging Data for Competitive Advantage. SAGE Publications Pvt. Ltd. 2022.
3. Edwards, M. R., Minbaeva, D., Levenson, A., &Huselid, M. A. (Eds.). Workforce Analytics: A Global Perspective. Routledge. 2023.
4. Jang, D., Edwards, M., & Edwards, K. Using R in HR Analytics. Kogan Page 2023.
5. Lochab, A., Duhan, P., &Dangi, H.K. HR Analytics: Concepts and Applications. S. Chand Publishing. 2025.

BAM404	MARKETING AND SOCIAL MEDIA WEB ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To showcase today's opportunities to leverage the power of marketing on the web and social media through web analytics.
- Understand the role of social media web analytics within the digital marketing landscape.
- Identify, define, and interpret commonly used web metrics and KPIs.
- Understand analytical methods to transform social media data into marketing insights.
- Understand the process of search engine optimization and the search behaviors of customers

UNIT - I MARKETING ANALYTICS 9

Introduction to Marketing Analytics - Marketing Budget and Marketing Performance Measure, Marketing Metrics and Its Applications - Financial Implications of Various Marketing Strategies- Geographical Mapping, Data Exploration, Market Basket Analysis.

UNIT - II COMMUNITY BUILDING AND MANAGEMENT 9

The History and Evolution of Social Media, Understanding the Science of Social Media, Goals for Using Social Media, Social Media Audience and Influencers, Keys to Community Building, Promoting Social Media Pages, Linking Social Media Accounts, The Viral Impact of Social Media, and Social Media as a Business.

UNIT - III SOCIAL MEDIA POLICIES AND MEASUREMENTS 9

Social Media Policies-Etiquette, Privacy- Ethical Problems Posed by Emerging Social Media Technologies - The Basics of Tracking Social Media. - Social Media Analytics-Insights Gained from Social Media- Customized Campaign Performance Reports - Observations of Social Media Use.

UNIT - IV WEB ANALYTICS 9

Web Analytics—Present and Future—Data Collection—Importance and Options,

Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of A Successful Web Analytics Strategy, Web Analytics Fundamentals, Concepts, Proposals & Reports, Web Data Analysis.

UNIT - V SEARCH ANALYTICS 9

Search Engine Optimization (SEO), User Engagement, User-Generated Content, Web Traffic Analysis, Navigation, Usability, Eye Tracking, Online Security and Ethics, Content Management System, Data Visualization. RSS Feeds, Mobile Platforms, Understanding Search Behaviors

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. The students will understand Marketing in Social Media, Web, and Social Media Analytics and their Potential Impact.
2. The students will be able to enhance their social media marketing skills.
3. The students can develop a mass communication strategy and guide marketing campaigns.
4. The students will understand the fundamentals and concepts of web analytics.
5. The students will learn to use the resulting insights effectively to support website design decisions, campaign optimisation, search analytics, etc.

REFERENCE BOOKS:

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013.
2. Christian Fuchs, Social Media: A Critical Introduction, Sage Publications Ltd, 2014.
3. Bittu Kumar, Social Networking, V & S Publishers, 2013.
4. Avinash Kaushik, Web Analytics - An Hour A Day, Wiley Publishing, 2007.
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media And Cafepress 2004

BAM405	OPERATION AND SUPPLY CHAIN ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce students to the foundational concepts of analytics and their strategic role in transforming supply chains using descriptive, predictive, and prescriptive methods.
- To equip learners with quantitative tools for warehousing decisions, including mathematical programming and heuristic methods for facility layout and space optimization.
- To develop an in-depth understanding of inventory management techniques, emphasizing risk analysis, aggregation models, and multi-echelon planning.
- To provide analytical skills to model and solve complex transportation and distribution network problems using graph theory, flow models, and routing algorithms.
- To enable application of Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, and TOPSIS in supply chain decision scenarios

UNIT - I INTRODUCTION 9

Introduction to analytics – descriptive, predictive, and prescriptive analytics, Data-driven supply chains, Road map for data-driven supply chains. Transforming supply chains, Barriers to implementation of supply chain strategies.

