J.N.N INSTITUTE OF ENGINEERING

AUTONOMOUS

NAAC 'A' Grade | Approved by AICTE | Affiliated to Anna University

ACADEMIC CURRICULUM

(REGULATION 2022)

FOR

UNDER GRADUATE PROGRAMMES

CHOICE BASED CREDIT SYSTEM

(Applicable to the students admitted from the Academic Year 2022 –2023 onwards)

B.Tech- AGRICULTURAL ENGINEERING

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REGULATIONS 2022
B.Tech- AGRICULTURAL ENGINEERING

ABOUT THE DEPARTMENT:

Agricultural Engineering program was established in the year 2020 with intake of 30 students. Agricultural Engineering deals with the study of agricultural processes and usage of technology with the aim to improve efficiency in food production. Agriculture is the largest participant in the Indian Economy. It is needless to say that a career in Agriculture in India is nothing but bright and shining.

Agriculture Engineering is the area of engineering concerned with the design, construction and improvement of farming equipment and machinery. Agriculture Engineers integrate technology with farming. For example, they design new and improved farming equipment that may work more efficiently, or perform new tasks. They may also help engineer solutions for pollution control at large farms. They may also design food storage structures and food processing plants. Some may design housing and environments for livestock. They may also plan and oversee land reclamation projects on farms. Others may be involved in agricultural waste-to-energy projects and carbon sequestration (absorbing carbon dioxide from the atmosphere into the soil, crops and trees).

VISION:

To develop Agriculture Engineering professionals, create and disseminate knowledge, and promote the application of engineering principles to meet the societal needs with respect to agriculture, farm mechanization, irrigation, soil and water conservation.

MISSION:

1. To ensure effective teaching learning process for educating and training future Agricultural professionals to face various agricultural challenges.
2. To promote research and training on sustainable development of agricultural productivity, economic farming, smart farming techniques, food processing and irrigation systems.
3. To empower students with various aspects of agriculture through integrated teaching methodologies, advanced laboratory activities, field visits, extensive training workshops and guest lectures.

4. To maintain a good rapport with leading industries and Agri-tech companies to succeed in Industry Institute Collaboration for training students based on the latest industrial needs.

PROGRAMME EDUCATIONAL OBJECTIVES:

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.
5. To impart positive and responsive out their mission as Engineers. To reach attitudes, initiative and creative thinking in their mission as engineers.
6. To understand ethical issues and responsibility of serving the society and the environment at large.

PROGRAMME OUTCOMES (POs):

Graduates of the programme B.Tech. Agricultural Engineering will be able to:

PO1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - 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.

PO4 - 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.

PO5 - 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.

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

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

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

PO9 - Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - 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.

PO11- 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.

PO12 - 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

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO-1: To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill.

PSO-2: To enhance the ability of the students to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.

PSO-3: To inculcate entrepreneurial skills through strong Industry-Institution linkage.

B.Tech. AGRICULTURAL ENGINEERING
CURRICULUM FOR SEMESTERS I TO VIII AND
SYLLABI FOR SEMESTERS I TO VIII
SEMESTER I

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
MANDATORY COURSE										
*	22IP100	Induction Programme	-	-	-	-	-	03 Weeks	0	-
THEORY COURSES										
1	22HST101	Professional English	L+P	3	0	2	0	5	4	HSMC
2	22BST101	Basic Mathematics for Engineers	L	3	2	0	0	5	4	BSC
3	22BST102	Engineering Physics	L	3	0	0	0	3	3	BSC
4	22BST103	Engineering Chemistry	L	3	0	0	0	3	3	BSC
5	22EST101	Problem Solving and Python Programming	L	3	0	0	0	3	3	ESC
6	22HSM101	Heritage of Tamils	L	1	0	0	0	1	1	HSMC
EMPLOYABILITY ENHANCEMENT COURSE										
7	22EET102	Skill Development Training-I (Student READY)	L+P	1	0	2	0	3	2	EEC
PRACTICAL COURSES										
8	22ESP101	Problem Solving and Python Programming Laboratory	P	0	0	4	0	4	2	ESC
9	22BSP101	Physics and Chemistry Laboratory	P	0	0	4	0	4	2	BSC
EMPLOYABILITY ENHANCEMENT COURSE										
10	22EEP101	Product Tinkering Laboratory	P	0	0	2	0	2	1	EEC
			TOTAL	**17**	**02**	**14**	**00**	**33**	**25**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1		Language Elective	L+P	2	0	4	0	6	4	HSMC
2	22BST202	Statistics and Numerical Methods	L	3	2	0	0	5	4	BSC
3	22AGT201	Principles of Crop Production and Agronomy	L+P	2	0	2	0	4	3	PCC
4	22EST201	Basic Electrical, Electronics Engineering and Measurements	L	3	0	0	0	3	3	ESC
5	22EST202	Engineering Graphics	L+P	1	0	4	0	5	3	ESC
6	22HSM201	Tamils and Technology	L	1	0	0	0	1	1	HSMC
EMPLOYABILITY ENHANCEMENT COURSE										
7	22EET202	Skill Development Training-II (Student READY)	L	2	0	0	0	2	2	EEC
MANDATORY COURSE										
8		NCC/NSS/YRC Credit Course Level- I	-	1	0	0	0	1	1#	-
PRACTICAL COURSES										
9	22ESP201	Engineering Product Laboratory	P	0	0	3	0	3	1.5	ESC
10	22ESP202	Basic Electrical, Electronics Engineering and Measurements Laboratory	P	0	0	3	0	3	1.5	ESC
			TOTAL	**14**	**02**	**16**	**00**	**32**	**23**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

 # 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. *Common for all branches

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22BST303	Fourier Series and Linear Programming	L	3	2	0	0	5	4	BSC
2	22AGT301	Principles of Soil Science and Engineering	L	3	0	0	0	3	3	PCC
3	22AGT302	Unit Operations in Agricultural Processing	L+P	2	0	2	0	4	3	PCC
4	22AGT303	Fluid Mechanics and Pumps	L	3	0	0	0	3	3	PCC
5	22AGT304	Surveying and Levelling	L	3	0	0	0	3	3	PCC
PRACTICAL COURSES										
6	22AGP301	Fluid Mechanics Laboratory	P	0	0	4	0	4	2	PCC
7	22AGP302	Soil Science Laboratory	P	0	0	4	0	4	2	PCC
8	22AGP303	Surveying and Levelling Laboratory	P	0	0	4	0	4	2	PCC
			TOTAL	**14**	**02**	**14**	**00**	**30**	**22**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22AGT401	Tractors and Engine Systems	L	3	0	0	0	3	3	ESC
2	22AGT402	Soil and Water Conservation Engineering	L	3	0	0	0	3	3	PCC
3	22AGT403	Strength of Materials for Agricultural Engineering	L	3	0	0	0	3	3	PCC
4	22AGT404	Hydrology and Water Resources Engineering	L	3	0	0	0	3	3	PCC
5	22AGT405	Engineering Thermodynamics	L	3	0	0	0	3	3	ESC
MANDATORY COURSE										
6	22BST401	Environmental Sciences and Sustainability	L	2	0	0	0	2	2	BSC
7		NCC/NSS/YRC Credit Course Level- II	-	1	0	0	0	1	1#	-
PRACTICAL COURSES										
8	22AGP401	Tractors and Farm Engines Laboratory	P	0	0	4	0	4	2	PCC
9	22AGP402	Strength of Materials Laboratory	P	0	0	4	0	4	2	PCC
EMPLOYABILITY ENHANCEMENT COURSE										
10	22EEP401	Quantitative Analysis and Logical Reasoning-I	P	0	0	2	0	2	1	EEC
		TOTAL		**17**	**00**	**10**	**00**	**27**	**22**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**
 # 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 V

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22AGT501	Farm Equipment and Machinery	L	3	0	0	0	3	3	PCC
PROFESSIONAL ELECTIVE										
2		Professional Elective I	L	3	0	0	0	3	3	PEC
3		Professional Elective II	L	3	0	0	0	3	3	PEC
4		Professional Elective III	L	3	0	0	0	3	3	PEC
5		Professional Elective IV	L	3	0	0	0	3	3	PEC
MANDATORY COURSE										
6		Mandatory Course - I	L	3	0	0	0	3	0	MCC
ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
7		Minor/Honour/ remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES										
8	22AGP501	Farm Machinery Laboratory	P	0	0	4	0	4	2	PCC
9	22AGP502	ICT in Agricultural Engineering Laboratory	P	0	0	2	0	2	1	PCC
10	22AGP503	CAD for Agriculture Machinery Laboratory	P	0	0	4	0	4	2	PCC
EMPLOYABILITY ENHANCEMENT COURSE										
11	22AGP504	3 weeks Industrial Attachment /Internship		0	0	0	0	0	1	EEC
			TOTAL	**18**	**00**	**06**	**00**	**24**	**21**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

*** Common to all branches**

**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22AGT601	Post-Harvest Technology	L	3	0	0	0	3	3	PCC
2	22AGT602	Irrigation and Drainage Engineering	L	3	0	0	0	3	3	PCC
OPEN ELECTIVE										
3		Open Elective-I	L	3	0	0	0	3	3	OEC
PROFESSIONAL ELECTIVE										
4		Professional Elective - V	L	3	0	0	0	3	3	PEC
5		Professional Elective - VI	L	3	0	0	0	3	3	PEC
MANDATORY COURSE										
6		Mandatory Course - II	L	3	0	0	0	3	0	MCC
7		NCC/NSS/YRC Credit Course Level- III	-	1	0	0	0	1	1#	-
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
8		Minor/Honour/ remedial class**		3	0	0	0	3	3**	PEC**
PRACTICAL COURSES - EMPLOYABILITY ENHANCEMENT COURSE										
9	22AGP604	3 weeks Experiential Learning On campus		0	0	0	0	0	2	EEC
10	22EEP601	Quantitative Analysis and Logical Reasoning-II		0	0	2	0	2	1	EEC
11	22EEP602	Comprehensive Assessment*		0	0	1	0	1	1	EEC
PRACTICAL COURSES										
12	22AGP601	Post – Harvest Technology Laboratory	P	0	0	3	0	3	1.5	PCC
13	22AGP602	Irrigation Field Laboratory	P	0	0	3	0	3	1.5	PCC
			TOTAL	**18**	**00**	**13**	**00**	**31**	**22**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods

C- Credits CAT- Category

*** Common to all branches**

**** Common to all branches, selection from one minor vertical/approved honors subjects**
 # NCC Credit Course level III 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 VII

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22AGT701	Remote Sensing and Geographical Information System	L	3	0	0	0	3	3	PCC
2	22AGT702	Renewable Energy in Agricultural Engineering	L	3	0	0	0	3	3	PCC
3	22HST701	Total Quality Management	L	3	0	0	0	3	3	HSMC
OPEN ELECTIVE										
4		Open Elective-II	L	3	0	0	0	3	3	OEC
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
5		Minor/Honour/ remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES										
6	22AGP701	Remote Sensing and GIS Laboratory	P	0	0	4	0	4	2	PCC
7	22AGP702	Renewable Energy in Agricultural Engineering Laboratory	P	0	0	4	0	4	2	PCC
PRACTICAL COURSES - EMPLOYABILITY ENHANCEMENT COURSE										
8	22AGP703	Mini Project	J	0	0	0	4	4	2	EEC
9	22AGP704	Industrial Exposure Visit (Registration only)	J	0	0	0	0	0	1	EEC
		TOTAL		**12**	**00**	**08**	**04**	**24**	**19**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods

C- Credits CAT- Category
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
1		Minor/Honour/remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES - EMPLOYABILITY ENHANCEMENT COURSE										
2	22AGP801	Project Work	J	0	0	0	20	20	10	EEC
			TOTAL	**00**	**00**	**00**	**20**	**20**	**10**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category
**** Common to all branches, selection from one minor vertical/approved honors subjects**

LANGUAGE ELECTIVE

Language Elective Choose any one Elective (Semester II)							
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Contact Hours**	**Credits**
1	22LET201	Functional English	3	0	2	5	4
2	22LET202	French Language Level 1	2	0	4	6	4
3	22LET203	German Level A1.1	2	0	4	6	4
4	22LET204	Basic Japanese	2	0	4	6	4

MANDATORY COURSES – I & II

Mandatory Courses I – Choose any one Course (Semester V)							
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Contact Hours**	**Credits**
1	22MCT001	Introduction to Women and Gender Studies	3	0	0	3	0
2	22MCT002	Elements of Literature	3	0	0	3	0
3	22MCT003	Film Appreciation	3	0	0	3	0
4	22MCT004	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	3	0	0	3	0
5	22MCT007	Industrial Safety	3	0	0	3	0

Mandatory Courses II– Choose any one Course (Semester VI)							
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Contact Hours**	**Credits**
1	22MCT009	History of Science and Technology in India	3	0	0	3	0
2	22MCT010	Political and Economic Thought for a Humane Society	3	0	0	3	0
3	22MCT011	State, Nation Building and Politics in India	3	0	0	3	0
4	22MCT012	Disaster Risk Reduction and Management	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I Food Processing	VERTICAL II Farm Machinery and Energy	VERTICAL III Water Management and Protected Cultivation	VERTICAL IV IT and Agricultural Business Management
Refrigeration and Cold Storage	Farm Power and Machinery Management	Watershed Planning and Management	Integrated Farming System
Food and Dairy Engineering	Testing and Evaluation of Farm Machinery and Equipment	Groundwater and Well Engineering	Agricultural Business Management
Process Engineering of Fruits and Vegetables	Biochemical and Thermochemical Conversion of Biomass	Design of Micro-Irrigation System	Sustainable Agriculture and Food Security
Storage and Packaging Technology	Waste and by-Product Utilization	Protected Cultivation	Systems Analysis in Agricultural Engineering
Food Process Equipment and Design	Human Engineering and Safety in Farm Machinery Operations	On-farm Water Management	IT in Agricultural System
Food Plant Design and Management	Precision Farming Equipment	Irrigation Water Quality and Waste Water Management	Automation in Agriculture
Emerging Technologies in Food Processing	Solar and Wind Energy System	Climate Change and Adaptation	Landscape Architecture
Development of processed products	Mechanics of tillage and traction	Management of canal irrigation system	Software applications in soil & water
Engineering properties of agricultural produce	Tractor and farm machinery operation and maintenance	Land and water management applications using google earth engine	Fundamentals of management for engineers
Instrumentation and sensors in food processing	Hydraulic drives and control	Water harvesting and soil conservation structures	

Registration of Professional Elective Courses from Verticals:

- Professional Elective Courses will be registered in Semesters V and VI.
- 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.
- 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

PROFESSIONAL ELECTIVE COURSES

VERTICAL I: FOOD PROCESSING

SL. NO.	COURSE CODE	COURSE NAME	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AGPE01	Refrigeration and Cold Storage	PEC	3	0	0	3	3
2.	22AGPE02	Food and Dairy Engineering	PEC	3	0	0	3	3
3.	22AGPE03	Process Engineering of Fruits and Vegetables	PEC	3	0	0	3	3
4.	22AGPE04	Storage and Packaging Technology	PEC	3	0	0	3	3
5.	22AGPE05	Food Process Equipment and Design	PEC	3	0	0	3	3
6.	22AGPE06	Food Plant Design and Management	PEC	3	0	0	3	3
7.	22AGPE07	Emerging Technologies in Food Processing	PEC	3	0	0	3	3
8.	22AGPE08	Development of processed products	PEC	3	0	0	3	3
9.	22AGPE09	Engineering properties of agricultural produce	PEC	3	0	0	3	3
10.	22AGPE10	Instrumentation and sensors in food processing	PEC	3	0	0	3	3

VERTICAL II: FARM MACHINERY AND ENERGY

SL. NO.	COURSE CODE	COURSE NAME	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AGPE11	Farm Power and Machinery Management	PEC	3	0	0	3	3
2.	22AGPE12	Testing and Evaluation of Farm Machinery and Equipment	PEC	3	0	0	3	3
3.	22AGPE13	Biochemical and Thermochemical Conversion of Biomass	PEC	3	0	0	3	3
4.	22AGPE14	Waste and by-Product Utilization	PEC	3	0	0	3	3
5.	22AGPE15	Human Engineering and Safety in Farm Machinery Operations	PEC	3	0	0	3	3

6.	22AGPE16	Precision Farming Equipment	PEC	3	0	0	3	3
7.	22AGPE17	Solar and Wind Energy System	PEC	3	0	0	3	3
8.	22AGPE18	Mechanics of tillage and traction	PEC	3	0	0	3	3
9.	22AGPE19	Tractor and farm machinery operation and	PEC	3	0	0	3	3
10.	22AGPE20	Hydraulic drives and control	PEC	3	0	0	3	3

VERTICAL III: WATER MANAGEMENT AND PROTECTED CULTIVATION

SL. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AGPE21	Watershed Planning and Management	PEC	3	0	0	3	3
2.	22AGPE22	Groundwater and Well Engineering	PEC	3	0	0	3	3
3.	22AGPE23	Design of Micro-Irrigation System	PEC	3	0	0	3	3
4.	22AGPE24	Protected Cultivation	PEC	3	0	0	3	3
5.	22AGPE25	On-farm Water Management	PEC	3	0	0	3	3
6.	22AGPE26	Irrigation Water Quality and Waste Water Management	PEC	3	0	0	3	3
7.	22AGPE27	Climate Change and Adaptation	PEC	3	0	0	3	3
8.	22AGPE28	Management of canal irrigation	PEC	3	0	0	3	3
9.	22AGPE29	Land and water management	PEC	3	0	0	3	3
10.	22AGPE30	Water harvesting and	PEC	3	0	0	3	3

VERTICAL IV: IT AND AGRICULTURAL BUSINESS MANAGEMENT

SL. NO.	COURSE CODE	COURSE NAME	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AGPE31	Integrated Farming System	PEC	3	0	0	3	3
2.	22AGPE32	Agricultural Business Management	PEC	3	0	0	3	3
3.	22AGPE33	Sustainable Agriculture and Food Security	PEC	3	0	0	3	3
4.	22AGPE34	Systems Analysis in Agricultural Engineering	PEC	3	0	0	3	3
5.	22AGPE35	IT in Agricultural System	PEC	3	0	0	3	3
6.	22AGPE36	Automation in Agriculture	PEC	3	0	0	3	3
7.	22AGPE37	Landscape Architecture	PEC	3	0	0	3	3
8.	22AGPE38	Software applications in soil & water	PEC	3	0	0	3	3
9.	22AGPE39	Fundamentals of management for	PEC	3	0	0	3	3

OPEN ELECTIVES

OFFERED BY DEPARTMENT OF AGRICULTURAL ENGINEERING

OPEN ELECTIVES – I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AGOE01	Traditional Indian Foods	OEC	3	0	0	3	3
2.	22AGOE02	Biodiversity	OEC	3	0	0	3	3
3.	22AGOE03	Energy Conservation	OEC	3	0	0	3	3
4.	22AGOE04	Drinking Water Supply and	OEC	3	0	0	3	3
5.	22AGOE05	Renewable Energy Technologies	OEC	3	0	0	3	3

OPEN ELECTIVES – II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AGOE06	Remote Sensing Concepts	OEC	3	0	0	3	3
2.	22AGOE07	Introduction to food processing	OEC	3	0	0	3	3
3.	22AGOE08	Drone Technologies	OEC	3	0	0	3	3
4.	22AGOE09	Geographical Information System	OEC	3	0	0	3	3
5.	22AGOE10	Basics of Integrated Water Resources	OEC	3	0	0	3	3
6.	22AGOE11	Energy Technology	OEC	3	0	0	3	3
7.	22AGOE12	Fundamentals of Food	OEC	3	0	0	3	3
8.	22AGOE13	Food safety and Quality	OEC	3	0	0	3	3

CREDIT DISTRIBUTION

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	EEC	MC	TOTAL	Total PER %
I	05	12	05				03	-	25	15
II	05	04	09	03			02	-	23	14
III		04		18				-	22	14
IV		02	06	13			01	-	22	14
V				08	12		01	-	21	12
VI				09	06	03	04	-	22	13
VII	03			10		03	03	-	19	12
VIII							10	-	10	06
TOTAL	13	22	20	61	18	06	24	-	164	100

CATEGORY		Breakup of Credits	PER % in Total
HSMC	Humanities & Social Science Including Management	13	07
BSC	Basic Science Courses	22	13
ESC	Engineering Science Courses	20	12.5
PCC	Professional Core Courses	61	38
PEC	Professional Elective Courses	18	11
OEC	Open Elective Courses	06	04
EEC	Employment Enhancement Courses	24	14.5
MCC	Mandatory Courses	-	-
	Total Credits	164	100

SEMESTER I

Course Code	Course Title	L	T	P	J	C
22HST101	PROFESSIONAL ENGLISH	2	0	4	0	4
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Provide learners with basic vocabulary and grammar to recognise and use in real time contexts
2. Improve communicative competence
3. Help use the language effectively in academic /work contexts
4. Build language skills by engaging in listening, speaking, vocabulary and grammar learning activities relevant to authentic contexts
5. Develop the ability to read and write complex texts, summaries, articles, blogs, definitions, essays, and user manuals

COURSE OUTCOME:

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

1. Become accustomed to the basic vocabulary and grammar
2. Listen and comprehend complex academic texts
3. Read and infer the denotative and connotative meanings of technical texts
4. Write definitions, descriptions, narrations, and essays on various topics
5. Speak fluently and accurately in formal and informal communicative contexts

UNIT-1	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	6 HOURS

Reading – Newspaper- sports/health; technical Brochures
Writing – Professional emails; Formal letters - Requisition & Business letters
Grammar – Word formation, Parts of speech, Framing questions
Vocabulary – Synonyms and Antonyms, One word substitution, Abbreviations and Acronyms

UNIT-2	NARRATION AND SUMMATION	6 HOURS

Reading – Biographies/ Travelogues
Writing - Guided writing- Paragraph; Short Report on an event (field trip etc.)
Grammar – Tenses; Subject-Verb Agreement; Prepositions
Vocabulary – Narrative vocabulary; Phrasal verbs

UNIT-3	DESCRIPTION OF A PROCESS / PRODUCT	6 HOURS

Reading – Gadget reviews; Advertisements
Writing - Product description, Process description; Instruction writing
Grammar – Imperatives; Degrees of comparison
Vocabulary – Compound words; Homonyms, homophones; discourse markers- Connectives and

Sequence words		
UNIT-4	**CLASSIFICATION ND RECOMMENDATIONS**	**6 HOURS**
Reading – Newspaper articles; journal reports **Writing** – Note-making; Interpretation of charts; Recommendations **Grammar** – Articles; Modal verbs **Vocabulary** - Collocations; Fixed / Semi fixed expressions.		
UNIT-5	**EXPRESSION**	**6 HOURS**
Reading – Editorials; opinion blogs **Writing** – Reports – Accident & Survey; Business letters **Grammar** – Punctuation; Negations; Simple, Complex and Compound sentences **Vocabulary** - Cause & Effect Expressions; Content vs Function words		
	TOTAL HOURS:	**30 HOURS**

TEXT BOOK(S):

1.	Hewings, Martin Advanced Grammar In Use. New Delhi: CUP,2008 MLA Handbook for Writers of Research Papers, 7th Edition
2.	English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1	Ian wood, Anne Williams with Anna Cowper, "Pass Cambridge BEC Preliminary", 2nd edition, Cengage Learning, 2015.
2	Technical Communication – Principles And Practices, Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
3	A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
4	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.

LIST OF EXPERIMENTS :

1. Listening to introductions of successful people
2. Self-Introduction and introducing a friend
3. Listening and filling out a form
4. Narrating a story using hints
5. Listening to telephone conversation
6. Telephonic Interview- Role play
7. Listening to podcasts, anecdotes/event narration
8. Narrating personal experiences/ events
9. Listening to celebrity interviews

10. Conversation Skills- Politeness strategies
11. Listening to process descriptions
12. Describing a process
13. Listening to travelogues
14. Narrating travel experiences
15. Listening to educational videos
16. Group discussion
17. Listening to TED Talks
18. Mini Presentations
19. Listening to description of art work
20. Picture description
21. Listening to scientific lectures
22. Summarizing a lecture
23. Listening to definitions/ descriptions of objects
24. One minute speech - Describing an object
25. Listening to Tv shows
26. Anchoring a reality show
27. Listening to advertisements
28. Adzap
29. Listening to autobiography
30. Visume
TOTAL HOURS: 60 HOURS

Course Code	Course Title	L	T	P	J	C
22BST101	BASIC MATHEMATICS FOR ENGINEERS	3	2	0	0	4
		Syllabus version			v. 2.0	
COURSE OBJECTIVES:						

After studying this course, you should be able to:

1. To develop the use of matrix algebra techniques that are needed by engineers for practical applications.
2. To acquaint the students with differential calculus.
3. To explain the student with functions of several variables.
4. To make the students understand various techniques of integration and its applications.
5. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

COURSE OUTCOME:

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

1. Use the matrix algebra methods for solving practical problems.
2. Apply differential calculus tools in solving various application problems.
3. Able to use differential calculus ideas on several variable functions.
4. Apply different methods of integration in solving practical problems.
5. Apply multiple integral ideas in solving areas, volumes and other practical problems.

UNIT-1	**MATRICES**	**9+3 HOURS**
Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation		
UNIT-2	**DIFFERENTIAL CALCULUS**	**9+3 HOURS**
Representation of functions - Limit of a function- Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Logarithmic differentiation - Maxima and Minima of functions of one variable.		
UNIT-3	**FUNCTIONS OF SEVERAL VARIABLES**	**9+3 HOURS**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Taylor's series for functions of two variables – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.		
UNIT-4	**INTEGRAL CALCULUS**	**9+3 HOURS**
Definite and Indefinite integrals - Substitution rule - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction		
UNIT-5	**MULTIPLE INTEGRALS**	**9+3 HOURS**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids		
	TOTAL LECTURE AND TUTORIAL HOURS:	**45+15 HOURS**

TEXT BOOK(S):

1.	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons,10th Edition, New Delhi, 2016.

2.	Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition , 2018.
3.	James Stewart, “Calculus: Early Transcendentals”, Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].
REFERENCE BOOKS:	
1.	Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016
2.	Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3.	Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4.	Narayanan. S. and Manicavachagom Pillai. T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6.	Srimantha Pal and Bhunia. S.C, “Engineering Mathematics" Oxford University Press, 2015.
7.	Thomas. G. B., Hass. J, and Weir. M.D, " Thomas Calculus", 14th Edition, Pearson India, 2018.

Course Code	Course Title	L	T	P	J	C
22BST102	**Engineering Physics**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	NIL	Syllabus version			v. 2.0	

COURSE OBJECTIVES:

1. To make the students effectively achieve an understanding of mechanics.
2. To enable the students to gain knowledge of electromagnetic waves and its applications.
3. To introduce the basics of oscillations, optics and lasers.
4. Equipping the students to successfully understand the importance of quantum physics.
5. To motivate the students towards the applications of quantum mechanics.

COURSE OUTCOME:

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

CO1: Understand the importance of mechanics.

CO2: Express their knowledge in electromagnetic waves.

CO3: Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Understand the importance of quantum physics.

CO5: Comprehend and apply quantum mechanical principles towards the formation of energy bands

UNIT I	MECHANICS	9 hours
Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - MI of a diatomic molecule - theorems of MI –moment of inertia of continuous bodies –- torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule.		
UNIT II	**ELECTROMAGNETIC WAVES**	**9 hours**
The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure – basic introduction to Satellite Communication (qualitative treatment)		
UNIT III	**OSCILLATIONS, OPTICS AND LASERS**	**9 hours**
Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave -– interference– Michelson interferometer – Theory of laser – characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.		
UNIT IV	**BASIC QUANTUM MECHANICS**	**9 hours**
Photons and light waves - Electrons and matter waves – Photoelectric effect - The Schrodinger equation (Time dependent and time independent forms) - interpretation of wave function –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization and probabilities – Bohr's correspondence principle (concept only).		
UNIT V	**APPLIED QUANTUM MECHANICS**	**9 hours**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunnelling (qualitative)- Tunnelling microscope - Resonant diode – Principle of quantum superposition – concept of quantum entanglement – concepts of quantum communication and quantum teleportation		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.	
2.	E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.	
3.	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.	
Reference Books		

1.	R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2.	Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3.	K. Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4.	D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5.	N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer Verlag, 2012.

Course Code	Course Title	L	T	P	J	C
22BST103	**Engineering Chemistry**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	NIL	Syllabus version			v. 2.0	

Course Objectives:

1. To inculcate a sound understanding of water quality parameters and water treatment techniques.
2. To impart knowledge on the basic principles and preparatory methods of nanomaterials.
3. To introduce the different polymers and composites for engineering applications.
4. To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5. To familiarize the students with the operating principles, working processes and applications of storage devices and computational chemistry that are essential for chemistry.

Course Outcomes:

1. To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
2. To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
3. To analyse the properties of different polymers and distinguish the polymers which can be degraded and demonstrate their usefulness and composites for material selection requirements.
4. To recommend suitable fuels for engineering processes and applications.
5. To solve chemical problems by simulating chemical systems (molecular, biological, materials) in order to provide reliable, accurate and comprehensive information at an atomic level.

Unit-1	**WATER AND ITS TREATMENT**	**9 hours**

Water: Sources and impurities, Requirements of portable water, Desalination of brackish water: Reverse Osmosis. Requirements of water for industrial use, Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment -Ion exchange demineralization and zeolite process. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination).

Unit-2	**NANOCHEMISTRY**	**9 hours**

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); 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 electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
Unit-3	**POLYMERS AND COMPOSITES**	**9 hours**
Definition of biodegradable polymers- Classification of biodegradable Polymers – Advantages, conducting polymers-polyaniline, polyacetylene, recycling of e-plastic waste (waste to wealth). Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer, matrix, metal matrix and ceramic matrix) and Reinforcement (fibre, particulates, flakes and whiskers). Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.		
Unit-4	**FUELS AND COMBUSTION**	**9 hours**
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel, Knocking - octane number, diesel oil-cetane number; Power alcohol and biodiesel. Combustion of fuels: Calorific value - higher and lower calorific values, Flue gas analysis - ORSAT Method. CO_2 emission and carbon footprint.		
Unit-5	**COMPUTATIONAL CHEMISTRY AND STORAGE DEVICES**	**9 hours**
Computational chemistry-molecular dynamics and chemical reactivity. Cheminformatics and Green IOT in biomedical applications, Artificial intelligence and machine learning methods to predict physicochemical properties. Batteries: a brief introduction to electrochemical cell (Daniel cell), Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; battery used in Electric vehicles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.	
2.	Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.	
3.	S.S. Dara, “A Text book of Engineering Chemistry”, S. Chand Publishing, 12th Edition.	
Reference Books		
1.	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Textbook of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.	
2.	O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.	

3.	Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
4.	ShikhaAgarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
5.	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

Course Code	Course Title	L	T	P	J	C
22EST101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		**Syllabus version**		**v. 1.0**		

COURSE OBJECTIVES: After studying this course, you should be able to:

1. To understand the basics of algorithmic problem solving.
2. To learn to solve problems using Python conditionals and loops.
3. To define Python functions and use function calls to solve problems.
4. To use Python data structures - lists, tuples, dictionaries to represent complex data.
5. To do input/output with files in Python.

COURSE OUTCOME:

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

- Develop algorithmic solutions to simple computational problems.
- Develop and execute simple Python programs.
- Write simple Python programs using conditionals and loops for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries etc.
- Read and write data from/to files in Python programs.

UNIT-1	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9 HOURS

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT-2	DATA TYPES, EXPRESSIONS, STATEMENTS	9 HOURS

Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.		
UNIT-3	**CONTROL FLOW, FUNCTIONS, STRINGS**	**9 HOURS**
Conditionals:Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT-4	**LISTS, TUPLES, DICTIONARIES**	**9 HOURS**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT-5	**FILES, MODULES, PACKAGES**	**9 HOURS**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S):		
1.	Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.	
2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017	
REFERENCE BOOKS:		
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition,2021.	
2.	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.	
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021	
4.	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.	

5.	Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

Course Code	Course Title	L	T	P	J	C
22HSM101	**HERITAGE OF TAMILS**	**1**	**0**	**0**	**0**	**1**
Pre-requisite		Syllabus version			v. 1.0	

Unit-1	**LANGUAGE AND LITERATURE**	**03 hours**

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

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

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

Unit-3	**FOLK AND MARTIAL ARTS**	**03 hours**

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

Unit-4	**THINAI CONCEPT OF TAMILS**	**03 hours**

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

Unit-5	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**03 hours**

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

Total Lecture hours:	15 hours

TEXT BOOK(S)

1.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
2.	Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by:

	Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
3.	Tamilaga Varalaru, Makalum Panpadum- Dr. K.K. Pillai
4.	Kanini Tamil- Munaivar L. Sundaram
REFERENCE BOOKS	
1.	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3.	Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4.	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author)
5.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

Course Code	Course Title	L	T	P	J	C
22EET102	**Skill Development Training-I (Student READY)**	**1**	**0**	**2**	**0**	**2**
Pre-requisite		**Syllabus version**		**v. 1.0**		

COURSE OBJECTIVES: After studying this course, you should be able to:

1. Understand the characteristics of 'engineering' and the quality engineers have played in shaping engineering up to the present and into the future
2. Understand a range of principles in science, mathematics, and engineering in order to make well-founded decisions as part of a design process
3. To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the present ability and overall utility value of content
4. To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
5. To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, present ability, aesthetics, using media elements and enhance the overall quality of presentations.

COURSE OUTCOME:

- Understand the basic knowledge in evolution of engineering
- Understand the basic knowledge in Engineering approach
- Use the MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

UNIT-1	**EVOLUTION OF ENGINEERING**	**6 HOURS**

Evolution of Engineering: Description of Engineering, Early stages of Engineering, Outline of Ancient Engineering, Case studies of historic engineers.
Introduction to Engineering Career: Engineering as a career and common qualities of employable engineers History of Engineering Domains Impact of engineering on society. Roles of Engineers and Career Paths.

UNIT-2	**ENGINEERING APPROACH**	**6 HOURS**

Introduction, problem statement: Detailing Customer Requirements, Setting Objectives, Identifying Constraints, Establishing Functions, generating solution Alternatives and Choosing a solution.Steps in problem-solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. seven steps in solving engineering problems, reverse engineering, forward engineering, concurrent engineering, and Value Engineering.

UNIT-3	**MS WORD**	**6 HOURS**

Create and format a document, Working with tables, Working with Bullets and Lists, Working with styles, shapes, smart art, charts Inserting objects, charts and importing objects from other office tools, Creating and Using document templates, Inserting equations, symbols and special characters, Working with Table of contents and References, citations Insert and review comments, Create bookmarks, hyperlinks, endnotes footnote, Viewing document in different modes, Working with document protection and security, Inspect document for accessibility.

UNIT-4	**MS EXCEL**	**6 HOURS**

Create worksheets, insert and format data, Work with different types of data: text, currency, date, numeric etc. Split, validate, consolidate, Convert data Sort and filter data Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,) Work with Lookup and reference formulae, Create and Work with different types of charts, Use pivot tables to summarize and analyse data, Perform data analysis using own formulae and functions, Combine data from multiple worksheets using own formulae and built-in functions to generate results, Export data and sheets to other file formats, Working with macros, Protecting data and Securing the workbook

UNIT-5	MS POWERPOINT	6 HOURS
Hours Select slide templates, layout and themes, Formatting slide content and using bullets and numbering, Insert and format images, smart art, tables, charts Using Slide master, notes and handout master, Working with animation and transitions, Organize and Group slides Import or create and use media objects: audio, video, animation, Perform slideshow recording and Record narration and create presentable videos.		
	TOTAL LECTURE HOURS:	**30 HOURS**

TEXT BOOK(S):

1.	Remesh S., Vishnu R. G., Life Skills for Engineers, Ridhima Publications, 1 stEdition,2016.
2.	Barun K. Mitra, Personality Development & Soft Skills, Oxford Publishers, Third impression, 2017.
3.	Dorothy House, Microsoft Word, Excel, and PowerPoint: Just for Beginners, Import, 29 January 2015

REFERENCE BOOKS:

1.	Paul H. Wright, Introduction to Engineering, School of Civil and Environmental Engineering, 3rd Edition, John Wiley & Sons, Inc,

Course Code	Course Title	L	T	P	J	C
22ESP101	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To understand the problem solving approaches.
2. To learn the basic programming constructs in Python.
3. To practice various computing strategies for Python-based solutions to real world problems.
4. To use Python data structures - lists, tuples, dictionaries.
5. To do input/output with files in Python.

COURSE OUTCOME:

On completion of the course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems

CO2: Develop and execute simple Python programs.

CO3: Implement programs in Python using conditionals and loops for solving problems.

CO4: Deploy functions to decompose a Python program.

CO5: Process compound data using Python data structures.

CO6: Utilize Python packages in developing software applications.

LIST OF EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern) Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity

using Pygame like bouncing ball, car race etc.

TOTAL LECTURE HOURS:	**30 HOURS**

Course Code	Course Title	L	T	P	J	C
22BSP101	**PHYSICS CHEMISTRY LABORATORY (CHEMISTRY)**	**0**	**0**	**4**	**0**	**2**
Pre-requisite	NIL	Syllabus version			v. 2.0	

Course Objectives:

1. To impart practical skills in the estimation of water quality parameters by volumetry and gravimetry.
2. To familiarize the students with the estimation of impurities in aqueous solutions through electro-analytical techniques such as pH metre, potentiometry and conductometry.

3. To demonstrate the analysis of metals by UV-Visible spectroscopy.
Course Outcome:
1. To independently estimate the water quality parameters, such as acidity, alkalinity, hardness, DO, TDS, chloride and copper contents by appropriate wet chemical analyses. 2. To quantitatively analyze the impurities in aqueous solution by electroanalytical techniques. 3. To determine the amount of metal ions in aqueous samples by spectroscopic techniques.
LIST OF EXPERIMENTS: ANY SEVEN
1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard 2. Determination of types and amount of alkalinity in water sample. 3. Determination of total, temporary & permanent hardness of water by EDTA method. 4. Determination of DO content of water sample by Winkler's method. 5. Determination of chloride content of water sample by Argentometric method. 6. Estimation of TDS of a water sample by gravimetry. 7. Determination of strength of given hydrochloric acid using pH meter. 8. Determination of strength of acids in a mixture of acids using conductivity meter. 9. Conductometric titration of barium chloride against sodium sulphate (precipitation titration) 10. Estimation of iron content of the given solution using potentiometer. 11. Estimation of iron content of the water sample using spectrophotometer (1,10-Phenanthroline / thiocyanate method).
Total Laboratory hours: 30hours

Course Code	Course Title	L	T	P	J	C
22BSP101	**PHYSICS CHEMISTRY LABORATORY (PHYSICS)**	**0**	**0**	**4**	**0**	**2**
Pre-requisite	NIL	Syllabus version			v. 2.0	

Course Objectives:
1. To learn the proper use of various kinds of physics laboratory equipment. 2. To learn how data can be collected, presented and interpreted in a clear and concise manner. 3. To learn problem solving skills related to physics principles and interpretation of experimental data. 4. To determine error in experimental measurements and techniques used to minimize such error. 5. To make the student an active participant in each part of all lab exercises
Course Outcome:

1. Understand the functioning of various physics laboratory equipment.
2. Use graphical models to analyse laboratory data.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. Access, process and analyse scientific information.
5. Solve problems individually and collaboratively..

LIST OF EXPERIMENTS(Any Seven Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wavelength of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

Total Laboratory hours:	**30hours**

Course Code	Course Title	L	T	P	J	C
22EEP101	PRODUCT TINKERING LABORATORY	0	0	2	0	1
		Syllabus version			v. 2.0	

COURSE OBJECTIVES:

1. Hands on practical training, maintenance and troubleshooting on mechanical and electrical appliances in day-to-day life.
2. Analyse single phase and three phase residential building wiring (Energy meter, fuse, earthing)
3. Understand the internal structure and layout of the computer system.
4. Learn to diagnose minor problems with the computer functioning.
5. Know the proper usage and threats of the world wide web.

COURSE OUTCOME:

1. Students will able to understand domestic wiring procedures practically.
2. Students are capable of assembling a personal computer, and can perform installation of system software like MS Windows and required device drivers.
3. Students can detect and perform minor hardware and software level troubleshooting.
4. Capacity to work on Internet & World Wide Web and make effective usage of the internet for academics.

LIST OF EXPERIMENTS:

1. **MECHANICAL EQUIPMENT STUDY**

(a) Hand drilling machine, Screw Jack and centrifugal pump

(b) Two wheeler, Refrigeration and Air Conditioning system.

2. **ELECTRICAL EQUIPMENT STUDY**

Light fittings, LED, Stabilizer, UPS, Iron box, calling bell, Fan regulator

3. ELECTRONIC EQUIPMENT STUDY

a) Study the elements of a smart phone.

b) Assembly and dismantle of LED TV.

c) Assembly and dismantle of computer/ laptop

4. COMPUTER PERIPHERALS STUDY

PC HARDWARE Identification of the peripherals of a computer, components in a CPU and its functions. Block diagram of the CPU along with the configuration of each peripheral. Functions of Motherboard. Assembling and Disassembling of PC. System Software and application software installation.