UNIT - II WAREHOUSING DECISIONS 9

Mathematical programming models - P-median methods - Guided LP approach - Balmer–Wolfe method, Greedy drop heuristics, Dynamic location models, Space determination and layout methods.

UNIT - III INVENTORY MANAGEMENT 9

Inventory aggregation models - Dynamic lot sizing methods, Multi-echelon inventory models, Aggregate inventory system and limit, Risk analysis in the supply chain - Measuring transit risks, Supply risks, Delivering risks, and risk pooling strategies.

UNIT - IV TRANSPORTATION NETWORK MODELS 9

The notion of graphs, Minimal spanning trees, Shortest path algorithms, Maximal flow problems, Multistage transhipments, and transportation problems, Set covering and set partitioning problems, Traveling salesman algorithms, and deficit function approach, Scheduling Algorithms.

UNIT - V MCDM MODELS 9

Multi-Criteria Decision-Making (MCDM) Techniques, Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the Analytical Network Process (ANP), TOPSIS-Application in SCM.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will understand and explain the concepts of descriptive, predictive, and prescriptive analytics and their role in enhancing data-driven supply chain decision-making.
2. Students will apply mathematical programming and heuristic methods such as P-median, Guided LP, and Greedy Drop techniques to make effective warehousing and location decisions.
3. Students will analyze and manage inventory using aggregation models, multi-echelon systems, and risk pooling strategies to improve supply chain resilience and efficiency.
4. Students will solve transportation network problems using graph-based algorithms like shortest path, maximal flow, and traveling salesman models to optimize logistics performance.
5. Students will evaluate complex supply chain scenarios using Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, TOPSIS, and fuzzy logic for better strategic decision- Making.

REFERENCE BOOKS:

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.

2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.
3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
4. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management ,
5. I.K. International Publishing House Pvt. Ltd., 2016.

BAM406	FINANCIAL ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares

- To introduce fundamental financial concepts and decision-making techniques relevant to corporate finance.
- To familiarize students with the basics of financial markets and time-series analysis techniques for estimating risk and return.
- To provide insights into portfolio theory and option pricing models used for investment analysis.
- To expose students to basic technical indicators and simulation strategies for analyzing stock market behavior.
- To enable students to understand and apply basic credit risk models using statistical and machine learning techniques.

UNIT - I FOUNDATIONS OF CORPORATE FINANCIAL ANALYSIS 9

Introduction to financial analytics. Basic financial models – Time value of money, cash flow analysis, cost of capital. Project appraisal methods – Payback period, NPV, IRR. Capital budgeting and financial break-even analysis.

UNIT - II FINANCIAL MARKET DATA AND TIME-SERIES ANALYSIS 9

Introduction to financial market instruments – Stocks and Bonds. Basics of risk and return. Overview of financial data and Time-Series characteristics. Introduction to Value at Risk (VaR). Basics of Auto Regressive Moving Average (ARMA), Autoregressive Conditional Heteroscedasticity (ARCH), and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models for volatility forecasting

UNIT - III PORTFOLIO THEORY AND DERIVATIVES 9

Portfolio diversification and risk-return trade-off. Capital Asset Pricing Model (CAPM). Sharpe ratio. Option pricing basics – Binomial model, Black-Scholes model. Implied volatility and option strategies.

UNIT - IV TECHNICAL ANALYSIS AND TRADING SIMULATIONS 9

Overview of technical indicators – Relative Strength Index (RSI), Moving Average

Convergence Divergence (MACD), Rate of Change (ROC), Moving Averages, Candlestick patterns. Simulation of basic trading strategies. Introduction to algorithmic trading concepts. Prediction of stock prices using chart patterns.