5. BIOMEDICAL EQUIPMENT

a) Assembly and dismantle of Electrocardiogram (ECG)

b) Assembly and dismantle of ventilator.

c) Assembly and dismantle of Doppler Ultra sound Scanner.

TROUBLESHOOTING

Hardware Troubleshooting: Students are to be given a PC which does not boot due to proper assembly or defective peripherals and the students should be taught to identify and correct the problem.

Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition.

Internet: Web Browsers, Access of websites, Surfing the Web, Search Engines, Customization of web browsers, proxy settings, bookmarks, search toolbars, pop-up blockers. Antivirus downloads, Protection from various threats.

TOTAL LECTURE HOURS:	**30 HOURS**

Course Code	Course Title	L	T	P	J	C
22LET201	FUNCTIONAL ENGLISH	3	0	2	0	4
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to:

1. Gain confidence to respond in English in both academic and professional contexts
2. Improve presentation skills to make effective presentations
3. Foster the ability to write effectively in all contexts
4. Strengthen the skills related to teamwork and leadership roles in society as well as in the workplace

COURSE OUTCOME:

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

1. Communicate fluently in professional situations
2. Express flexibility and appropriacy in Technical Events
3. Demonstrate complex forms and sentence structures with adequate vocabulary
4. Report events and the processes of technological & Industrial firms.
5. Present effective Profile in the context of job search

UNIT-1	**COMMUNICATIVE COMPETENCE**	**9 HOURS**

Speaking: Interactive skills- Initiation & turn taking; relevance to the topic, puzzles & riddles
Reading – Skimming, Scanning, Churning & Assimilation
Writing – Paragraphs; Free writing & opinion paragraphs
Grammar – Order of Adjectives, Primary Auxiliary Verbs
Vocabulary – Phonetics – sounds and symbols; Vocabulary used in letters and emails

UNIT-2	**SITUATIONAL CONVERSATIONS**	**9 HOURS**

Speaking – Practicing fluency- cohesion, coherence, and speed of delivery
Reading – Reading social media messages
Writing – Checklist; Letter to the editor
Grammar – Infinitives, Gerunds and Participles, Interrogative and Reflexive Pronoun
Vocabulary – Verbal Analogies, Same words used as different parts of speech

Unit-3	**REPORT ON TECHNICAL EVENTS**	**9 hours**

Speaking –Mock TV news Reading/ anchoring
Reading – Motivational essays on famous Engineers and Technologists
Writing – Dialogue writing; Minutes of Meeting
Grammar – Reported Speech, Modal Verbs
Vocabulary – Technical Vocabulary, Jargon

Unit-4	**DEVELOPING DISCUSSION SKILLS**	**9 hours**

Speaking – Giving short talks on technical topics
Reading - Descriptive passages – magazines/ articles
Writing – Recommendations; Job application
Grammar – If conditional sentences, Articles
Vocabulary - Purpose statements

Unit-5	**PRESENTATION SKILLS**	**9 hours**

Speaking – Presentations using visual aids-Visume using appropriate body language and gestures; stating and asking for opinions and clarifications **Reading** – Predicting the content, speed reading techniques **Writing** – Precis Writing, Profile Writing **Grammar** – Mixed Tenses, Embedded Clause **Vocabulary** – Error Spotting, Sentence Completion	
TOTAL LECTURE HOURS:	**45 HOURS**
List of Experiments :	
1. Initiation and turn taking	
2. Writing opinion paragraph	
3. Situational conversations	
4. Writing Checklists	
5. Mock TV news reading	
6. Writing the project proposal or Project report	
7. Short talk on technical topics	
8. Writing recommendations	
9. PPT Presentation	
10. Profile writing	
TOTAL PRACTICAL HOURS:	**30 HOURS**
Text Book(s)	
1.	English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University
2.	Functional English for Communication (2022 edition) Ujjwala Kakarla, Guru Nanak Institutions Technical Campus (Autonomous), Hyderabad.
Reference Books	
1.	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2.	Hewings, Martin. Advanced Grammar In Use. New Delhi: CUP,2008 MLA Handbook for Writers of Research Papers, 7th Edition
3.	Klaus Bruhn Jensen. A handbook of Media and Communication Research. Routledge, 2003

Course Code	Course Title	L	T	P	J	C
22LET202	**FRENCH LANGUAGE LEVEL 1**	**2**	**0**	**4**	**0**	**6**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To acquire an understanding of basic French language parts of speech
2. To facilitate learner's ability to learn the French language grammar.
3. To nurture learner's ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks

Course Outcome:

1. Read and write technical basic French language parts of speech
2. Speak appropriately learner's ability to learn the French language grammar.
3. Listen and comprehend lectures learner's ability to understand the sentence structure
4. Write correctly, clearly and concisely technical writing skills through tenses and numbers
5. Prepare self-introduction comprehend various lectures and talks

Unit-1	**PARTS OF SPEECH**	**12 hours**

1. inviter et répondre à une invitation, Pronoms sujets 2. L'article définis, l'article indéfinis 3. Conjugation : présent, adjectifs possessifs 4. interrogation, décrire les personnes 5. La vie de quatre parisiens de professions différentes

Unit-2	**ELEMENTS OF GRAMMAR:**	**12 hours**

1. Exprimer l'ordre et l'obligation demander et commander 51
2. l'adjectif possessifs, l"article partitif, l'article démonstratif, négation ne
3. pas, l'article contracté 4. verbe pronominaux 5. prepositions

Unit-3	**SENTENCE STRUCTURE:**	**12 hours**

1. Raconter et reporter-donner son avis
2. Futur simple, pronom complètement d'objet direct, passé composé
3. plusieurs région de France, imparfait, pronom y/en, imparfait

Unit-4	**TENSES AND NUMBERS**	**12 hours**

1. Demander l'autorisation-passé récent, futur proche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport

Unit-5	**DISCOURSE**	**12 hours**

1. le discours rapporté, décrire un lieu, exprimer ses préférences 2. décrire la carrière, discuter d"système éducation de France 3. parler de la technologie de l"information

Total Lecture hours:	45 hours

Text Book(s)

1.	Christine Andant étal "À propos (livre de l'élève", LANGER., NEW DELHI,2012

2.	Myrna Bell Rochester "Easy French Step By Step", MCGraw Hill Companies., USA, 2008
Reference Books	
1.	Michael D. Oates "Entre Amis: An Interactive Approach", 5 th Edition, Houghton Mifflin., 2005
2.	Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French"
3.	Simone Renaud, Dominique van Hooff "En bonne forme

Course Code	Course Title	L	T	P	J	C
22LET203	**GERMAN- LEVEL A1.1**	**2**	**0**	**4**	**0**	**4**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To acquire an understanding of basic German language parts of speech
2. To facilitate learner's ability to learn the German language grammar.
3. To nurture learner's ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks

Course Outcome:

1. Read and write technical basic German language parts of speech
2. Speak appropriately learner's ability to learn the German language grammar.
3. Listen and comprehend lectures learner's ability to understand the sentence structure
4. Write correctly, clearly and concisely technical writing skills through tenses and numbers
5. Prepare self-introduction comprehend various lectures and talks

Unit-1	**GUTEN TAG!**	**10 ours**

1. To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages
2. Vocabulary: related to the topic
3. 3. Grammar: W – Questions, Verbs & Personal pronouns I

Unit-2	**FREUNDE, KOLLEGEN UND ICH**	**10 ours**

1. To speak about hobbies, jobs, learn numbers from 20; build dialogues and frame simple questions & answers
2. Vocabulary: related to the topic
3. Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural

Unit-3	**IN DER STADT**	**12 hours**

1. To know places, buildings, question, know transport systems, understand international words; build dialogues and write short sentences 2. Vocabulary: related to the topic 3. Grammar: Definite & indefinite articles, Negotiation, Imperative with Sien verbs		
Unit-4	**GUTEN APPETIT!**	**13 hours**
1. To speak about food, shop, converse; Vocabulary: related to the topic; build dialogues and write short sentences 2. Grammar: Sentence position, Accusative, Accusative with verbs, personal pronouns & prepositions, Past tense of haben & sein verbs		
Unit-5	**TAG FŸR TAG/ZEIT MIT FREUNDEN**	**15 hours**
1. To learn time related expressions, speak about family, about birthdays, understand & write invitations, converse in the restaurant; ask excuse, fix appointments on phone 2. Vocabulary: related to the topic 3. Grammar: Time related prepositions, Possessive articles, Modalverbs		
	Total Lecture hours:	**60 hours**

Text Book(s)

1.	Dengler Stefanie "Netzwerk A1.1", Klett-Langenscheidt Gmbh., München,2013
2.	Sandra Evans, Angela Pude "Menschen A1", Hueber Verlag., Germany, 2012

Reference Books

1.	Stefanie Dengler "Netzwerk A1", Klett-Langenscheidt Gmbh., München, 2013
2.	Hermann Funk, Christina Kuhn "Studio d A1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3.	Rosa-Maria Dallapiazza "Tangram Aktuell 1 (Deutsch als Fremdsprache)", Max Hueber Verlag., Munchen, 2004
4.	Christiane Lemcke und Lutz Rohrmann ""Grammatik Intensivtrainer A 1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2012

Course Code	Course Title	L	T	P	J	C
22LET204	**BASIC JAPANESE**	**2**	**0**	**4**	**0**	**4**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To acquire an understanding of basic Japanese language parts of speech
2. To facilitate learner's ability to learn the Japanese language grammar.
3. To nurture learner's ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks

Course Outcome:

1. Read and write technical basic Japanese language parts of speech
2. Speak appropriately learner's ability to learn the Japanese language grammar.
3. Listen and comprehend lectures learner's ability to understand the sentence structure
4. Write correctly, clearly and concisely technical writing skills through tenses and numbers
5. Prepare self-introduction comprehend various lectures and talks

Unit-1	JAPANESE PEOPLE AND CULTURE	12 hours

1. Basic greetings and responses
2. Basic script–Method of writing hiragana and katakana –Combination sounds and simple words
3. Self-introductions:"Hajimemashite" -Demonstratives "Kore", "Sore", "Are"–Demonstrative "Kono","Sono","Ano"
4. Possessive noun particle "no" –Japanese apartments: Greeting your neighbor

Unit-2	PATICLE "NI (AT)" FOR TIME	12 hours

: 1. kara (from) ~ made(until) – Particle "to (and)"
2. Time periods: Days of the week, months, time of day –Verbs (Present / future and pasttense)
3. Telephone enquiry: Asking for a phone no. And business hours- Destination particle "e".

Unit-3	LIKES AND DISLIKES	12 hours

1. Potential verbs (wakarimasu and dekimasu) – "Kara (~ because)"
2. Adverbs –Asking some one out over the phone-Verbs denoting presence
3. Introduction to Adjectives (na and ii type) -Verb groups – I, II and III – Exercises to group verbs- Please do (te kudasai)
4. Present continuous tenses (te imasu) – Shall I? (~ mashou ka) – Describing a natural phenomenon (It is raining) (12)

Unit-4	DIFFERENT USAGES OF ADJECTIVES	12 hours

1. Comparison –Likes and dislikes –Going to a trip- Need and desire (ga hoshii) –Wanting to…(Tabeti desu)- Going for a certain purpose (mi –ni ikimasu)
2. Choosing from a menu-Adjectives ("i" and "na" type) – Adjectives (Positive and negative useage)

Unit-5	ROLE PLAYS IN JAPANESE	12 hours

1. Framing simple questions & answers
2. Writing Short paragraphs & Dialogues
3. A demonstration on usage of chopsticks and Japanese tea party (12)

Total Lecture hours:	60 hours

Text Book(s)

1.	Minna no Nihongo, Honsatsu Roma "ji ban (Main Textbook Romanized Version)",

	International publisher – 3A Corporation., Tokyo, 2012
Reference Books	
1.	Eri Banno et.al "Genki I: An Integrated Course in Elementary Japanese I -Workbook", ., 1999
2.	Tae Kim "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", 2014
3.	Minna No Nihongo "Translation & Grammatical Notes In English Elementary",

Course Code	Course Title	L	T	P	J	C
		3	2	0	0	4
22BST202	STATISTICS AND NUMERICAL METHODS	Syllabus version			v. 2.0	

COURSE OBJECTIVES:

1. This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

COURSE OUTCOME:

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

UNIT-1	TESTING OF HYPOTHESIS	12 HOURS

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit

UNIT-2	DESIGN OF EXPERIMENTS	12 HOURS
One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design.		
UNIT-3	**SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**	**12 HOURS**
Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel- Eigenvalues of a matrix by Power method.		
UNIT-4	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**12 HOURS**
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
UNIT-5	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**12 HOURS**
Taylor's series method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Milne's forth predictor corrector methods for solving first order differential equations.		
	TOTAL LECTURE HOURS:	**60 HOURS**

TEXT BOOK(S)

1.	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, 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. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4.	Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

Course Code	Course Title	L	T	P	J	C
22AGT201	**PRINCIPLES OF CROP PRODUCTION AND**	**2**	**0**	**2**	**0**	**3**

	AGRONOMY					
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To introduce the students to principles of agricultural and horticultural crop production
2. Understand the crop selection and establishment procedures
3. Learn about the different management practices during crop establishment and growth.
4. To introduce the production practices of agricultural and horticultural crops
5. To delineate the role of agricultural engineers in relation to various crop production practices

COURSE OUTCOME:

After the completion of the course, student will be able to:

1. Students completing this course would have acquired knowledge on the basic principles of crop production
2. Students will be able to select suitable crops and decide upon its establishment procedures
3. Students will get knowledge on the different crop management practices
4. The students will have the required knowledge in the area of production of agricultural and horticultural crops
5. Students will be able to delineate their role in relation to various crop production practices

Unit-1	**AGRICULTURE AND CROP PRODUCTION**	9 hours

Introduction to agriculture and its crop production sub-sectors - field crop production and horticulture; Factors affecting crop growth and production: genetic (internal) and environmental (external) factors; Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices

Unit-2	**CROP SELECTION AND ESTABLISHMENT**	9 hours

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-3	**CROP MANAGEMENT**	9 hours

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

Unit-4	**PRODUCTION PRACTICES OF AGRICULTURAL CROPS**	9 hours

Generalized management and cultivation practices for important groups of field crops in Tamil Nadu: cereal crops, grain legumes, oil seed crops, sugarcane, and fiber crops, and special purpose crops such as those grown for green manure and fodder.		
Unit-5	**PRODUCTION PRACTICES OF HORTICULTURAL CROPS**	9 hours
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 LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):	
1.	Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015.
2.	Reddy T. Sankara G.H. Yellamanda Reddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 2005
3.	Handbook of Agriculture. ICAR Publications, New Delhi, 2011
REFERENCE BOOKS:	
1.	Bose T. K. and L.P.Yadav. Commercial Flowers, Naya Prakash, Calcutta.1989
2.	Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005
3.	Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan, I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil. 1993

List of Challenging Experiments (Indicative)
Identification of field and horticultural crops
Seeds - estimation of seed rate, germination of seeds
Nursery, demonstration on different types in field
Fertilizers-type, estimation of recommended dose
Weeds, identification of major weed type, demonstration on simple weeding implements. Weedicide uses and caution
Pest identification and control, demonstration of IPM methods
Harvesting methods for various field and horticultural crops and implements used
Observing in demonstration field, cultivation of wetland, dry land and garden land crops and documenting of growth stage and recording of biometric observations.

Total Laboratory Hours	**15 hours**

Course Code	Course Title	L	T	P	J	C
22EST201	**BASIC ELECTRICAL, ELECTRONICS ENGINEERING AND MEASUREMENTS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To introduce the basics of electric circuits and analysis
2. To impart knowledge in the basics of working principles and application of electrical machines
3. To introduce analog devices and their characteristics
4. To educate on the fundamental concepts of linear integrated circuits
5. To introduce the functional elements and working of measuring instruments.

COURSE OUTCOME:

1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of linear integrated circuits
5. Explain the operating principles of measuring instruments.

UNIT-1	**ELECTRICAL CIRCUITS**	**9 HOURS**

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-2	**ELECTRICAL MACHINES**	**9 HOURS**

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-3	**ANALOG ELECTRONICS**	**9 HOURS**

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-4	LINEAR INTEGRATED CIRCUITS	9 HOURS
Ideal OP-AMP characteristics, Basic applications of op-amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator-S/H circuit, D/A converter (R- 2R ladder), A/D converters- Flash type ADC using OP-AMPS . Functional block, characteristics of 555 timer– Astable multi-vibrator mode.		
UNIT-5	**MEASUREMENTS AND INSTRUMENTATION**	**9 HOURS**
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 LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):

1.	D P Kothari and I.J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, Second Edition, 2020.
2.	Allan S Moris, “Measurement and Instrumentation Principles”, Third Edition, Butterworth Heinemann, 2001
3.	S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4.	James A .Svoboda, Richard C. Dorf, “Dorf’s Introduction to Electric Circuits”, Wiley, 2018.

REFERENCE BOOKS:

1.	Thomas L. Floyd, ‘Electronic Devices’, 10th Edition, Pearson Education, 2018
2.	A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, New Delhi,January 2015.
3.	Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017

Course Code	Course Title	L	T	P	J	C
22EST202	**ENGINEERING GRAPHICS**	**1**	**0**	**4**	**0**	**3**
		Syllabus version			v. 2.0	

COURSE OBJECTIVES:

1. To develop students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing National standards related to technical drawings.
3. To Familiarize with basic geometrical constructions and orthographic projections.
4. To make the students to draw the different projections of the solids.
5. To view the true shape and apparent shape of the sectioned solids and their developments.
6. To get an idea about 3D views through isometric projections.

COURSE OUTCOME:

1. Perform basic geometrical constructions and principles of orthographic projections.
2. Project orthographic projections of lines and plane surfaces.
3. Draw projections of solids and development of surfaces.
4. Visualize and to project isometric views and conversion of Isometric views to Orthographic views.
5. Understand the basics of AUTO CAD and fundamentals of perspective projections.

UNIT-0	**CONCEPTS AND CONVENTIONS (Not for Examination)**	**3+9 HOURS**
Importance of graphics in engineering applications — Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.		
UNIT-1	**PLANE CURVES, PROJECTIONOF POINTS AND LINES**	**3+9 HOURS**
Conic Sections - Construction of Ellipse, Parabola & hyperbola by eccentricity method – Construction of cycloid. Introduction of Orthographic projection. First angle projection - projection of points and Projection of Lines (only for understanding)		
UNIT-2	**PROJECTION OF PLANES AND SOLIDS**	**3+9 HOURS**
Projection of simple planes (Square, circular, Hexagon, Pentagon) inclined to both the principal planes by rotating object method. Projection of simple solids like Prism, Pyramid, Cylinder& Cone when the axis is inclined to one of the principal planes by rotating object method.		
UNIT-3	**SECTION AND DEVELOPMENT SURFACES OF SOLIDS**	**3+9 HOURS**
Sectioning of simple solids (Prism, Pyramid, Cylinder& Cone) in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of surfaces of right regular sectioned solids		
UNIT-4	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS**	**3+9 HOURS**
Principles of Isometric Projections-Isometric scale- Isometric Views of simple and truncated solids. Conversion of Isometric views of the objects to Orthographic views Exercises using free hand sketching.		
UNIT-5	**COMPUTER AIDED DRAFTING (Only for Internal Evaluation)**	**3+9 HOURS**
Introduction to engineering graphics CAD tools, Drawing Orthographic views from Isometric views using CAD tools--Floor plans of simple buildings- Exercise of circuit diagram (2D Orthographic Views) and 3D modeling (Isometric Views) using AutoCAD Software.		
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 scale to fit solution within A3 size 4. The examination will be conducted in appropriate sessions on the same day		
	TOTAL LECTURE HOURS:	**60 HOURS**
TEXT BOOK(S):		

1.	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2.	Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3.	Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCE BOOKS:

1.	Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edit ion, 2019.
2.	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3.	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.
4.	Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
5.	Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
6.	Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

LIST OF EQUIPMENTS

S. NO	DESCRIPTION OF EQUIPMENT	QUANTITY
1.	Computer nodes or systems with suitable graphics facility	30 Nos
2.	Software for Drafting and Modelling	30 Nos
3.	Laser Printer or Plotter to print / plot drawings	1 No

LIST OF EXPERIMETS:

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software.
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola
3. Drawing orthographic view of simple solids like Prism, Pyramids, Cylinder, Cone, etc, and dimensioning.
4. Drawing of simple solids like prism and pyramids when the axis is inclined to HP.
5. Drawing of simple solids like cylinder and cone when the axis is inclined to HP.
6. Drawing isometric projection of simple solids.
7. Drawing of star –delta starter circuit
8. Drawing an electrical circuit of three-point starter.
9. Drawing of an electrical power supply circuit.
10. Drawing of Hartley oscillator.

Course Code	Course Title	L	T	P	J	C
22HSM201	**TAMILS AND TECHNOLOGY**	**1**	**0**	**0**	**0**	**1**
Pre-requisite		Syllabus version			v. 1.0	

Unit-1	**WEAVING AND CERAMIC TECHNOLOGY**	**03 hours**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
Unit-2	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**03 hours**
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 Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.		
Unit-3	**MANUFACTURING TECHNOLOGY**	**03 hours**
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-4	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**03 hours**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, 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-5	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**03 hours**
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 Lecture hours:	15 hours

TEXT BOOK(S)	
1.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
2.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
3.	Tamilaga Varalaru, Makalum Panpadum- Dr. K.K. Pillai
4.	Kanini Tamil- Munaivar L. Sundaram
5.	Porunai- Attrangarai Nagarigam
REFERENCE BOOKS	
1.	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

2.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3.	Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4.	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author)
5.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book

Course Code	Course Title	L	T	P	J	C
22EET202	**Skill Development Training-II (Student READY)**	**2**	**0**	**0**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. Learn design thinking concepts and principles
2. Use design thinking methods in every stage of the problem
3. Learn the different phases of design thinking
4. Apply various methods in design thinking to different problems
5. Apply the various the testing and implementation

COURSE OUTCOME:

1. Innovation of the new environmental conditions
2. Define key concepts of design thinking
3. Practice design thinking in all stages of problem-solving
4. Apply design thinking approach to real-world problems
5. Understand the testing and implementation

UNIT-1	**INNOVATIONS**	**6 HOURS**

Introduction, innovation in current environment, types of innovation, schools of innovation, analyzing the current business scenario, challenges of innovation, steps of innovation management, experimentation in innovation management, participation for innovation, co-creation for innovation, prototyping to incubation. blue ocean strategy –I, blue ocean strategy-II. marketing of innovation, technology innovation process.

UNIT-2	**DESIGN THINKING**	**6 HOURS**

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment, System Thinking, Product Thinking.

UNIT-3	**UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM**	**6 HOURS**

Search field determination - Problem clarification - Understanding of the problem - Problem analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.		
UNIT-4	**IDEATION AND PROTOTYPING**	**6 HOURS**
Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.		
UNIT-5	**TESTING AND IMPLEMENTATION**	**6 HOURS**
Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking. Design Thinking meets the corporation – The New Social Contract – Design Activism – Designing tomorrow.		
	TOTAL LECTURE HOURS:	**30 HOURS**
TEXT BOOK(S):		
1.	Christian Mueller-Rotenberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.	
2.	Designing for Growth: a design thinking tool kit for managers by Jeanne Liedtka and Tim Ogilvie.	
3.	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown.	
4.	John. R. Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage Learning (International edition) Second Edition, 2013	
REFERENCE BOOKS:		
1.	Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.	
2.	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.	
3.	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 201 4. http://ajjuliani.com/design-thinking-activities/ 5. https://venturewell.org/class-exercises	
4.	Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.	

Course Code	Course Title	L	T	P	J	C
22ESP201	ENGINEERING PRODUCT LABORATORY	0	0	3	0	1.5
		Syllabus version			v. 2.0	

COURSE OBJECTIVES: The main learning objective of this course is to provide hands on training to the students in:

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

COURSE OUTCOME: At the end of the course, the student will be able to

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES PLUMBING WORK 15

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.

b) Preparing plumbing line sketches.

c) Laying pipe connection to the suction side of a pump

d) Laying pipe connection to the delivery side of a pump.

e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

PART II ELECTRICAL ENGINEERING PRACTICES 15

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring with introduction to CFL and LED types.
3. Stair case wiring
4. Residential house wiring using fuse, switch, indicator, lamp and energy meter.
5. Measurement of energy using single phase energy meter.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

Demonstrating welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

BASIC MACHINING WORK:

Demonstrating of a) (simple)Turning. b) (simple)Drilling. c) (simple)Tapping.

3D PRINITNG:

Demonstrating of working principle of 3D Printer machine.

FOUNDRY WORK:

a) Demonstrating basic foundry operations

SHEET METAL WORK:

b) Making of a square tray

c) Making of a cone

FITTING EXERCISE:

Make a model by using fitting exercise

PART IV ELECTRONIC ENGINEERING PRACTICES 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, EOR 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.

TOTAL LABORATORY HOURS:	**60 HOURS**

Course Code	Course Title	L	T	P	J	C
22ESP202	**BASIC ELECTRICAL, ELECTRONICS ENGINEERING AND MEASUREMENTS LABORATORY**	**0**	**0**	**3**	**0**	**1.5**
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To train the students in conducting load tests on electrical machines
2.To gain practical experience in characterizing electronic devices
3.To train the students to use DSO for measurements

COURSE OUTCOME:

After completing this course, the students will be able to

1. Use experimental methods to verify the Ohm's and Kirchhoff's Laws.
2. Analyze experimentally the load characteristics of electrical machines
3. Analyze the characteristics of basic electronic devices
4. Use DSO to measure the various parameters

LIST OF EXPERIMENTS:

ELECTRICAL

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Induction Motor

ELECTRONICS

6. Experiment on Transistor based application circuits (Inverting and non-inverting amplifier or switching circuits) (Or) Experiments on Operational Amplifier based Inverting and non-inverting amplifier.
7. Experiments on ADC.
8. Experiments on 555 timer

MEASUREMENTS

9. Study on function of DSO.
10. Measurement of Amplitude, Frequency, Time, Phase Measurement using DSO.

TOTAL LECTURE HOURS:	**60 HOURS**

COURSE CODE	COURSE TITLE	L	T	P	J	C
22NCC201	**NCC Credit Course Level 1* (ARMY WING)**	**1**	**0**	**0**	**0**	**1**
		Syllabus version			**v. 1.0**	

UNIT-1	NCC GENERAL	3 HOURS

NCC 1 Aims, Objectives & Organization of NCC
NCC 2 Incentives
NCC 3 Duties of NCC Cadet
NCC 4 NCC Camps: Types & Conduct

UNIT-2	NATIONAL INTEGRATION AND AWARENESS	3 HOURS

NI 1 National Integration: Importance & Necessity
NI 2 Factors Affecting National Integration
NI 3 Unity in Diversity & Role of NCC in Nation Building
NI 4 Threats to National Security

UNIT-3	PERSONALITY DEVELOPMENT	3 HOURS

PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving
PD 2 Communication Skills
PD 3 Group Discussion: Stress & Emotions

UNIT-4	LEADERSHIP	2 HOURS
L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code L 2 Case Studies: Shivaji, Jhasi Ki Rani		
UNIT-5	**SOCIAL SERVICE AND COMMUNITY DEVELOPMENT**	**4 HOURS**
SS 1 Basics, Rural Development Programmes, NGOs, Contribution o Youth SS 2 Protection of Children and Women Safety SS 3 Road / Rail Travel Safety SS 4 New Initiatives SS 5 Cyber and Mobile Security Awareness		
	TOTAL LECTURE HOURS	**15 HOURS**

COURSE CODE	COURSE TITLE	L	T	P	J	C
22NCC202	NCC Credit Course Level 1* (NAVAL WING)	1	0	0	0	1
		Syllabus version			v. 1.0	

UNIT-1	NCC GENERAL	3 HOURS
NCC 1 Aims, Objectives & Organization of NCC NCC 2 Incentives NCC 3 Duties of NCC Cadet NCC 4 NCC Camps: Types & Conduct		
UNIT-2	**NATIONAL INTEGRATION AND AWARENESS**	**3 HOURS**
NI 1 National Integration: Importance & Necessity NI 2 Factors Affecting National Integration NI 3 Unity in Diversity & Role of NCC in Nation Building NI 4 Threats to National Security		
UNIT-3	**PERSONALITY DEVELOPMENT**	**3 HOURS**
PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving PD 2 Communication Skills PD 3 Group Discussion: Stress & Emotions		
UNIT-4	**LEADERSHIP**	**2 HOURS**
L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code L 2 Case Studies: Shivaji, Jhasi Ki Rani		

UNIT-5	**SOCIAL SERVICE AND COMMUNITY DEVELOPMENT**	**4 HOURS**
SS 1 Basics, Rural Development Programmes, NGOs, Contribution o Youth SS 2 Protection of Children and Women Safety SS 3 Road / Rail Travel Safety SS 4 New Initiatives SS 5 Cyber and Mobile Security Awareness		
	TOTAL LECTURE HOURS	**15 HOURS**

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**J**	**C**
22NCC203	**NCC Credit Course Level 1* (AIR FORCE WING)**	**1**	**0**	**0**	**0**	**1**
		Syllabus version			**v. 1.0**	

UNIT-1	**NCC GENERAL**	**3 HOURS**
NCC 1 Aims, Objectives & Organization of NCC NCC 2 Incentives NCC 3 Duties of NCC Cadet NCC 4 NCC Camps: Types & Conduct		
UNIT-2	**NATIONAL INTEGRATION AND AWARENESS**	**3 HOURS**
NI 1 National Integration: Importance & Necessity NI 2 Factors Affecting National Integration NI 3 Unity in Diversity & Role of NCC in Nation Building NI 4 Threats to National Security		
UNIT-3	**PERSONALITY DEVELOPMENT**	**3 HOURS**
PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving PD 2 Communication Skills PD 3 Group Discussion: Stress & Emotions		
UNIT-4	**LEADERSHIP**	**2 HOURS**
L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code L 2 Case Studies: Shivaji, Jhasi Ki Rani		
UNIT-5	**SOCIAL SERVICE AND COMMUNITY DEVELOPMENT**	**4 HOURS**

SS 1 Basics, Rural Development Programmes, NGOs, Contribution o Youth SS 2 Protection of Children and Women Safety SS 3 Road / Rail Travel Safety SS 4 New Initiatives SS 5 Cyber and Mobile Security Awareness	
TOTAL LECTURE HOURS	**15 HOURS**

SEMESTER – III

Course Code	Course Title	L	T	P	J	C
22BST303	**Fourier Series and Linear Programming**	**3**	**2**	**0**	**0**	**4**
Pre-requisite		Syllabus version			v. 2.0	

COURSE OBJECTIVES:

1. To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
2. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
3. To acquaint the student with Fourier, transform techniques used in wide variety of situations
4. To have knowledge in solving linear programming problems.
5. To acquaint knowledge to solve transportation and assignment problems.
6. To familiar with the method of solving nonlinear programming problems.

COURSE OUTCOME:

1. Apply Fourier series techniques used in wide variety of situations in which the functions used are not periodic and to solve boundary value problems.
2. Apply the Fourier transform techniques to solve boundary value problems.
3. Develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the Simplex method for solving linear programming problems.
4. Analyze the concept of developing, formulating, modelling and solving transportation and assignment problems.
5. Determine the optimum solution for non-linear programming problems.

Unit-1	FOURIER SERIES	12 hours

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity— Harmonic analysis.

Unit-2	FOURIER TRANSFORMS	12 hours

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem –Parseval's identity.		
Unit-3	**LINEAR PROGRAMMING PROBLEMS**	**12 hours**
Mathematical formulation – Graphical method – Simplex method – Artificial variable techniques – Big M Method – Two phase Simplex method		
Unit-4	**TRANSPORTATION AND ASSIGNMENT PROBLEMS**	**12 hours**
Matrix form – Loops in T.P – Initial basic feasible solutions – Transportation algorithm – Degeneracy in T.P – Assignment and Routing problems.		
Unit-5	**NON-LINEAR PROGRAMMING PROBLEMS**	**12 hours**
Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions – Quadratic programming.		
	Total Lecture hours:	60 hours

TEXT BOOK(S)

1.	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2.	H.A. Taha, "Operations Research – An introduction", 10th Edition, Pearson Education, New Delhi, 2017.
3.	Kanti Swarup, Guptha P.K. and Man Mohan, "Operations Research", 5th Edition, Sultan Chand & Sons, New Delhi, 2010.

REFERENCE BOOKS

1.	Kreyszig E, "Advanced Engineering Mathematics", 10th Edition, John Wiley, New Delhi, India, 2016.
2.	Ravindran, Philips and Solberg "Operations Research, Principles and Practice", 2nd Edition, Wiley, New Delhi, 2007.
3.	Frederick S Hillier and Gerald J. Lieberman, "Introduction to Operations Research", Mc Graw Hill, New Delhi, 2017.
4.	J.K. Sharma," Operations Research – Theory and Applications ", Mac Millan India Ltd ,2 nd Edition, New Delhi, 2003.
5.	Richard Bronson & Govindasami Naadimuthu, "Operations Research" (Schaum's Outlines – TMH Edition) Tata McGraw Hill, 2nd Edition, New Delhi, 2004.

Course Code	Course Title	L	T	P	J	C
22AGT301	**Principles of Soil Science and Engineering**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:		
1. To expose the students to the fundamental knowledge on Soil physical parameters, Permeability 2. Compaction, Bearing Capacity and types and methods of soil survey and interpretative groupings		
Course Outcome:		
1. Understand the fundamental knowledge of soil physical parameters. 2. Perform soil survey and classify soil based on its characteristics 3. Explain the phase relationship and soil compaction. 4. Analyze Engineering properties of soil 5. Understand Concepts of bearing capacity and slope stability.		
Unit-1	**Introduction and Soil Physics**	**9 hours**
Soil - definition - major components –Soil forming minerals and processes - soil profile -Physical properties - texture – density-porosity-consistence-colour-specific gravity - capillary and non-capillary -plasticity. Soil air - soil temperature - soil water - classification of soil water- Movement soil water. Soil colloids – organic and inorganic matter-Ion exchange- pH – Plant nutrient availability		
Unit-2	**Soil Classification and Survey**	**9 hours**
Soil taxonomy – Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey – Field mapping- mapping units - base maps -preparation of survey reports - concepts and uses - Land Capability Classes and subclasses - soil suitability -Problem soils – Reclamation.		
Unit-3	**Phase Relationship and Soil Compaction**	**9 hours**
Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil – Soil compaction- factors affecting compaction- field and laboratory methods.		
Unit-4	**Engineering Properties of Soil**	**9 hours**
Shear strength of cohesive and cohesionless - Mohr-Coulomb failure theory- Measurement of shear strength, direct shear, Triaxial and vane shear test- -Permeability- Coefficient of Permeability-Darcy's law-field and lab methods - Assessment of seepage - Compressibility.		
Unit-5	**Bearing Capacity and Slope Stability**	**9 hours**
Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow foundations-Terzaghi"s formula- BIS standards - Slope Stability-Analysis of infinite and finite slopes- friction circle method-slope protection measures.		
	Total Lecture hours:	45 hours
Text Book(s)		
1.	Nyle C. Brady, "The Nature and Properties of Soil", Macmillan Publishing Company, 10th Edition, New York, 2008.	

2.	Punmia, B.C., “Soil Mechanics and Foundation “Laxmi Publishers, New Delhi, 2007.
Reference Books	
1.	Edward J. Plaster., “Soil Science”, Cengage Learning India Ltd, New Delhi, 2009.
2.	Arora, K.R. “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 2007.
3.	Murthy, V.N.S. “Soil Mechanics and Foundation Engineering”, UBS Publishers and Distributors, New Delhi, 2007.
4.	Sehgal, S.B., “Text Book of Soil Mechanics”, CBS Publishers and Distributors New Delhi, 2007.

Course Code	Course Title	L	T	P	J	C
22AGT302	**Unit Operations in Agricultural Processing**	**2**	**0**	**2**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. The students would be exposed to the fundamental knowledge in Evaporation, Filtration, Sedimentation, Processing, Sieve analysis, Crystallization and Distillation in processing of agricultural produce.

Course Outcome:

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

Unit-1	**Evaporation And Concentration**	**6 hours**

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-2	**Mechanical Separation**	**6 hours**

Filtration – definition –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter cake resistance-filtration equipment – rotary vacuum filter – filter press-sedimentation – gravitational sedimentation of particles in a fluid – Stoke's law, sedimentation of particles in gas-cyclones – settling under sedimentation and gravitational sedimentation-centrifugal separations – rate of separations – liquid – liquid separation – centrifuge equipment.		
Unit-3	**Size Reduction**	**6 hours**
Size reduction – grinding and cutting – principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products-energy and power requirements in comminuting – crushing efficiency – Rittinger's, Bond's and Kick's laws for crushing-size reduction equipment – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.		
Unit-4	**Contact Equilibrium Separation**	**6 hours**
Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – 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 – equipment		
Unit-5	**Crystallisation And Distillation**	**6 hours**
Crystallization-Equilibrium –Rate of crystal growth stage-Equilibrium crystallization-Crystallizers-Equipment-Classification- Construction and operation – Crystallizers-Tank-Agitated batch-Swenson-Walker and Vacuum crystallizers-Distillation-Binary mixtures-Flash and differential distillation-Steam distillation –Theory-Continuous distillation with rectification –Vacuum distillation - Batch distillation-Operation and process-Advantages and limitation-Distillation equipment-Construction and operation-Factors influencing the operation.		
	Total Lecture hours:	30 hours
Text Book(s)		
1.	Earle, R.L., "Unit operations in Food Processing", Pergamon Press, Oxford, U.K, 1985.	
2.	McCabe, W.L., and Smith, J.C., "Unit Operations of Chemical Engineering", Mc-Graw-Hill Inc., Kosaido Printing Ltd., Tokyo, 1990.	
3.	Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th Edition, Prentice Hall, 2003.	
Reference Books		
1.	Coulson, J.M and J.F. Richardson. Chemical Engineering. Volume I to V. The Pergamon Press. New York, 1999.	
2.	Albert Ibarz and Gustavo V. Barbosa-Cánovas. Unit Operations in Food Engineering. CRC Press LLC, Florida, 2003.	

List of Challenging Experiments (Indicative)	
1.	Determination of thermal efficiency and economy of evaporator
2.	Determination of separation efficiency of centrifugal separator
3.	Determination of collection efficiency in cyclone separator
4.	Determination of efficiency of liquid-solid separation by filtration
5.	Determination of absorption efficiency in a packing tower
6.	Performance evaluation of a sieve and determination of particle size of granular foods by sieve analysis
7.	Determination of energy requirement in size reduction using the burr mill
8.	Determination of energy requirement in size reduction using the ball mill and hammer mill
9.	Determination of mixing index for solids
10.	Determination of economy and thermal efficiency of rotary flash evaporator
11.	Concentration of juice
12.	Performance evaluation of a steam distillation process
Total Laboratory Hours	30 hours

Course Code	Course Title	L	T	P	J	C
22AGT303	**Fluid Mechanics and Pumps**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To introduce the students about the properties of the fluids, behaviour of fluids under static, kinematic and dynamic conditions through the control volume approach and expose them to the applications of the conservation laws and to impart basic knowledge of the dimensional analysis and model studies along with flow through pipes.
2. The students will be exposed to the basic concepts of open channel flows with significance to steady uniform flows along with flow measurements in open channels.
3. To expose the students to the classification of pumps the basic principles of working and to design centrifugal pump.

Course Outcome:

1. Demonstrate the properties of fluid and its behaviour in static conditions along with pressure measurements.
2. Apply the conservation laws applicable to fluid flows and its application through fluid kinematics

and dynamics.
3. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel and to understand the concept of application of dimensional analysis in model studies.
4. Describe the basics characteristics of open channel flows and analysis of steady uniform flow with hydraulically efficient channel sections and to measure the flows in artificial/natural channels.
5. Explain the classification, design and working principles of various pumps.