UNIT - V CREDIT RISK ANALYTICS 9

Introduction to credit risk. Data pre-processing for credit modelling. Logistic regression, decision trees, and model evaluation techniques. Application of analytics in credit scoring and loan approvals, and evaluating credit risk model.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will apply core financial concepts to evaluate corporate investment decisions using tools like NPV and IRR.
2. Students will analyze risk and return using financial time-series models and interpret key market indicators.
3. Students can able to construct and assess investment portfolios and derivative strategies using theoretical models.
4. Students will use basic technical analysis indicators and simulate simple trading strategies.
5. Students can develop and evaluate credit risk models using statistical methods like logistic regression and decision trees.

REFERENCE BOOKS:

1. Mark J. Bennett, Dirk L. Hugen, "Financial Analytics with R: Building a Laptop Laboratory for Data Science", Cambridge University Press, 1st Edition, 2016.
2. Pavel Ryzhov, "Haskell Financial Data Modeling and Predictive Analytics", Packt Publishing, 1st Edition, 2013.
3. Edward E. Williams, John A. Dobelman, "Quantitative Financial Analytics: The Path to Investment Profits", World Scientific Publishing, 1st Edition, 2017.
4. Yuxing Yan, "Python for Finance – Second Edition: Apply Powerful Finance Models and Quantitative Analysis with Python", Packt Publishing, 2nd Edition, 2017.
5. James Ma Weiming, "Mastering Python for Finance – Second Edition: Implement Advanced State-of-the-Art Financial Statistical Applications Using Python", Packt Publishing, 2nd Edition, 2019.

VERTICAL V: ENVIRONMENT AND SUSTAINABILITY

AGM501	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about sustainable Infrastructure development goals.
- To practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
- To understand how infrastructure projects are conceptualised and planned and the project lifecycle phases
- To learn concepts related to infrastructure economics and finance, including various project feasibility models
- To understand and assess the use of various risk management processes and practices in the context of infrastructure projects

UNIT- I SUSTAINABLE DEVELOPMENT GOALS 9

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian — Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands — Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian — Infrastructure Project finance — Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT- II SUSTAINABLE INFRASTRUCTURE PLANNING 9

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning —

Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT- III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES 9

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction — Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT- IV SUSTAINABLE CONSTRUCTION MATERIALS 9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility — Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization — Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations — Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC — Case studies.

UNIT- V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS 9

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management -

Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. — Use of Emerging Technologies — IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the environment sustainability goals at global and Indian scenario.
2. Understand risks in development of projects and suggest mitigation measures.
3. Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
4. Explain Life Cycle Analysis and life cycle cost of construction materials.
5. Explain the new technologies for maintenance of infrastructure projects.

TEXTBOOKS:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine

REFERENCE BOOKS:

1. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press.
2. Munier N, "Introduction to Sustainability", Springer 2005.
3. Sharma, “Sustainable Smart Cities In India: Challenges And Future Perspectives”, SPRINGER, 2022.
4. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009

5. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010

AGM501	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	1	1	-	2	3	1	1	-	2	1	1	2	1	-
CO2	3	1	3	2	1	2	2	-	1	1	1	2	2	2	2	-
CO3	2	2	3	1	1	1	1	-	-	-	1	1	1	3	1	-
CO4	3	1	3	2	2	1	3	1	1	1	1	2	2	2	2	-
CO5	3	1	2	2	2	2	3	1	-	1	1	2	2	3	2	-
Average	3	1	3	2	2	2	3	1	1	1	1	2	2	3	2	-

AGM502	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems,
- To introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.
- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT- I AGROECOLOGY , AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS **9**

Ecosystem definition - Biotic *Vs*. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems.

UNIT- II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT **9**

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control.

UNIT- III WATER MANAGEMENT **9**

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use.

UNIT- IV ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture.

UNIT- V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production **-** Goals and components of a community food system - Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able

1. Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
2. Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
3. Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
4. Develop energy and waste management plans for promoting sustainable agriculture in non- sustainable farming areas
5. Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

TEXTBOOKS:

1. Approaches to Sustainable Agriculture — Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.

3. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
4. Saroja Raman, “Agricultural Sustainability – Principles, Processes and Prospects”, CRC Press, 2013.
5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

REFERENCE BOOKS:

1. Agricultural Economics and Agribusiness, Cramer, Jensen, and Southgate, John Wiley.
2. Agricultural Economics, Drummond and Goodwin, Prentice Hall.
3. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.
4. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020
5. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.