Unit-1	**Fluid Properties And Fluid Statics**	**9 hours**
Definition and properties of fluid - Mass density – Specific weight - Specific volume – Specific gravity - Equation of state – Perfect gas - Viscosity – Vapour pressure – Compressibility and elasticity - Surface tension – Capillarity- Fluid statics – Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges - Forces on plane and curved surfaces - Buoyancy and floatation - Stability of floating bodies.		
Unit-2	**Fluid Kinematics And Fluid Dynamics**	**9 hours**
Classification of flows - Methods of analysis- Continuum hypothesis - System and Control volume approach - Streamline, streak-line and path-lines - Stream function - Velocity potentials - Flow nets - Application of control volume to continuity, energy and momentum - Euler's equation of motion along a stream line - Bernoulli's equation - Linear momentum equation – Applications.		
Unit-3	**Flow Through Pipes And Model Studies**	**9 hours**
Reynolds experiment - Laminar flow through circular pipe - Darcy-Weisbach equation - Moody diagram - Major and minor losses in pipe flow – Total energy line – Hydraulic grade line – Siphon - Pipes in series and parallel- Equivalent pipes- Fundamental dimensions - Dimensional homogeneity - Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.		
Unit-4	**Open Channel Flows**	**9 hours**
Types of flow – Characteristics of open channel - Chezy's equation - Manning equation – Hydraulically efficient channel sections - Critical depth – Specific energy application to channel transitions – Flow measurement in channels – Notches – Weirs - Parshall flume - Flow measurement in natural streams – float method – current meter.		
Unit-5	**Pumps**	**9 hours**
Types of pumps – Head of pump – Losses and efficiencies -Selection of pump capacity - Centrifugal pump – Components – Working principle – Types of impellers - Priming – NPSH - Cavitation – Minimum speed to start the pump - Specific speed – Characteristics curves - Turbine pump - Submersible pump - Jet pump – Air lift pump - Reciprocating pump - Sludge pump.		
	Total Lecture hours:	45 hours
Text Book(s)		

1.	Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2017.
2.	Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, New Delhi, 2019.
3.	Subramanya K., Flow in Open Channels, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2019.
Reference Books	
1.	Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
2.	S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Education (India) Pvt. Ltd., 2017.
3.	Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017
4.	Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
5.	Subramanya K, Fluid Mechanics and Hydraulic Machines: Problems and Solutions, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2018.

Course Code	Course Title	L	T	P	J	C
22AGT304	**Surveying and Levelling**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To introduce the rudiments of plane surveying and geodetic principles to Agricultural Engineers and to learn the various methods of plane and geodetic surveying to solve the real world problems.
2. To introduce the concepts of Control Surveying. To introduce the basics of Astronomical Surveying.

Course Outcome:

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

Unit-1	**Fundamentals Of Conventional Surveying**	**9 hours**

Definition – Classifications – Basic 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 – Radiation – Intersection – Resection – Plane table traversing.

Unit-2	Levelling	9 hours
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-3	**Theodolite Surveying**	**9 hours**
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-4	**Control Surveying And Adjustment**	**9 hours**
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-5	**Modern Surveying**	**9 hours**
Total Station: Digital Theodolite, EDM, Electronic field book – Advantages – Parts and accessories – Working principle – Observables – Errors - COGO functions – Field procedure and applications. GPS: Advantages – System components – Signal structure – Selective availability and antispoofing receiver components and antenna – Planning and data acquisition – Data processing – Errors in GPS – Field procedure and applications.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016.
2.	T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008.
Reference Books	
1.	R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2.	James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.
3.	Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4.	S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India 2010.
5.	K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013.
6.	C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.

Course Code	Course Title	L	T	P	J	C
22AGP301	**FLUID MECHANICS LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus			v. 1.0	

		version	
Course Objectives:			
1. Students should able to verify the principles studied in theory by performing the experiments in the laboratory.			
Course Outcome:			
1. Apply Bernoulli equation for calibration of flow measuring devices. 2. Measure friction factor in pipes and compare with Moody diagram 3. Determine the performance characteristics of rotodynamic pumps. 4. Determine the performance characteristics of positive displacement pumps.			
LIST OF EXPERIMENTS:			
1. Calibration of Rotameter 2. Flow through Venturimeter 3. Flow through a circular Orifice 4. Determination of mean velocity by Pitot tube 5. Flow through a Triangular Notch 6. Flow through a Rectangular Notch 7. Determination of friction coefficient in pipes 8. Determination of losses due to bends, fittings and elbows 9. Characteristics of Centrifugal pump 10. Characteristics of Submersible pump 11. Characteristics of Reciprocating pump			
		Total Lecture hours:	**60hours**

Course Code	Course Title	L	T	P	J	C
22AGP302	**SOIL SCIENCE LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	
Course Objectives:						
1. Students should able to verify various quality aspects of soil and water studied in theory by performing experiments in the laboratory.						
Course Outcome:						
1. Explain soil physical properties and compare the properties based on soil and water system. 2. Analyse the soil chemical properties to classify the arable and problem soils to develop different reclamation practices.						
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. Specific gravity determination by Pycnometer 6. Textural analysis of soil by International Pipette method 7. Grain size analysis by using Mechanical shake 8. Determination of Organic carbon 9. Estimation of Gypsum requirements 10. Estimation of Index properties of the soil

Total Lecture hours:	**60hours**

Course Code	Course Title	L	T	P	J	C
22AGP303	**SURVEYING AND LEVELLING LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. The student will possess knowledge about survey field techniques.

Course Outcome:

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

LIST OF EXPERIMENTS:

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset.
2. Setting out works – Foundation marking using tapes single Room and Double Room.
3. Compass Traversing – Measuring Bearings & arriving included angles.
4. Fly levelling using Dumpy level &Tilting level.
5. Check levelling.
6. Measurements of horizontal angles by reiteration and repetition and vertical angles.
7. Determination of elevation of an object using single plane method when base is Accessible/inaccessible.
8. Determination of Tacheometric Constants.
9. Heights and distances by stadia Tacheometry.
10. Heights and distances by Tangential Tacheometry.
11. Traverse using Total station and Area of Traverse.

12. Determination of distance and difference in elevation between two inaccessible points using Total station.	
Total Lecture hours:	**60hours**

SEMESTER - IV

Course Code	Course Title	L	T	P	J	C
22AGT401	**TRACTORS AND ENGINE SYSTEMS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

To introduce the students to the different systems and working principles of tractor, power tiller, makes of tractors and power tillers.

Course Outcome:

On completion of the course, the student is expected to

1. Get an idea on various machinery available for farm mechanization
2. Calculate the valve timing of an IC engine and represent by a drawing
3. Gain knowledge on the transmission system of a tractor
4. Understand the hydraulic system in a tractor and estimate the traction.
5. Gain knowledge on power tillers, bulldozers and different tractor testing procedures.

Unit-1	**TRACTORS**	**9 hours**

Classification of tractors – Tractor engines – construction of engine blocks, cylinder head and crankcase – features of cylinder, piston, connecting rod and crankshaft – firing order combustion chambers.

Unit-2	**ENGINE SYSTEMS**	**9 hours**

Valves-inlet and outlet valves – valve timing diagram. Air cleaner- exhaust – silencer. Cooling systems – lubricating systems – fuel system – governor- electrical system.

Unit-3	**TRANSMISSION SYSTEMS**	**9 hours**

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-4	**HYDRAULIC SYSTEMS**	**9 hours**

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

Unit-5	**POWER TILLER, BULLDOZER AND TRACTOR TESTING**	**9 hours**
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 –Test code for performance testing of tractors and power tiller.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Jain, S.C. and C.R. Rai. Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 1999.
2.	Alfred V. Aho, John E. Hopperoft, Jeffrey D. Uilman, “Data Structures and Algorithms”, First Edition, Pearson Publishers, 1983.
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, Delhi,1999.
3.	Black, P.O. Diesel engine manual. Taraporevala Sons& Co., Mumbai, 1996.
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.	Jagadeeshwar Sahay, Elements of Agricultural Engineering, Standard Publishers Co., New Delhi, 2010.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22AGT402	**SOIL AND WATER CONSERVATION ENGINEERING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

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

Course Outcome:

On completion of the course, the student is expected to

1. Gain fundamental knowledge on the concepts of erosion and sedimentation.
2. Gain knowledge about evolution of Universal Soil Loss Equation: and its applications.
3. Explain and design erosion control measures types and design specifications
4. Have sufficient knowledge on soil and water conservation measures.
5. Have sufficient knowledge on reservoir sedimentation and sediment control methods.

Unit-1	**SOIL EROSION PRINCIPLES**	**9 hours**

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

Unit-2	**ESTIMATION OF SOIL EROSION**	**9 hours**

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

Unit-3	**EROSION CONTROL MEASURES**	**9 hours**

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

Unit-4	**WATER CONSERVATION MEASURES**	**9 hours**

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

Unit-5	**SEDIMENTATION**	**9 hours**

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 Lecture hours:	**45 hours**

Text Book(s)	
1.	Suresh, R., “Soil and Water Conservation Engineering”, Standard Publication, New Delhi, 2007.
2.	Ghanshyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2000.
3.	“Sedimentation Engineering”, 2006, ASCE manual and Report on Engineering Practice No. 54, Edited by Vito A. Vanoni. ASCE publishing.
Reference Books	
1.	Murthy, V.V.N., “Land and Water Management Engineering”, Kalyani Publishers, Ludhiana, 1998.
2.	Gurmail Singh, “A Manual on Soil and Water Conservation”, ICAR Publication, New Delhi, 1982.
3.	Mal, B.C., “Introduction to Soil and Water Conservation Engineering”, Kalyani Publishers, New Delhi, 2002

Course Code	Course Title	L	T	P	J	C
22AGT403	**STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

To understand the stresses developed in bars, compound, bars, beams, shafts, cylinders and spheres.

Course Outcome:

1. Find the stress distribution and strains in regular and composite structures subjected to axial loads.
2. Evaluate the stresses in plane trusses.
3. Assess the shear force, bending moment and bending stresses in beams.
4. Apply torsion equation in design of circular shafts and helical springs.
5. Evaluate the slope and deflection of beams and buckling loads of columns under different.

Unit-1	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9 hours

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 - deformation of thin cylinder – stresses in spherical shells – Deformation of spherical shells.

Unit-2	ANALYSIS OF PLANE TRUSSES	9 hours
Determinate and indeterminate plane trusses – determination of member forces by method of joints, method of sections and method of tension coefficient.		
Unit-3	**TRANSVERSE LOADING AND STRESSES IN BEAM**	**9 hours**
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-4	**TORSION**	**9 hours**
Torsion formula - stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs - carriage springs.		
Unit-5	**DEFLECTION OF BEAMS**	**9 hours**
Computation of slopes and deflections in determinate beams - Double Integration method – Macaulay"s method – Area moment method – Conjugate beam method.		
Total Lecture hours:		45 hours
Text Book(s)		
1.	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007	
2.	Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007	
Reference Books		
1.	Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2001	
2.	Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,2007.	
3.	Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007	
4.	Ferdinand P. Been, Russell Johnson, Jr. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing „co. Ltd., New Delhi, 2005.	

Course Code	Course Title	L	T	P	J	C
22AGT404	**HYDROLOGY AND WATER RESOURCES ENGINEERING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To introduce to the students, the concepts of hydrological processes, hydrological extremes and groundwater.
2. To prepare the students to quantify, regulate and manage water resources.

Course Outcome:

On completion of the course, the student is expected to

1. Define the hydrological processes and their integrated behaviour in catchments
2. Apply the knowledge of hydrological processes to address basin characteristics, runoff and hydrograph
3. Explain the concept of hydrological extremes and its management strategies
4. Describe the principles of storage reservoirs
5. Understand and apply the concepts of groundwater management

Unit-1	**PRECIPITATION AND ABSTRACTIONS**	**9 hours**

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

Unit-2	**RUNOFF**	**9 hours**

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

Unit-3	**HYDROLOGICAL EXTREMES**	**9 hours**

Natural Disasters - Frequency analysis - Flood estimation - Flood management - Definitions of drought: Meteorological, Hydrological, Agricultural and Integrated - IMD method - NDVI analysis - Drought Prone Area Programme (DPAP).

Unit-4	**RESERVOIRS**	**9 hours**

Classification of reservoirs - Site selection - General principles of design - Spillways – Elevation Area-Capacity curve – Storage estimation – Sedimentation – Life of reservoirs – Rule curve.

Unit-5	**GROUNDWATER AND MANAGEMENT**	**9 hours**

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

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Subramanya K, "Engineering Hydrology"- Tata McGraw Hill, 2010
2.	Jayarami Reddy P, "Hydrology", Tata McGraw Hill, 2008.
Reference Books	
1.	David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2.	Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.
3.	Raghunath. H.M., "Hydrology", Wiley Eastern Ltd., 1998.
4.	Bhagu R. Chahar, Groundwater Hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

Course Code	Course Title	L	T	P	J	C
22AGT405	**ENGINEERING THERMODYNAMICS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
2. Impart knowledge on the second law of thermodynamics in analyzing the performance of thermal devices.
3. Impart knowledge on availability and applications of second law of thermodynamics
4. Teach the various properties of steam through steam tables and Mollier chart.
5. Impart knowledge on the macroscopic properties of ideal and real gases.

Course Outcome:

On completion of the course, the student is expected to

1. Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
2. Apply the second law of thermodynamics in analyzing the performance of thermal devices through energy and entropy calculations.
3. Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
4. Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
5. Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

Unit-1	**BASICS, ZEROTH AND FIRST LAW**	**9 hours**

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.		
Unit-2	**SECOND LAW AND ENTROPY**	**9 hours**
Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.		
Unit-3	**AVAILABILITY AND APPLICATIONS OF II LAW**	**9 hours**
Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High and low grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency		
Unit-4	**PROPERTIES OF PURE SUBSTANCES**	**9 hours**
Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.		
Unit-5	**GAS MIXTURES AND THERMODYNAMIC RELATIONS**	**9 hours**
Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. Vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius-Clapeyron equation.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Nag.P.K., “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill (2017), New Delhi.	
2.	Natarajan, E., “Engineering Thermodynamics: Fundamentals and Applications”, 2nd Edition (2014), Anuragam Publications, Chennai	
Reference Books		
1.	Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.	
2.	Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.	
3.	Rathakrishnan, E., “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.	

4.	Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 10th Edition, Wiley Eastern, 2019.
5.	Venkatesh. A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007.

Course Code	Course Title	L	T	P	J	C
22BST401	**ENVIRONMENTAL SCIENCES AND SUSTAINABILITY**	**2**	**0**	**0**	**0**	**2**
Pre-requisite		Syllabus version		v. 1.0		

Unit-1	**ENVIRONMENT AND BIODIVERSITY**	**9 hours**

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 – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

Unit-2	**ENVIRONMENTAL POLLUTION**	**9 hours**

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 .

Unit-3	**RENEWABLE SOURCES OF ENERGY**	**9 hours**

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-4	**SUSTAINABILITY AND MANAGEMENT**	**9 hours**

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and Protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

Unit-5	**SUSTAINABILITY PRACTICES**	**9 hours**

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cyclescarbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socioeconomical and technological change..	
Total Lecture hours:	**45 hours**
Text Book(s)	
1.	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3.	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5.	Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7.	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
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.

Course Code	Course Title	L	T	P	J	C
22AGP401	**TRACTOR AND FARM ENGINES LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	
Course Objectives:						

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

Course Outcome:

On completion of the course, the student is expected to

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

LIST OF EXPERIMENTS:

1. Identification and study of different components of diesel engine
2. Identification and study of different components of petrol engine
3. Method of working of diesel engine with the help of working models
4. Method of working of diesel engine with the help of working models
5. Dismantling and assembly of diesel engine
6. Dismantling and assembly of petrol engine
7. Study of clutch – components and method of working
8. Study of gear box – components and method of working
9. Study of differential and final drive– components and method of working
10. Study of braking system and steering system – components and method of working
11. Study of hydraulic system and PTO system in a tractor
12. Study of electrical system, instruments in the dash board and controls – components: dynamo, starting motor, battery, lights, horn, odometer, amperemeter, accelerator, brake,differential lock, PTO lever, hydraulic lever, draft and position control lever.

LIST OF EQUIPMENT REQUIRED

1. Working model of diesel engine
2. Working model of petrol engine
3. Working model of clutch
4. Working model of gear box
5. Working model of differential
6. Working model of final drive
7. Working model of brake system
8. Working model of steering system9. Condemned tractor
10. Condemned diesel engine
11. Condemned petrol engine

Total Lecture hours:	**60hours**

CO-PO MAPPING: TRACTOR AND FARM ENGINES LABORATORY

	PO/PSO	CO1	CO2	CO3	correlation of COs with
PO1	Knowledge of Engineering Sciences	2	3	3	3
PO2	Problem Analysis	2	1	2	2
PO3	Design/ Development of Solutions	2	2	2	2
PO4	Investigations	1	1	1	1
PO5	Modern Tool Usage	3	3	3	3
PO6	Individual and Team work	1	1	1	1
PO7	Communication	-	-	-	-
PO8	The Engineer and Society	-	-	-	-
PO9	Ethics	-	-	-	-
PO10	Environment and Sustainability	1	1	1	1
PO11	Project Management and Finance	2	2	2	2
PO12	Life Long Learning	1	1	1	1
PSO1	To bring expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill	3	3	3	3
PSO2	To enhance the ability of students to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.	3	3	3	3
PSO3	To inculcate entrepreneurial skills through strong Industry-Institution linkage.	3	3	3	3

Course Code	Course Title	L	T	P	J	C
22AGP402	**STRENGTH OF MATERIALS LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

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

Course Outcome:

On completion of the course, the student is expected 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

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

LIST OF EQUIPMENT REQUIRED

1. UTM of minimum 400 kN capacity
2. Torsion testing machine
3. Izod impact testing machine
4. Hardness testing machine
5. Rockwell, Vicker's, Brinnel (any 2)
6. Extensometer
7. Compressometer
8. Dial gauges
9. Le Chatelier's apparatus
10. Vicat's apparatus

Total Lecture hours:	**60hours**

CO-PO MAPPING: STRENGTH OF MATERIALS LABORATORY

	PO/PSO	CO1	CO2	CO3	correlation of COs with PO
PO1	Knowledge of Engineering Sciences	2	3	3	3
PO2	Problem Analysis	2	1	2	2
PO3	Design/ Development of Solutions	2	2	2	2
PO4	Investigations	1	1	1	1
PO5	Modern Tool Usage	-	-	-	-
PO6	Individual and Team work	1	1	1	1
PO7	Communication	-	-	-	-
PO8	The Engineer and Society	-	-	-	-
PO9	Ethics	-	-	-	-
PO10	Environment and Sustainability	-	-	-	-
PO11	Project Management and Finance	2	2	2	2
PO12	Life Long Learning	1	1	1	1

PSO1	To bring expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill	3	3	3	3
PSO2	To enhance the ability of students to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.	3	3	3	3
PSO3	To inculcate entrepreneurial skills through strong Industry-Institution linkage.	1	1	1	1

Course Code	Course Title	L	T	P	J	C
22EEP401	**QUANTITATIVE APTITUDE AND LOGICAL REASONING -1**	**0**	**0**	**2**	**0**	**1**
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. This module would train the students on the quick ways to solve quantitative aptitude problems

and questions applying logical reasoning, within a short time span given during the placement drives.

COURSE OUTCOME:

Upon the completion of this course, the students will be able to;

- CO1: Demonstrate the various Mock interviews on one-on-one basis.
- CO2: Analyze and Identify Quantitative aptitude.
- CO3: Analyze and Identify Logical Reasoning.

LIST OF EXPERIMENTS:

1. Mock interviews on one-on-one basis
2. Quantitative aptitude
3. Partnership
4. Simple Interest, Compound Interest
5. Profit and Loss
6. Problems on Clock, Calendar and Cubes
7. Permutation and Combination
8. Allegation and mixtures
9. Logical Reasoning
10. Letter and Symbol series
11. Number series
12. Analyzing arguments

13. Making judgments	
Total Lecture hours:	**30 hours**

SEMESTER-V

Course Code	Course Title	L	T	P	J	C
22AGT501	**FARM EQUIPMENT AND MACHINERY**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To introduce the students to the working principles of farm equipments, tillage implements
2. To expose the students to farm mechanization benefits and constraints, identification of components of primary and secondary tillage implements

Course Outcome:

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

Unit-1	**FARM MECHANIZATION**	**9 hours**

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

Unit-2	**PRIMARY AND SECONDARY TILLAGE IMPLEMENTS**	**9 hours**

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

Unit-3	**SOWING AND FERTILIZING EQUIPMENT**	**9 hours**

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

Unit-4	**WEEDING AND PLANT PROTECTION EQUIPMENT**	**9 hours**

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-5	**HARVESTING MACHINERY**	**9 hours**
Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder combine harvesters, balers, threshers, tractor on top combine harvester, combine losses		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Jagdishwar Sahay. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.,2010	
2.	Michael and Ohja. Principles of Agricultural Engineering. Jain brothers, New Delhi., 2005	
Reference Books		
1.	Kepner, R.A., et al. Principles of farm machinery. CBS Publishers and Distributers, Delhi. 99, 1997.	
2.	Harris Pearson Smith et al. Farm machinery and equipment. Tata McGraw-Hill pub., New Delhi.,1996	
3.	Srivastava, A.C. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi, 1990.	

Course Code	Course Title	L	T	P	J	C
22AGP501	**FARM MACHINERY LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	
Course Objective:						
1. The students will be introduced to the practice of different farm machinery in the field on tillage, sowing, plant protection, harvesting and threshing; care and maintenance; lubrication; fits and tolerances and replacements; adjustments of farm machines; dismantling and reassembling of a disc harrow, seed-cum fertilizer drill and sprayer, engine pumps						
Course Outcome:						

- To identify major systems in a tractor and general guidelines on preliminary check measures before starting a tractor.
- To have knowledge of the field operations and management of tillage implements.
- To have knowledge of the field operations and management of seeder devices and plant protection equipment.
- To have knowledge of the field operations and management of harvesters, threshers and combines.
- To have knowledge of the field operations and management of heavy earth moving machinery.

LIST OF EXPERIMENTS:

1. Identification of major systems of a tractor and general guidelines on preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor.
2. Identification of components of power tiller, their maintenance and study on preliminary check measures and safety aspects before starting a power tiller - procedure for starting, running and stopping the power tiller.
3. Field operation and adjustments of ploughs
4. Field operation and adjustments of harrows
5. Field operation and adjustments of cultivators
6. Field operation of sowing and planting equipment and their adjustments
7. Field operation of plant protection equipment
8. Field operation on mowers and reapers
9. Field operation of combine and determination of field losses
10. Field operation of threshers and their performance evaluation
11. Studies on methods of repair, maintenance and off-season storage of farm equipment
12. Opening and reassembly of disc harrows, determination and adjustment of tilt and disc angles
13. Hitching of agricultural implements and trailers
14. Study and operation of bulldozer
15. Visit to agro-manufacturers

Text Book(s)

1.	Jain, S.C. and C.R. Rai. Farm Tractor Maintenance and Repair. Standard publishers and Distributors, New Delhi, 1999.
2.	Herbert L.Nichols Sr., Moving the Earth, D. Van Nostrand company Inc. Princeton, 1959.

REFERENCE BOOKS

1.	John A Havers and Frank W Stubbs, Hand book of Heavy Construction, McGraw – Hill book Company, New York, 1971
2.	Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.
Total Lecture hours:	**60hours**

Course Code	Course Title	L	T	P	J	C
22AGP502	**ICT IN AGRICULTURAL ENGINEERING LABORATORY**	**0**	**0**	**2**	**0**	**1**
Pre-requisite		Syllabus version			v. 1.0	

Course Objective:

1. To gain practical knowledge on various technologies in information and communication for agriculture.

Course Outcome:

- Knowledge on meteorological measurements
- Obtain knowledge on triggering an agricultural system
- Knowledge on Image processing as tool for biotic and abiotic stress identification
- Ability to conduct spatial analysis of rainfall data and design water storage reservoirs.

LIST OF EXPERIMENTS:

1. Configuring timers for automatic switching “on and off” of irrigation systems
2. Experience with solenoid valves for pressurized irrigation
3. Using sensors for Agro meteorological measurements
4. Employing Printed Circuit Board (PCB) or Breadboard for controlling or triggering an agricultural system
5. Use of mobile apps for controlling or triggering an agricultural system
6. Construction of crop growth functions (best fit) for crop yields simulations
7. Image processing as tool for biotic and abiotic stress identification
8. Experience with existing open source crop simulation models
9. Exposing cloud resources for agricultural applications
10. Developing automated agro advisory systems

Total Lecture hours:	**60hours**

Course Code	Course Title	L	T	P	J	C
22AGP503	**CAD FOR AGRICULTURE MACHINERY LABORATORY**	**0**	**0**	**4**	**0**	**2**

Pre-requisite		Syllabus version	v. 1.0

Course Objective:

1. To draft the agricultural engineering related machineries and structures manually and also by computer aided methods

Course Outcome:

- Understand the plan and layout of underground pipes, post harvesting units and check dams
- Design and draw the components using computer aided methods

LIST OF EXPERIMENTS:

1. Design and Drawing of Underground pipeline system
2. Design and Drawing of Check dam
3. Design and Drawing of Mould board plough
4. Design and Drawing of Disk plough
5. Design and Drawing of Post-harvest technology units (threshers and winnowers)
6. Design and Drawing of Biogas plant.
7. Introduction & demonstration on 3D modeling softwares like Pro/E, Creo, Solid works, Solid Edge etc.

Text Book(s)

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

REFERENCE BOOKS

1.	Rai, G.D. “Nonconventional Sources of Energy”, Khanna publishers, New Delhi, 1995
2.	Michael, A.M. “Irrigation Theory and Practice”, Vikas Publishing House, New Delhi, 1999
3.	Srivastava, A.C.”Elements of Farm Machinery”, Oxford and IBH Publications Co., New Delhi, 1990.

Total Lecture hours:	**60hours**

Course Code	Course Title	L	T	P	J	C
22AGP504	**INDUSTRIAL ATTACHMENT /INTERNSHIP (3 WEEKS DURING IV SEMESTER –SUMMER)**	**0**	**0**	**0**	**0**	**1**
Pre-requisite		Syllabus version			v. 1.0	

Course Objective:

1. 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
2. To gain working experience and skills in carrying out engineering tasks related to various fields of agriculture.

Course Outcome:

- Gain practical knowledge by attaching themselves to the industry.
- Gain Hands on experience and skills in their specialization.
- To work efficiently as a team.
- To execute the theoretical concepts experimentally in field.
- At the completion of the training, students will be able to furnish a full report on the work done.

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. The students can go internship 3 weeks on various specialization or in the same specialization. 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.

Total Lecture hours: 60hours

SEMESTER VI

Course Code	Course Title	L	T	P	J	C
22AGT601	**POST- HARVEST TECHNOLOGY**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. The students would be exposed to fundamental knowledge in engineering properties of agricultural materials, different Post Harvest operations and processing methods of harvested crops and storage of crops

Course Outcome:

- Understand the importance of post-harvest processing and determine moisture content of products
- Perform drying of agricultural products and analyze performance of dryers
- Recognize the working principles of grain cleaning and grading devices and able to select suitable equipment for cereal grains, oilseeds, and pulses
- Understand the operation of post-harvest equipment like shellers, conveyors
- Different Post Harvest operations and processing methods of harvested crops

Unit-1	**FUNDAMENTALS OF POST HARVESTING**	**9 hours**

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

Unit-2	**PSYCHROMETRY AND DRYING**	**9 hours**

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

Unit-3	**CLEANING AND GRADING**	**9 hours**

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

Unit-4	**SHELLING AND HANDLING**	**9 hours**

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

Unit-5	**CROP PROCESSING**	**9 hours**

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 Lecture hours:	**45 hours**

Text Book(s)

1.	Chakraverty, A.Post harvest technology for Cereals, Pulses and oilseeds. Oxford & IBH publication Pvt Ltd, New Delhi, Third Edition, 2000

2.	Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing. Vikas publishing house Pvt. Ltd., New Delhi, 1994.
Reference Books	
1.	Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994
2.	Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955

Course Code	Course Title	L	T	P	J	C
22AGT602	**IRRIGATION AND DRAINAGE ENGINEERING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. Inculcate water resources development and various parameters required for irrigation scheduling and its requirement
2. Understand different kinds of irrigation system and choose appropriate system for a given environment.
3. Introduce different types of water control and diversion structures for planning the irrigation system.
4. Understand canal, tank irrigation and command area development.
5. Understand the basic concepts for planning, design and management of land drainage works in field areas

Course Outcome:

- The students will have knowledge and skills on Planning, design, operation and management of Water Resources and Irrigation Requirement.
- The student will gain knowledge on different methods of irrigation including canal irrigation.
- Obtain knowledge on different types Diversion and Impounding Structures
- Understand the concept Canal Irrigation and Command Area Development
- Understand the concept recycling of drainage water for irrigation

Unit-1	**WATER RESOURCES AND IRRIGATION REQUIREMENT**	**9 hours**

Water Resources- River basins-Development and Utilization in India and Tamil Nadu-Irrigation – duty and delta - Rooting characteristics - Moisture use of crop, Evapotranspiration - ET plot - Crop water requirement - Effective rainfall - Scheduling - Irrigation requirement - Irrigation frequency, Irrigation efficiencies.

Unit-2	**METHODS OF IRRIGATION**	**9 hours**

Methods of Irrigation – Surface and Subsurface methods – Drip and Sprinkler - Hydraulics and design - Erodible and non-erodible, Kennedy's and Lacey's theories, Materials for lining water courses and field channel, Water control and diversion structure - Underground

pipeline irrigation system		
Unit-3	**DIVERSION AND IMPOUNDING STRUCTURES**	**9 hours**
Head works –Weirs and Barrage –Types of impounding structures - Factors affecting, location of dams -Forces on a dam -Design of Gravity dams- Earth dams, Arch dams – Spillways -Energy dissipaters.		
Unit-4	**CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT**	**9 hours**
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 - Concept, Components of CADP - On Farm Development works, Farmer's committee - its role for water distribution and system operation - rotational irrigation system.		
Unit-5	**AGRICULTURAL DRAINAGE**	**9 hours**
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 Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books

1.	Basak, N.N., "Irrigation Engineering", Tata McGraw-Hill Publishing Co, New Delhi, 2008
2.	Murthy, V.V.N. Land and water management, Kalyani publishing, New Delhi, 1998
3.	Bhattacharya, A.K., and Michael, A.M., "Land Drainage – Principles, Methods and Applications", Konark Publishers Pvt. Ltd., New Delhi, 2003
4.	Irrigation water Management, Training Manual No 6, Drainage of Irrigated Lands, Food and Agriculture Organisation, Rome 1996
5.	Kessler, J., "Drainage Principles and Applications", Vol. II and IV, International

	Institute of Land Reclamation and Improvement, Netherlands, 1979.

Course Code	Course Title	L	T	P	J	C
22AGP601	**POST – HARVEST TECHNOLOGY LABORATORY**	**0**	**0**	**3**	**0**	**1.5**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. After the end of this lab, students will be able to determine various engineering properties of grains, test and evaluate different post harvesting machineries

Course Outcome:

- Determine the different engineering properties of biological materials and their importance
- Determine the efficiency of various post-harvest equipment

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. Testing of groundnut decorticator & maize sheller
6. Evaluation of thin layer drier
7. Evaluation of L.S.U. drier.
8. Determining the efficiency of bucket elevator and screw conveyor
9. Evaluation of shelling efficiency of rubber roll sheller
10. Determining the oil content of oil seeds.
11. Visit to modern rice mill
12. Visit to pulse milling industry

Total Lecture hours:	**60hours**

Text Book(s)

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

Reference Books	
1.	Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994.
2.	Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955.
3.	Mohsenin, N.N. Physical Properties of Plant and Animal Materials Gordon and Breach Publishers, Ludhiana, 1970.

Course Code	Course Title	L	T	P	J	C
22AGP602	**IRRIGATION FIELD LABORATORY**	**0**	**0**	**3**	**0**	**1.5**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. Students should be able to verify the principles studied in theory by performing the experiments in lab.

Course Outcome:

- On the completion of the course the student will have the knowledge on various meteorological instruments and understanding the concept of different irrigational systems in the laboratory tests
- The student will gain knowledge on infiltrometer
- Obtain knowledge on Drip irrigation system with all accessories
- Obtain knowledge on Sprinkler irrigation system with all accessories

LIST OF EXPERIMENTS:

1. To study various instruments in the Meteorological Laboratory
2. Determination of infiltration rate using double ring and digital infiltrometer
3. Determination of soil moisture wetting pattern for irrigation scheduling
4. Design of Drip irrigation system
5. Design of sprinkler irrigation system
6. Measurement of flow properties in open irrigated channels (flumes, notches)
7. Evaluation of surface irrigation
8. Determination of uniformity coefficient for drip irrigation system
9. Determination of uniformity coefficient for sprinkler system (catch can method)
10. To conduct experiment on disc filter for micro irrigation systems

Total Lecture hours:	**60hours**

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.

SEMESTER VII

Course Code	Course Title	L	T	P	J	C
22AGT701	REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM	3	0	0	0	3
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To introduce the principles and basic concepts of Remote Sensing and GIS
2. To introduce the remote sensing systems, data products and analysis
3. To introduce concepts of GIS 9 Map and their influences
4. To introduce the spatial data models, analysis and presentation techniques
5. To study the applications of Remote Sensing and GIS in agriculture, soil and water resources

Course Outcome:

- Understand the remote sensing principles and systems
- Gain sufficient knowledge on satellite data processing and available data products.
- Know the concept of GIS and its tools.
- Have knowledge on data input and analysis techniques.
- Utilize these advanced techniques in addressing the real world problems.

Unit-1	CONCEPTS OF REMOTE SENSING AND SATELLITES	9 hours

Definition- Historical background - Components of remote sensing – Energy source, electromagnetic spectrum, radiation principle, platforms and sensors - Active and passive remote sensing interference - Atmospheric effects on remote sensing – Energy interaction with earth surface feature - Data acquisition - Reflectance, spectral signatures for water, soil and vegetation.- Satellites - Types - Sun synchronous - Geo synchronous remote

sensing satellites - LANDSAT,SPOT & IRS - Resolution - Spectral, spatial, radiometric and Temporal resolution - Recent satellites with its applications		
Unit-2	**DATA PRODUCTS AND IMAGE ANALYSIS**	9 hours
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-3	**CONCEPTS OF GIS**	9 hours
Definition – Map and their influences – Characteristics of Maps – Elements – Map scale, Projection, Coordinate systems – Sources of spatial data – History and development of GIS – Definition – Components – Hardware and Software		
Unit-4	**DATA INPUT AND ANALYSIS**	9 hours
Data – Spatial, Non-Spatial – Database models – Hierarchical network, Relational and Object Oriented Data Models – Raster and Vector – Methods of Data input – Data Editing – Files and formats – Data structure – Data compression. Introduction to analysis – Measurements – Queries – Reclassification – Simple spatial analysis – Buffering – Neighboring functions – Map overlay – Vector and raster – Spatial interpolation – Modelling in GIS – Digital Elevation Modelling – Expert systems		
Unit-5	**APPLICATION OF RS AND GIS**	9 hours
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 Lecture hours:	**45 hours**
Text Book(s)		
1.	Anji Reddy. M, Remote Sensing and Geographical Information Systems, BS Publications, Hyderbad, 2001	

2.	Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.
Reference Books	
1.	Bettinger, P., and Michael, G.W., "Geographical Information System: Applications in Forestry and Natural Resources Management," Tata McGraw–Hill Higher Education, New Delhi, 2003
2.	2. Ian Heywood., "An Introduction to GIS", Pearson Education, New Delhi, 2001.
3.	Jeffery Star and John Estes, "Geographical Information System – An Introduction," Prentice Hall India Pvt. Ltd., New Delhi, 1998.
4.	Patel A.N & Surendra Singh, "Remote sensing principles & applications", Scientific Publishers , Jodhpur 1992

Course Code	Course Title	L	T	P	J	C
22AGT702	**RENEWABLE ENERGY IN AGRICULTURAL ENGINEERING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To impart the fundamental knowledge on the importance of Bio resources, Bio energy and reactors.
2. To study Slurry handling
3. To study Bio reactors/ fermenters
4. To study Alcohol and ethanol production and
5. To study Energy and Environment

Course Outcome:

- The students will be able to understand the concepts of bio energy sources and its applications.
- Gain sufficient knowledge on Bioenergy.
- Know the concept of Bioreactors and Fermentors and their working principles.
- Have knowledge on production of alcohol.
- Utilize these advanced techniques in conserving energy and protecting the environment.

Unit-1	BIO RESOURCE – AN INTRODUCTION	9 hours
Bio resource – origin – biomass types and characteristics- biomass conversion technology Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance.		
Unit-2	**BIO ENERGY**	9 hours
Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation		
Unit-3	**BIO REACTORS AND FERMENTORS**	9 hours
Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Downstream processing-Recovery and purification of products		
Unit-4	**ALCOHOL PRODUCTION**	9 hours
Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis – Antibiotics enzymes- principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers		
Unit-5	**ENERGY AND ENVIRONMENT**	9 hours
Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – – Bioenergy policy.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Rai G.D, Non-conventional sources of Energy, Khanna publishers, New Delhi, 1995.
2.	Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986
Reference Books	
1.	Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986

Course Code	Course Title	L	T	P	J	C
22HST701	TOTAL QUALITY MANAGEMENT	3	0	0	0	3
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2. Explain the TQM Principles for application
3. Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
4. Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
5. Illustrate and apply QMS and EMS in any organization

Course Outcome:

- Ability to apply TQM concepts in a selected enterprise.
- Ability to apply TQM principles in a selected enterprise
- Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA
- Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
- Ability to apply QMS and EMS in any organization.

Unit-1	INTRODUCTION	9 hours

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM

Unit-2	TQM PRINCIPLES	9 hours

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S

and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.		
Unit-3	**TQM TOOLS & TECHNIQUES I**	9 hours
The seven traditional tools of quality - New management tools - Six-sigma Process Capability Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		
Unit-4	**TQM TOOLS & TECHNIQUES II**	9 hours
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR		
Unit-5	**QUALITY MANAGEMENT SYSTEM**	9 hours
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Dale H.Besterfiled, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.	
Reference Books		
1.	Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017	
2.	Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.	
3.	Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003	
4.	Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India)	

	Pvt. Ltd., 2006 .

Course Code	Course Title	L	T	P	J	C
22AGP701	REMOTE SENSING AND GIS LABORATORY	0	0	4	0	2
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

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

Course Outcome:

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

LIST OF EXPERIMENTS:

1. Measurement of relief displacement using parallax bar
2. Stereoscopic vision test
3. Aerial photo interpretation – visual
4. Satellite images interpretation – visual
5. Introduction to QGIS
6. Geo-referencing of images
7. Image enhancement practice
8. Supervised classification practice
9. Unsupervised classification practice
10. Database Management Systems
11. Spatial data input and editing – Digitising
12. Raster analysis problems – Database query
13. GIS applications in DEM and its analysis
14. GIS application in watershed analysis
15. GIS application in rainfall-runoff modelling
16. GIS application in soil erosion modelling

	Total Lecture hours:	**60hours**
Text Book(s)		
1.	Lillesand, T.M. and Kiefer, R.W. 2005. “Remote Sensing and Image Interpretation “, II edition. John Wiley & sons	
2.	Heywood, I., Cornelius. S., Carver. S 2002. An Introduction to Geographical Information Systems. Addison Wesley Longman, New York.	
Reference Books		
1.	Floyd F. Sabins. 2005. “Remote Sensing: Principles and Interpretation”, III edition. Freeman and Company New York	
2.	Jensen, J.R., 2004. “Introductory Digital Image Processing: A Remote Sensing Perspective”. Prentice – Hall. New Jersey	

Course Code	Course Title	L	T	P	J	C
22AGP702	**RENEWABLE ENERGY IN AGRICULTURAL ENGINEERING LABORATORY**	**0**	**0**	**4**	**0**	**2**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To gain the practical knowledge on various renewable energy gadgets.
2. To Know the concept of Automatic weather station
3. To get knowledge on Testing of natural convection solar dryer

Course Outcome:

- Be exposed to renewable energy sources and their applications.
- Aim sufficient knowledge on Purification of biogas – CO_2 and H_2S removal
- Know the concept of Automatic weather station
- Have knowledge on Testing of natural convection solar dryer

LIST OF EXPERIMENTS:

1. Characterization of biomass – proximate analysis
2. Determination of caloric value of fuels – solids and gases
3. Design of KVIC / Deenbandhu model biogas plant
4. Study of UASB biomethanation plant
5. Purification of biogas – CO_2 and H_2S removal
6. Performance evaluation of agro based gasifier
7. Study on pyrolysis unit – Biochar, Charcoal and Tar making process
8. Testing of biogas/producer gas engines

9. Study on briquetting and Stoichiometric calculations
10. Automatic weather station – Analysis of wind data and prediction
11. Testing of solar water heater
12. Testing of natural convection solar dryer
13. Study on Solar power and I-V Characteristics
14. Testing of solar photovoltaic water pumping system

The lab includes visit to biomass power plant and wind farms.

Total Lecture hours:	**60hours**

Reference Books

1.	Khandelwal, K.C. and Mahdi, S.S. “Biogas Technology”. Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 1986.
2.	Nijaguna, B. T. “Biogas Technology” New Age International Pvt. Ltd., New Delhi, 2006.
3.	Rao. S and B.B. Parulekar. Energy Technology – Non conventional, Renewable and Conventional. Khanna Publishers, New Delhi, 2000
4.	Solanki, C.S. “Solar Photovotaics – Fundamentals, Technologies and Applications”, PHI Learning Pvt. Ltd., New Delhi, 2011

Course Code	Course Title	L	T	P	J	C
22AGP801	**PROJECT WORK**	**0**	**0**	**0**	**20**	**10**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. 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 and to face reviews and viva voce examination.