AGM502	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	2	-	-	-	-	-	2	-	2	-	-	2	2	-	-
CO2	-	2	-	2	2	2	-	-	-	-	-	-	3	2	-	-
CO3	-	-	-	2		2	-	-	-	-	-	-	3	2	3	-
CO4	3	2	-	-	2	-	-	2	2	2	2	-	3	2	3	-
CO5	-	2	3	2	-	-	1	-	-	-	-	1	-	2	-	-
Average	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3	-

AGM503	SUSTAINABLE BIO MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT- I INTRODUCTION TO BIOMATERIALS 9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

UNIT- II BIO POLYMERS 9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT- III BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Compsite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT- IV METALS AS BIOMATERIALS 9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants — biological tolerance of implant metals

UNIT- V NANOBIOMATERIALS 9

Steel construction, Types of steel used for construction, Methods of utilizing steel construction, Advantages and Applications of steel in construction.

Advanced Materials: Adhesives in construction industry-Acrylics, Bridge bearings, Industrial waste materials in concrete Rapid wall panels, Moisture Barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will gain familiarity with Biomaterials and they will understand their importance.
2. Students will get an overview of different biopolymers and their properties
3. Students gain knowledge on some of the important Bioceramics and Biocomposite materials
4. Students gain knowledge on metals as biomaterials
5. Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

TEXTBOOKS:

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.
2. Donglu shi “Introduction to Biomaterials” Tsinghua University press, 2006.
3. Joon Park, R.S.Lakes “Biomaterials An Introduction” third edition, Springer 2007.
4. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh “Characterization of Biomaterials” Wood head publishing, 2013.
5. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.

REFERENCE BOOKS:

1. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018
2. Leopoido Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.
3. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.
4. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.
5. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

AGM503	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	1	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	2	1	-	-	-	-	-	-	-	-	-	-
Average	**2.2**	**1.8**	**1.8**		**1.7**	**1**	-	-	-	-	-	-	-	-	-	-

AGM504	MATERIALS FOR ENERGY AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the students about the challenges and demands of energy sustainability.
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell.
- To enable students to appreciate novel materials and their usage in photovoltaic application.
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT- I SUSTAINABLE ENERGY SOURCES 9

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy.

UNIT- II ELECTROCHEMICAL DEVICES 9

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).

UNIT- III FUEL CELLS 9

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton

conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT- IV PHOTOVOLTAICS 9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)

UNIT- V SUPERCAPACITORS 9

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance — electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)-Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels — Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two -Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will acquire knowledge about energy sustainability and principles of different electrochemical devices and working of fuel cells and their application.
2. The students gain knowledge on different types of supercapacitors and the performance of various materials.
3. Comprehend and learn concepts related to building automation hardware and software and their application in smart buildings
4. Examine and apply lighting control, air conditioning and related applications in the context of smart buildings
5. Assess and apply other critical smart building applications and appreciate the role of data analytics in the control of building systems

TEXTBOOKS:

1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.
3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.
4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

REFERENCE BOOKS:

1. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
2. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.
3. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today:

Proceedings, 2022.

4. Raphael, B. (2022). Construction and Building Automation: From Concepts to Implementation. Routledge.
5. Sinopoli, J. M. (2009). Smart buildings systems for architects, owners and builders. Butterworth-Heinemann.