Course Outcome:

- Identify agricultural engineering problems reviewing available literature.
- Identify appropriate techniques to analyze complex agricultural engineering problems.
- Apply engineering and management principles through efficient handling of project, have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way

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.	
Total Lecture hours:	**300 PERIODS**

PROFESSIONAL ELECTIVES
VERTICAL 1: FOOD PROCESSING

Course Code	Course Title	L	T	P	J	C
22AGPE01	**REFRIGERATION AND COLD STORAGE**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To interpret principles of operation of different Refrigeration & Air conditioning systems
2. To understand the types of compressors and expansion devices and their applications
3. To combine the parameters involved in design of the various air conditioning and cold storage systems

Course Outcome:

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

Unit-1	REFRIGERATION PRINCIPLES AND COMPONENTS	9 hours

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

Unit-2	VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE	9 hours

Simple vapour compression cycle - T-S diagram - p-h chart- vapour compression system-different types-vapour absorption cycle simple and practical vapour absorption system-advantages- ideal vapour absorption system- Electrolux refrigerator Lithium bromide refrigeration-construction and principles.

Unit-3	APPLIED PSYCHROMETRY	9 hours
Principle and properties of psychrometry, Representation of various psychometric processes on psychometric chart and their analysis, by-pass factor, sensible heat factor, room sensible heat factor, equipment sensible heat factor, grand sensible heat factor, apparatus dew point, ventilation and infiltration, energy efficiency ratio. Use of psychometric charts. Cooling and heating load calculations		
Unit-4	**AIR CONDITIONING SYSTEM**	**9 hours**
Air conditioning systems-equipment used-classification-comfort and Industrial air conditioning system- winter, summer and year- round air conditioning system- unitary and central air conditioning system- application of refrigeration and air conditioning-domestic refrigerator and freezer- ice manufacture.		
Unit-5	**APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION**	**9 hours**
Cooling and heating load estimation, cold storage design, types of cooling plants for cold storage. Insulation properties and types of insulation material. Cold storage for milk, meat, fruits, vegetables, poultry and marine products. Refrigerated Transport, Handling and Distribution, Cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display. Sensors for cold storage management.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2008
2.	Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2009

Reference Books

1.	Roy J. Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 2007
2.	N. F Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2008
3.	Jeffery Star and John Estes, “Geographical Information System – An Introduction,” Prentice Hall India Pvt. Ltd., New Delhi, 1998.

Course Code	Course Title	L	T	P	J	C
22AGPE02	**FOOD AND DAIRY ENGINEERING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To acquire better understanding of the food concentration and thermal processing of foods

2. To know the physical and thermal properties of milk and different methods of milk processing and milk products
3. To gain knowledge on the theory, methods, and equipment for the various unit operations of dairy industry

Course Outcome:

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

Unit-1	**BASIC PROPERTIES AND THERMAL PROCESSING OF FOODS MATERIALS**	**9 hours**

Constituents of food and their energy values – rheological properties of food materials- texture of food materials -viscometry - Concentrations of foods - freeze concentration - membrane concentration -Thermal processing of foods - product-time-temperature relationships - cooking, blanching pasteurization techniques- UHT Processing - sterilization of solid and liquid foods- batch and continuous sterilization equipment- interaction of heat energy on food components - kinetics of microbial destruction - Preservation by retort processing - principles and applications - microwave and radio frequency heating in food processing- Canning- Aseptic packaging.

Unit-2	**DRYING AND DEHYDRATION**	**9 hours**

Food spoilage - causes for spoilage -Moisture content - free moisture - bound and unbound moisture - equilibrium moisture content - Water activity - sorption behaviour of foods - types of dryers - drum, spray, Freeze drying, dryers-advantages and disadvantages - dehydration - methods of dehydration osmotic dehydration

Unit-3	**MILK PROCESSING**	**8 hours**

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

Unit-4	**DAIRY EQUIPMENT AND PRODUCTS**	**10 hours**

Homogenisation - theory and working of homogenisers - high pressure homogenization of milk and other food suspensions - design criteria for homogenizing equipment- cream separation principles - types of separators. Clarifiers - butter churns - ghee manufacture - equipment - whey manufacture- techniques - equipment - ice cream freezers - condensed milk - milk powder manufacturing drying equipment- milk products - paneer - casein - probiotic dairy products - kefirmilk plant sanitation requirements - Cleaning in-place and its functions.		
Unit-5	**ADVANCED TECHNOLOGIES IN FOOD PROCESSING**	**9 hours**
Non-thermal and other alternate thermal processing in Food processing - Nanotechnology: History- fundamental concepts - tools and techniques Nanomaterials - applications in food packaging and products, implications, environmental impact of nanomaterials and their potential effects on global economics, regulation of nanotechnology		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	R. Paul Singh and Dennis R. Heldman. Introduction to Food Engineering. 5th edition Academic Press, USA. 2013.	
2.	Heldman, Dennis R., Daryl B. Lund, and Cristina Sabliov, eds. Handbook of food engineering. CRC press, 2018.	
Reference Books		
1.	H.G.Kessler, Food Engineering and Dairy Technology, Freising, Germany, Verlag A.Kessler, 1981	
2.	Sukumar De, Outlines of Dairy: Technology, Oxford University Press, 2001	
3.	Minj, Jagrani, Aparna Sudhakaran, and Anuradha Kumari, eds. Dairy Processing: Advanced Research to Applications. Singapore: Springer, 2020.	
4.	V. Chelladurai, and Digvir S. Jayas. Nanoscience and nanotechnology in foods and beverages. CRC Press, 2018.	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22AGPE03	**PROCESS ENGINEERING OF FRUITS AND VEGETABLES**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	
Course Objectives:						
1. Implement specific post-harvest handling technique for storage and transport of fruits and vegetables 2. Apply preservation techniques to produce value added fruits and vegetable products 3. Learn the industrial scale processing and preservation methods to extend the shelf life of fruit and vegetable commodities						
Course Outcome:						

1. Implement low temperature, modified atmosphere and controlled atmospheric storage methods for storage of fruits and vegetables
2. Produce value added products from fruits and vegetables by using suitable preservation method (sugar, salt or dehydration)
3. Produce dehydrated fruits and vegetables
4. Apply minimal processing and fermentation methods to produce value added products from fruits and vegetables
5. Plan to produce canned and bottled fruits and vegetables

Unit-1	**HARVESTING, HANDLING AND STORAGE OF FRUITS AND VEGETABLES**	**9 hours**

Fruits and vegetables: classification, nutritional profile - Harvesting of fruits and vegetables - maturity indices - post harvest physiology - handling - pre-cooling and storage - Storage under 108 ambient condition, low temperature storage - chilling, frozen storage- chilling injury, freeze burn. Controlled atmosphere storage, Modified atmosphere storage - concepts and methods - gas composition - Changes during storage

Unit-2	**PRESERVATION OF FRUITS AND VEGETABLES BY VALUE ADDITION**	**9 hours**

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

Unit-3	**PRESERVATION BY DRYING AND DEHYDRATION**	**9 hours**

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

Unit-4	**MINIMAL PROCESSING AND FERMENTATION**	**9 hours**

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

Unit-5	**CANNING AND BOTTLING**	**9 hours**

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

	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Norman W. Desrosier, and James N. Desrosier. The Technology of Food Preservation 4th Edition, CBS Publisher & Distributions, New Delhi, 2004.	
2.	R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.	
Reference Books		
1.	A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.	
2.	Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.	
3.	D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.	
4.	K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22AGPE04	**STORAGE AND PACKAGING TECHNOLOGY**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

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

Course Outcome:

1. Possess the knowledge on Storage environment and storage structures
2. The students will have a clear understanding of various methods of storage and different packaging techniques for food.
3. Determine the principles of Controlled Atmosphere Storage and Modified Atmosphere Packaging
4. Differentiate various canning systems and their application in food industry
5. Apply the knowledge to choose suitable flexible packaging film and the sealing technique for processed foods.

Unit-1	**STORAGE ENVIRONMENT AND STORAGE STRUCTURES**	**9 hours**

Storage losses in agricultural commodities. Physical properties of grain affecting storabilityFactors of spoilage- fungi and mycotoxins- Treatments for enhancing shelf life- Fumigation Processes for bag storage piles. Rural storage structures- Bag Storage and its Design. Parameters and types of storage structure. Bulk Storage in silos and large Bins Construction of Silos, Problems of Silo storage, relative Costs of Silo and Bag Storage. Quality Changes and remedial measures of Grains during storages. Design considerations and heat load calculation of cold storage		
Unit-2	**INTRODUCTION TO PACKAGING**	**9 hours**
Introduction Protection of Food products major role and functions of food packaging Effect of environmental factors, mechanical forces and biological factors on food quality and shelf life. Estimating the shelf life requirement accelerated storage studies. Tests on packaging materials Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates.		
Unit-3	**CONTROLLED ATMOSPHERE STORAGE AND MODIFIED ATMOSPHERE PACKAGING**	**9 hours**
Introduction Protection of Food products major role and functions of food packaging Effect of environmental factors, mechanical forces and biological factors on food quality and shelf life. Estimating the shelf life requirement accelerated storage studies. Tests on packaging materials Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates.		
Unit-4	**CANNING**	**9 hours**
Introduction and concept of CA Storage Equipment for creating, maintaining and measuring controlled atmosphere - Biochemical aspects of CA storage - Static & Dynamic CA, Fruit Ripening, Hypobaric and Hyperbaric Storage. Effects of concentrations of compositional gases on Fruits and vegetables. MAP-Film & Coating types, Permeability, Gas Flushing, Perforation, Absorbents, Humidity, Temperature, Chilling Injury, Shrink wrapping, Vacuum Packing, Modified Interactive Packaging, Minimal Processing, Equilibrium Modified Atmosphere Packaging, Effect of scavengers		
Unit-5	**FLEXIBLE FILMS PACKAGING**	**9 hours**
Formation of Films and pouches, Co-extruded films and Laminates applications. Filling and Sealing of pouches and flexible plastic containers, Pouch form fill seal machines: Rigid and Semi rigid plastic packaging. Fabrication methods Thermo forming, Blow moulding, Injection moulding, Extrusion Blow moulding applications. Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging - applications. Nano packaging and smart packaging. Printing on packages, Bar codes, Nutrition labeling and legislative requirements. Sensors and IoT in Food packaging.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Sahay, K.M. and K.K.Singh. 1996. Unit operations of agricultural processing. Vikas Publishing House Pvt. Ltd., New Delhi.
2.	Pandey, P.H.2002. Post harvest engineering of horticultural crops through objectives. Saroj Prakasam. Allahabad.
Reference Books	
1.	Food Packaging Technology, Hand book, 2004. NIIR Board, New Delhi.
2.	Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall, 1992
3.	N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman), Oxford, UK,1994

Course Code	Course Title	L	T	P	J	C
22AGPE05	**FOOD PROCESS EQUIPMENT AND DESIGN**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

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

Course Outcome:

1. Analyse the various process equipment design.
2. Understand the design procedure the development of vessels and cleaners.
3. Analyse the different types heat exchanger methods
4. Apply the different methods of conveying system
5. Optimize the variables using CAD for the process equipment design.

Unit-1	PROCESS EQUIPMENT DESIGN	9 hours
Introduction on process equipment design, principles and selection of food processing equipment Application of design engineering for processing equipment.		

Unit-2	DESIGN PROCEDURE	9 hours
Design parameters and general design procedure, Material specification, Types of material for process equipment, Design codes, Pressure vessel design, Design of cleaners		

Unit-3	HEAT EXCHANGER	9 hours

Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger Problems on tubular heat exchanger, shell and tube type heat exchanger and plate heat exchanger		
Unit-4	**CONVEYING SYSTEM**	**9 hours**
Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers. Design of milling equipment.		
Unit-5	**CAD**	**9 hours**
Optimization of design with respect to process efficiency, energy and cost, Computer Aided Design		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Rajput R K, 2008 Heat and Mass Transfer. S Chand Publishers
2.	Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.

Reference Books

1.	Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.
2.	Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi
3.	Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K

Course Code	Course Title	L	T	P	J	C
22AGPE06	**FOOD PLANT DESIGN AND MANAGEMENT**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. State the different specifications and processes involved in the design and development of food processing plant
2. Define the processes involved in layout design
3. Evaluate the projects and cost estimation of designing food plant
4. Outline the product cost and plant overheads
5. Perform profitability analysis in food processing industry

Course Outcome:

1. Design and construct the well-equipped food processing plant for effective processing
2. List the start – to – end facilities, infrastructure, utilities, investments along with 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 the problems involved in deciding the level of manufacture of a food product

Unit-1	PLANT LAYOUT-INTRODUCTION	9 hours

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-2	PROCESS ECONOMICS OF PLANT LAYOUT	9 hours

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 and computer aided development of flow charts

Unit-3	DEVELOPMENT AND PRESENTATION OF LAYOUT	9 hours

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-4	FOOD PROCESSING PLANT & EQUIPMENT LAYOUT	9 hours

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 understanding of equipment layout and. Preparation of flow sheets for material movement and utility consumption in food plants.

Unit-5	PROJECT EVALUATION AND COST ESTIMATION	9 hours

Preparation of flow sheets for material movement and utility consumption in food plants; Application of Program Evaluation and Review Technique (PERT) and 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 Lecture hours:	**45 hours**

Text Book(s)

1.	Maroulis, Z.B. and Saravacos, G.D. . Food Process Design. Marcel Dekker Inc,. 2003
2.	Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas,"Food Plant Design (Food Science and Technology)", CRC Press, 2005.

Reference Books	
1.	Towler, G. and Sinnott, R.K. Chemical Engineering design principles, practice and Economics of Plant and Procese. 2nd Edition. Elsevier.2012.
2.	Theunis C. Robberts . Food plant engineering system. II Edition, CRC Press, Washington, 2013.
3.	M Moore, Mac Millan, Plant Layout & Design. Lames, New York, 1971

Course Code	Course Title	L	T	P	J	C
22AGPE07	**EMERGING TECHNOLOGIES IN FOOD PROCESSING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. Understand and apply the different emerging technologies in processing of foods
2. Familiarize about the equipment used for the processing of foods by novel technologies.
3. Compare the application of alternate thermal and non-thermal processing techniques on foods

Course Outcome:

1. Understand the effect of high pressure processing on microbial inactivation of foods
2. Apply the principle of pulsed electric field and analyse the impact of pulsed electric field processing for both solid and liquid foods
3. Apply and assess the irradiation dosage requirement for foods
4. Apply non thermal technologies for inactivation of microorganisms and improve the food quality
5. Apply advanced thermal treatments for food processing and preservation

Unit-1	HIGH PRESSURE PROCESSING	9 hours

Principles - Mechanism and applications of high pressure processing to food systems - High pressure processing of salads, meats and sea foods, fruits and fruit products -Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods - Other applications of high pressure processing - High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

Unit-2	PULSED ELECTRIC FIELDS PROCESSING	9 hours

Principles - Mechanism - PEF treatment systems - Main processing parameters PEF technology - Equipment - Applications - Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

Unit-3	FOOD IRRADIATION	9 hours
Introduction - Fundamentals of food Irradiation - Type and sources of radiation, dosimetry, mode of action of ionizing radiation - Direct and indirect effect, radiation effect on food constituents, Dose requirement for different products and regulations.		
Unit-4	**ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES**	**9 hours**
High intensity pulsed light technology: principles of PLT technology - Technological aspects of PLT - Effects of PLT technology on microorganisms and food quality. Ultrasound Processing: Principle of ultrasound - Fundamentals - Ultrasound as a processing and food preservation tool - Effect of ultra sound on properties of foods - Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing - challenges in ultrasound processing. Radio frequency electric fields: equipment, applications for heating and drying, effect of radio frequency electrical field on inactivation of microorganisms		
Unit-5	**ALTERNATIVE THERMAL PROCESSING TECHNIQUES**	**9 hours**
Hurtle technology- Microwave heating and microwave drying: Microwaves - dielectric heating, dielectric properties of foods - thermal properties of foods - Recent developments in microwave heating - combined microwave-vacuum drying, microwave freeze-drying - applications. Case Study – development of a nonthermal processing technique for food and beverages.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 2 Edition, 2014.
2.	Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. BarbosaCanovas, CRC Press, 1st Edition, 2004.

Reference Books

1.	Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010.
2.	Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V. M. Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T. C. Yuan, Nonthermal Processing Technologies for Food,2000
3.	Amit K. Jaiswal, Food Processing Technologies: Impact on Product Attributes. CRC Press, 2017

Course Code	Course Title	L	T	P	J	C
22AGPE08	**DEVELOPMENT OF PROCESSED PRODUCTS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

4. To enable the students to understand the food processing methods
5. To understand the concepts of parboiling and technology of foods
6. To acquire the knowledge on food product development
7. To make the students to learn the fundamental concepts of thermal processing
8. To enable the students to study on mechanical handling of foods

Course Outcome:

At the end of the Course, Student will be able to

6. Choose the basic unit operations and processing methods of foods
7. Explain about parboiling and technology of foods
8. Explain about food product development
9. Explain about thermal processing operations
10. Describe mechanical handling of foods

Unit-1	**Applications of unit operations to the food industry**	**9 hours**

Analytical processing concepts with regards to mass and energy balances, equipment involved in the commercially important food processing methods and unit operations; value addition to cereals like rice, wheat etc.

Unit-2	**Parboiling**	**9 hours**

Parboiling of rice, quality of processed products of rice & wheat. Processing of pulses,extruded food product, fermented food product, frozen and dried product, technology ofmeat, fish and poultry products, technology of milk and milk products.

Unit-3	**Technology of oilseeds and fat products**	**9 hours**

Snack foods, Fruits and vegetable products- candy, nutraceuticals, food product development trends, food additives and labeling.

Unit-4	**Process equipment for thermal processing**	**9 hours**

Evaporation, dehydration, drying, blanching, pasteurization, distillation, mechanical separation-filtration, sieving, centrifugation and sedimentation.

Unit-5	**Mechanical handling**	**9 hours**

Conveying and elevation, size reduction and classification Mixing, Kneading, Blending and Emulsification.

Total Lecture hours:	**45 hours**

Text Book(s)

1. Carl.W. Hall. (1988). Processing Equipments for Agrl.Products. McGraw Hill Pub.Co.

2.	Girdhari Lal, G.S. Siddappa & G.L. Tandon . (1998). Preservation of Fruits and Vegetables. ICAR, New Delhi.
Reference Books	
1.	Gould, G. (1989). Mechanism of action of Food Preservation Procedures. Elsivier applied Science.
2.	Kent, N.L. (1975). Technology of Cereals. Oxford Pergamom.
3.	Kessle, H.G. Food Engineering and Dairy Technology. U.A. Kessler Freising, Germany.

Course Code	Course Title	L	T	P	J	C
22AGPE09	**ENGINEERING PROPERTIES OFAGRICULTURAL PRODUCE**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

- To enable the students to understand the principles and concepts of various properties of biological materials.
- To understand the concepts of rheology and different rheological models.
- To acquire the knowledge on physical, thermal, electrical, frictional and aerodynamic properties of food.
- To make the students to learn the fundamental concepts of the basic properties of food materials and enable them to process, preserve and use them for various applications.

Course Outcome:

At the end of the Course, Student will be able to:

1. Calculate the basic engineering properties of a biological material.
2. Analyze the flow behavior of biological materials and force deformation.
3. Analyze the Maxwell and Kelvin model equations in the rheology for important biological materials.
4. Explain the applications of frictional and aerodynamic properties in the design of processing equipment.
5. Explain the applications of electrical and thermal properties in the design of processing equipment.

Unit-1	**Physical Properties**	**9 hours**

Introduction and application of engineering properties of biological material. Physical properties of different food commodities and aided products – importance. Shape and size – criteria for describing shape and size. Roundness and sphericity – Volume and density – Specific gravity – Bulk density. Porosity – surface area – measurement of the same.