AGM504	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	-	-	-	1	-	-	2	-	3	1	-
CO3	-	-	-	3		1	2	-	-	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	1	-	-	3	-	1	-	2	-
CO5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	**1.5**	**-**	**-**	**3**	**-**	**1**	**2**	**2**	**1.5**	**-**	**3**	**2**	**1.5**	**2.5**	**1.5**	**2**

AGM505	GREEN TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To understand the principles of green chemistry and eco friendly methodologies.
- To create awarenes on Clener development mechanisms.
- To develop concepts on various energy efficient systems and green buildings.
- To provide green engineering solutions to energy demand, reduced energy

UNIT- I PRINCIPLES OF GREEN CHEMISTRY 9

Introduction to green chemistry and technology. Twelve principles of green chemistry, Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

UNIT- II POLLUTION TYPES 9

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT- III GREEN REAGENTS AND GREEN SYNTHESIS 9

Cleaner development technologies Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling. Oxidation technology for waste water treatment- Cavitation, Fenton chemistry, photocatalysis and hybrid processes.

UNIT- IV DESIGNING GREEN PROCESSES 9

Energy efficient systems and processes Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly

materials in manufacturing, design and implementation of sustainable green production systems.

UNIT- V GREEN NANOTECHNOLOGY 9

Green Buildings Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Ecofriendly and cost effective materials, Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand the principles of green engineering and technology
2. To learn about pollution using hazardous chemicals and solvents
3. To modify processes and products to make them green and safe.
4. To design processes and products using green technology.
5. To understand advanced technology in green synthesis.

TEXTBOOKS:

1. Soli J. Arceivala, "GREEN TECHNOLOGIES", McGraw Hill Education,2017.
2. Khan B.H, Non conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
3. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.
4. Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi 2009.
5. Paul L. Bishop, Pollution prevention–Fundamentals and Practices, McGraw-Hill- international 2000.

REFERENCE BOOKS:

1. Ritu Dogra,"Renewable Energy and Green Technology", Brillion Publishing, 2023.
2. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications,2008

3. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017
4. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
5. Sambit Kumar Mishra, Zdzislaw Polkowski, Samarjeet Borah, Ritesh Dash, “AI in Manufacturing and Green Technology: Methods and Applications” CRC Press, 2021.

AGM505	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
CO5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.0	2.0	2.0	3.0	0	0	3.0	0	2.0	1.0	1.0	2.0	1.0

AGM506	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.
- To know the analytical and instrumental methods to measure various IEQ parameters
- To familiarize the regulations, standards and guidelines of IEQ
- To learn the fundamentals of computational fluid dynamics (CFD)

UNIT- I ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction to indoor environmental quality – Parameters: Thermal Comfort - thermal balance of human body – instrumentation and measurement - impact of thermal comfort on human productivity and health.

UNIT- II MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme- International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT- III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT- IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT **9**

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification- exposure assessment- dose-response assessment; risk characterization.

UNIT- V AUTOMATED DATA ACQUISITION AND PROCESSING **9**

Fundamentals of mass transport – definition of intraphase and inter-phase chemical flux; interphase mass transport, diffusion coefficient and convenction mass transfer coefficients. Chemical Exchange between air-water Overall transport model and scenarios.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will know

1. Basic concepts of environmental standards and monitoring.
2. The ambient air quality and water quality standards;
3. The various instrumental methods and their principles for environmental monitoring.
4. The significance of environmental standards in monitoring quality and sustainability of the environment.
5. The various ways of raising environmental awareness among the people.

TEXTBOOKS:

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc.
3. Pengler, J.D.; McCarthy, J.F.; Same, J.M., Indoor Air Quality Handbook. McGraw Hill, 2000.
4. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
5. Daoliang Li, Shuangyin Liu, “Water Quality Monitoring and Management” Elsevier, 2018.

REFERENCE BOOKS:

1. Nazaroff, W.W., and Alvarez-Cohen, L., Environmental Engineering Science. Wiley sons, Newyork, 2001.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3. Maroni, M.; Seifert, B.; Lindvall, T., Indoor Air Quality: A Comprehensive Reference Book. Elsevier Science Ltd, 1996.
4. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.
5. Nicolas Mazzeo, “Air Quality Monitoring, Assessment and Management”, IntechOpen.

AGM506	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
CO2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
CO4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	2.0	2.0	2.0	0.0	2.0	3.0	2.0	0.0	3.0	0.0	2.0	1.0	1.0	0.0	1.0