Unit-2	**Rheology**	**9 hours**

Introduction to rheology, basic concepts, Classification of rheology, ASTM standard definition of terms. Rheological Properties, Flow behavior of biological materials, force deformation curve; linear elastic limit, yield point, bio-yield point and rupture point. Stress relaxation and creep behavior. Visco-elasticity and visco- plasticity.		
Unit-3	**Rheological Models**	**9 hours**
Introduction to mechanical models. Kelvin and maxwell models. Electrical equivalence of mechanical models. Rheological equations of maxwell model, generalized maxwell model, kelvin model and generalized kelvin model. Difference between kelvin and maxwell model. Viscosity; Measurement of viscosity using viscometer, types of viscometer, problems on viscometer		
Unit-4	**Frictional and Aerodynamic Properties**	**9 hours**
Basic concepts, effect of load sliding velocity. Friction in agricultural materials, measurement. Rolling resistance, angle of internal friction and angle of repose. Applications of frictional properties in design of processing equipment. Importance of aerodynamic properties in Agricultural Processing equipments with examples. Terminal velocity and drag coefficient; frictional drag and profit drag or pressure drag. Terminal velocity of different grains, working of pneumatic conveyor based on aerodynamic properties.		
Unit-5	**Electrical properties and Thermal Properties**	**9 hours**
Electrical properties: Di-electrical properties; Dielectric loss factor and dielectric constant. Applications and role of electrical properties in food processing. Introduction to thermal properties; Specific heat, thermal conductivity, thermal diffusivity, latent heat of vaporization, latent heat of fusion, sensible heat, enthalpy and heat energy calculation.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Physical properties of plant and animal materials, Mohsenin N N, Gordon and Breach Science Publishers, New York, 2nd edition ,1986.	
2.	Engineering Properties of Foods, Rao M A, Syed S H Rizvi and Ashim K Datta,CRC Press – Taylor & Francis Group, Boca Raton, FL, 4th edition, 2014.	
Reference Books		
1.	Food and Process Engineering Technology, Wilhelm LR, Suler W A and Brusewitz, GH, American Society of Agricultural Engineers (ASAE), St. Joseph, Ml.	
2.	Engineering Properties of Biological Materials, O.P. Singhal and D.V.K. Samuel, Saroj Prakashan, Allahabad, 1st edition, 2003.	

Course Code	Course Title	L	T	P	J	C
22AGPE10	**INSTRUMENTATION AND SENSORS IN FOOD PROCESSING**	**3**	**0**	**0**	**0**	**3**

Pre-requisite		Syllabus version	v. 1.0

Course Objectives:

To build the students ability to control and operate all kinds of measuring instruments and sensors used in food processing industries.

Course Outcome:

At the end of the Course, Student will be able to:

1. To control basic instruments used for measuring speed and velocity of equipment's
2. To control basic instruments used for measuring energy of equipment's
3. control the process operations through precise instrumentation
4. knowledge of sensors for precision analysis of food quality in food industries.
5. knowledge of image processing methods for precision analysis of food quality in food industries

Unit-1	**Basic instrumentation systems**	**9 hours**

Basic instrumentation systems and transducer principles. Displacement transducers, Potential meters, LDVT, Piezoelectric and capacitive transducers, Digital transducers, velocity transducers.

Unit-2	**Method of separation of force**	**9 hours**

Acceleration and absolute motion measurement, Force transducer, Strain gauge, Hydraulic load cell, Cantilever type and probing ring. Method of separation of force: Torque, power and energy measuring technique.

Unit-3	**Temperature measuring instruments**	**9 hours**

Temperature measurement using bi-metals, thermisters, thermocouples, humidity measurement, manometers. Flow transducer, positive displacement, venturimeter, Rotameter, Drag force, hot wire anemometer.

Unit-4	**Biosensor**	**9 hours**

Theory and classifications of chemical sensors, biosensors, fibre optic sensors, gas sensors etc. Biosensor: Concepts, types of biosensors, methods of immobilizing biosensors, application.:

Unit-5	**Imaging processing methods**	**9 hours**

X-ray imaging, Computed tomography, MRI, Ultrasound, Hyperspectral imaging. Spectroscopy and chemometrics: UV and visual spectroscopy, NIR spectroscopy, FTIR spectroscopy.

	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Doebelin EO. 1990. Measurement Systems Applications and Design. Tata McGraw Hill.
2.	Erika KR and Brimelow JB. 2001. Instrumentation and Sensors for the Food Industry. CRC Woodhead.
Reference Books	
1.	Nakra BC and Chaudhary KK. 2004. Instrumentation Measurement and Analysis. Tata McGraw Hill
2.	Mukhopadhyay. 2014. Novel Sensors for Food Inspection: Modelling, Fabrication a nd Experimentation. Springer

VERTICAL 2- FARM MACHINERY AND ENERGY

Course Code	Course Title	L	T	P	J	C
22AGPE11	**FARM POWER AND MACHINERY MANAGEMENT**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To expose the student with the mechanization status in the country and management techniques for future requirements.

Course Outcome:

At the completion of the course the student will:

- have knowledge about the present status of farm mechanization
- be able to optimally select machinery for varying uses.
- be able to plan for mechanization of the farm.
- be able to estimate the cost of machinery.
- be able to create custom hiring centers

Unit-1	**FARM MECHANIZATION**	9 hours

The role of farm mechanization and its relationship to productivity, employment, social and Technological change.- Farm Power availability- Mechanization status in India–performance index of power source and farm machinery -Scheduling of farm operations

Unit-2	**COST ANALYSIS**	9 hours

Farm records and inventory control - cost analysis of machinery: fixed cost and variable costs, effect of inflation on cost; Cost economics of tractor and farm machinery – land preparation, planting , intercultural, plant protection and harvesting machinery cost calculation

Unit-3	MACHINERY SELECTION	9 hours
Selection of tractor and farm machinery – Matching implements for different hp- computation of hp requirement -optimum machinery and Replacement criteria; Break-even analysis, reliability and cash flow problems;		
Unit-4	**FARM MACHINERY OPERATION AND MANAGEMENT**	9 hours
Operations and adjustments of Land preparation , planting, intercultural, plant protection and harvesting machinery – management of machinery .		
Unit-5	**CUSTOM HIRING MODELS**	9 hours
Establishment of CHC-operationalization – Custom hiring models – case studies of custom hiring – Custom hiring project formulation – ownership vs custom hiring services- Economic viability of custom hiring service units – Replacement of farm machinery		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Donnell Hunt , Farm Power and Machinery Management	
2.	Johl S S and Kapur T R 1989. Fundamentals of Farm Business Management, Kalyani Publishers , Ludhiana	
Reference Books		
1.	Mahajan M 2001. Industrial Engineering and Production Management Dhanpet Rai and Co (P) Ltd. New Delhi	
2.	Sharma D N and S.Mukesh, 2013. Farm Power and Machinery Management, Jain Brothers, New Delhi.	

Course Code	Course Title	L	T	P	J	C
22AGPE12	**TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	
Course Objectives:						
1. Learn out testing of tractors and all other agricultural equipment and machinery						
Course Outcomes:						
• Understand the basics of testing procedures and standards of tractor testing						

- Understand the testing procedures and standards of tillage, sowing equipment
- Understand the testing procedures and standards of intercultural equipment
- Understand the testing procedures and standards of harvesting equipment
- Understand the safety standards and testing procedures

Unit-1	**TESTING OF AGRICULTURAL TRACTORS**	9 hours

Testing and evaluation system in India - Agricultural machinery situation -Mechanization policy – future prospects - standardization efforts - type of testing systems – General regulations - terminology- basic measurements, speed, fuel consumption, smoke density and power measurement - test items, specifications checking - PTO performance test- engine test, drawbar performance test - field test procedures -interpretation of results

Unit-2	**TESTING OF TILLAGE AND SOWING EQUIPMENT**	9 hours

Testing of tillage machinery - laboratory test (hardness testing, chemical analysis) - field test (rate of work, quality of work, draft measurement, fuel consumption) - seed drill - laboratory test (seed drill calibration) - field checking and field tests

Unit-3	**TESTING OF INTERCULTURAL EQUIPMENT**	9 hours

Testing and evaluation of weeders - types of tests for weeder - types of pesticide application equipment - terminology - types of tests for sprayers - testing methods - types of test for duster - testing methods

Unit-4	**TESTING OF COMBINE HARVESTER**	9 hours

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-5	**SAFETY TESTING OF AGRICULTURAL MACHINERY**	9 hours

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 Lecture hours:	**45 hours**

Text Book(s)	
1.	Metha M.L., SR.Verma, K Mishra and VK Sharma. 1995. Testing and Evaluation of Agricultural Machinery, National Agricultural Technology Information Centre, Ludhiana
2.	Indian Standards Test Codes related to tractors, power tillers and agricultural implements
Reference Books	
1.	Anonymous. 1983. RNAM Test Codes & Procedures for Farm Machinery. Technical Series
2.	Nebraska Tractor Test Codes for Testing Tractors, Nebraska, USA.

Course Code	Course Title	L	T	P	J	C
22AGPE13	**BIOCHEMICAL AND THERMOCHEMICAL CONVERSION OF BIOMASS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To expose the students with different bio and thermal conversion of biomass

Course Outcome:

- Biomass identification and classes
- Biomass characters and biochemical conversion.
- Thermo chemical conversion techniques and cogeneration from waste
- To know about application of biomass conversion
- Analyse the energy generated from waste

Unit-1	BIOMASS CHARACTERIZATION	9 hours

Biomass – types – fuels from biomass. Terms and units used in biomass production. Biomass fuel characterization – physical, chemical and thermal – energy release. Supply chain – harvesting / collection – transportation and processing. Briquetting – types – pelletizing.

Unit-2	BIOCHEMICAL CONVERSION	9 hours

Biochemical degradation – factors affecting biogas production - types of biogas plants – construction details – operation and maintenance – utilization of biogas - slurry handling, utilization and enrichment – high rate biomethanation process – landfills – bioethanol – feedstock – process – utilization - composting - methods – machinery.		
Unit-3	**THERMO CHEMICAL CONVERSION BY COMBUSTION**	9 hours
Thermochemical degradation. stoichiometric air requirement - Combustion process – chemistry of combustion - combustion zones - emissions. Cofiring of biomass. Incinerators - layout. Combustion of wastes and MSW. Wood burning stoves - types- operation.		
Unit-4	**THERMOCHEMICAL CONVERSION BY GASIFICATION AND PYROLYSIS**	9 hours
Biomass gasification – chemistry of gasification – types of gasifier – Gas cleaning & conditioning - utilization of producer gas - emissions – commercial gasifies plants. Pyrolysis – product recovery – types - biochar – bio oil – operation – recovery.		
Unit-5	**COGENERATION AND WASTE HEAT RECOVERY**	9 hours
Cogeneration technologies – cycles – topping – bottoming – problems – applications – selection. Waste heat recovery - plate heat exchangers - waste heat boilers - heat pumps - thermic fluid heaters - selection of waste heat recovery.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Chawla, O.P.1986. “Advances in Biogas Technology”. ICAR Publication, New Delhi	
2.	Rao. S and B.B. Parulekar. 2000. Energy Technology – Non conventional, Renewable and Conventional. Khanna Publishers, New Delhi.	
Reference Books		
1.	Khandelwal K.C. and Mahdi, S.S. 1986. Biogas Technology. Tata Mc Graw Hill Pub. Co. Ltd., New Delhi.	
2.	Srivastava, P.K., Shukla, B.D. and Ojha, T.P. 1993. Technology and application of biogas. Jain Brothers, New Delhi.	
3.	Mathur,A.N.and Rathore,N.S.1993.,Biogas production Management and Utilisation. Himanshu Publication. New Delhi.	

4.	Chakraverty, A. 1993. Biotechnology and other alternate technologies for utilisation of biomass. Oxford and IBH Publishing Co., New Delhi.

Course Code	Course Title	L	T	P	J	C
22AGPE14	WASTE AND BY PRODUCT UTILIZATION	3	0	0	0	3
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To expose the students with different by-products of food industry and waste water management of any industry.

Course Outcome:

- Types of waste and influences
- Waste water management from any food industry.
- By product utilization from processing plants of cereals, pulses
- Hands on training in wastewater treatment process
- Advance procession techniques for waste water treatment.

Unit-1	INTRODUCTION TO WASTE WATER TREATMENT	9 hours

Types and formation of by-products and waste; magnitude of Waste generation in different food processing industries; concept scope and maintenance of waste management and effluent treatment

Unit-2	CHEMICAL PROPERTIES	9 hours

Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbigy of waste, other ingredients like insecticide, pesticides and fungicides residues.

Unit-3	BY-PRODUCTS UTILIZATION	9 hours

Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization, waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermi-composting

Unit-4	**PROCESSING TECHNIQUES**	9 hours
Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary· treatments: Biological and chemical oxygen demand for different food plant waste- trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, Tertiary treatments.		
Unit-5	**ADVANCED WASTE WATER TREATMENT PROCESSES**	9 hours
Sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Huang, R.T. 1982. Compost Engineering: Principles and Practices.John Willey & Sons, New York.

Reference Books

1.	Standards, ASAE: Manure Production and Characteristics. ASAE, NewYork.
2.	USDA: Agricultural Waste Management Field Hand Book, New York, USA.

Course Code	Course Title	L	T	P	J	C
22AGPE15	**HUMAN ENGINEERING AND SAFETY IN FARM MACHINERY OPERATIONS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To impart the fundamental knowledge to the student on the importance of human engineering and safety in the field of agriculture machinery.

Course Outcome:

- Understand the importance of human factors and their application in system development.
- Know the effect of visual, auditory and factual displays in human performance.
- Understand the importance of optimum work-rest cycles in endurance.
- Be able to ideally design the work space in accordance to anthropometry.

- Have the general understanding safety features and regulation acts in farm machinery

Unit-1	**ERGONOMICS**	9 hours

Ergonomics- introduction- Role of ergonomics in Agriculture - Human metabolism- energy liberation in human body- Types of human metabolism- energy requirements at work - acceptable work load

Unit-2	**PHYSIOLOGICAL FUNCTIONS**	9 hours

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-3	**ENERGY EXPENDITURE**	9 hours

Energy expenditure of activities-keeping energy expenditure within bounds- Energy expenditure of Spraying-Weeding operations - Movements of body members- Strength and endurance of movements - Movement of body members related to Agricultural activities - Speed and accuracy of movements - Time and distance of movements - Reaction time

Unit-4	**ANTHROPOMETRY**	9 hours

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-5	**HUMAN SAFETY**	9 hours

Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

Total Lecture hours:	**45 hours**

Text Book(s)

1.	Ernest and Mc Cormick, E.L. (1970). Human factors in engineering and design. Mc Graw Hill Co., New York

2.	Grandjean, E. (1988). Fitting the task to the man. Taylor and Francis, London
3.	Liljedhal, J.B, Carleton, W.M, Smith, P.K and David, M. (1978). Tractors and power units. John Wiley and sons, New York.
4.	Murrel, K.H.F. (1978). Ergonomics, Man in his working environment. Chapman and Hall, London.
Reference Books	
1.	Astrand, O.P and Rodhal, J. (1977). Work Physiology. Mc Graw hill Co. New York.
2.	http://www.derby.ac.uk/online/course/ergonomics-msc
3.	http://www.online.colostate.edu/certificates/ergonomics/

Course Code	Course Title	L	T	P	J	C
22AGPE16	**PRECISION FARMING EQUIPMENT**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To learn about the fundamentals of precision farming principles and application of precision farming equipment

Course Outcome:

- Understand the role of electronics in precision farming
- Analyse the principles and applications of sensors, micro controllers and actuators in precision farming equipment
- Understand the precision farming concepts and machinery
- Understand about site specific management system and unmanned vehicles & IoT applications
- Analyse the application of sensors and electronics in farm machinery

Unit-1	**ROLE OF ELECTRONICS IN AGRICULTURAL ENGINEERING**	9 hours

Role of electronics in agricultural engineering for precision agriculture. Basics of precision agriculture, tools for implementation of precision agriculture. Introduction of GIS/GPS positioning system for precision farming. Use of GIS and GPS in farm machinery and equipment.

Unit-2	SENSORS, MICROCONTROLLER AND ACTUATOR FOR PRECISION AGRICULTURE	9 hours
Types of sensor- principle and concept of different sensor like ultrasonic, proximity, PIR, IR, radar, pressure, gas, temperature, moisture, strain /weight, colour sensor etc. used in agriculture. Microcontroller: Arduino, Raspberry Pi and PLC Actuator: DC Motor, Pump, linear Actuator etc. - Basic input circuits and signal conditioning systems – amplifiers and filters.		
Unit-3	**PRECISION FARMING CONCEPTS AND PRECISION FARMING MACHINERY**	9 hours
Precision farming concepts- Map based system- Real time system – Combination Map and real time system -components of PF – Site specific management- Constraints of PF- Precision tillage, planting, intercultural, plant protection and harvesting equipment, laser guided leveller, power sprayer, straw chopper cum spreader, straw bailer, combine harvester etc.		
Unit-4	**SITE-SPECIFIC MANAGEMENT SYSTEM**	9 hours
Site-specific nutrient management- weeds management- Agro-chemicals and fertilizer management, data sources and decision making for site-specific management. Grain quality and yield. Yield monitoring and mapping, soil sampling and analysis.		
Unit-5	**UNMANNED VEHICLES AND IOT IN AGRICULTURE**	9 hours
UAV -Drones- Types - applications – rules and regulations – Autonomous ground vehicles – Robotics- platforms and unmanned agricultural vehicles- IoT - crop yield estimates- threat identification- crop insurance-pesticides spraying, environmental monitoring- protected cultivation food quality monitoring etc.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Brase, T.A. 2006. Precision Agriculture. Thomson Delmar Learning, New York.
2.	Hermann, J.H. 2013. Precision in Crop Farming, Site Specific Concepts and Sensing Methods: Applications and Results. Springer, Netherlands.
3.	Krishna, K. R. 2016. Push Button Agriculture Robotics, Drones, Satellite-Guided Soil

	and Crop Management. Apple Academic Press
4.	Srivastava, A K., Carroll E.G., Roger P. R. and Dennis R.B.2006. Engineering Principles of Agricultural Machines. American Society of Agricultural and Biological Engineers, USA.
5.	Zhang, Q. 2015. Precision Agriculture Technology for Crop Farming. CRC Press, New York.
Reference Books	
1.	Sahay, K.M. and Singh, K.K. 1994. Unit Operation of Agricultural Processing. Vikas Publ. House
2.	Michael, A.M. 2007. Irrigation: Theory and Practice. Vikash Publishing House Pvt. Ltd., New Delhi
3.	Rai G.D. 1994. Non-conventional sources of energy. Khanna Publishers, Delhi
4.	Kepner, R.A., Bainer, R. and Berger, E.L. 1978. Principles of Farm Machinery.AVI Publ.

Course Code	Course Title	L	T	P	J	C
22AGPE17	SOLAR AND WIND ENERGY SYSTEM	3	0	0	0	3
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To learn about the fundamental aspects of solar energy availability, solar energy conversion technologies
2. To understand about the fundamental aspects of wind energy availability and wind power generators
3. To acquire the knowledge on the alternate sources of energy such as geothermal energy, wave ene`rgy, tidal energy, OTEC energy, fuel cells and energy storage

Course Outcome:

- Understand the basics of solar energy and solar thermal energy conversion technologies and compare direct mode and indirect mode solar dryers
- Analyse the principles and applications of solar thermal power stations, solar pond, and solar stills
- Understand the wind power laws and calculate the torque and power characteristics of wind energy

- Design wind mills and test the units for certification
- Understand the principles of geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and analyse their applications

Unit-1	**SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS**	9 hours

Solar radiation availability - radiation measurement -transmittance - absorptance flat plate collectors - heat transfer correlations - collector efficiency - heat balance -absorber plate - types - selective surfaces. Solar driers types heat transfer performance of solar dryers agro industrial applications

Unit-2	**SOLAR CONCENTRATING COLLECTORS AND PV TECHNOLOGY**	9 hours

Optically concentrating collectors- types reflectors - solar thermal power stations principle and applications - solar stills- types- solar pond performance- characteristics applications. Photovoltatics types characteristic- load estimation batteries invertors operation system controls. PV system installations standalone systems- PV powered water pumping system sizing and optimization hybrid system solar technologies in green buildings.

Unit-3	**WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND**	9 hours

Nature of wind - wind structure and measurement - wind power laws - velocity and power duration curves- aero foil - tip speed ratio - torque and power characteristics power coefficients - Betz coefficient

Unit-4	**WIND MILL DESIGN AND APPLICATIONS**	9 hours

Turbines- Wind mill - classification - power curve. Upwind and downwind systems - transmission rotors - pumps - generators - standalone system - grid system -batteries. Wind energy storage - wind farms - wheeling and banking - testing and certification procedures.

Unit-5	**ALTERNATE ENERGY SOURCES**	9 hours

Ocean energy - off shore and on shore ocean energy conversion technologies - OTEC principles - open and closed cycles. Tidal energy - high and low tides - tidal power - tidal energy conversion. Geothermal energy - resources - classification and types of geothermal power plants. Nuclear energy - reactions -fusion, fission, hybrid reactors. Fuel cell - principle and operation - classification and types. Energy storage- pumped hydro and underground pumped hydro - compressed air - battery - flywheel - thermal.	
Total Lecture hours:	**45 hours**
Text Book(s)	
1.	Rai., G.D. “Solar Energy Utilization” Khanna publishers, New Delhi, 2002
2.	More, H.S and R.C. Maheshwari, “ 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.	Rao. S and B.B. Parulekar. “Energy Technology – Non conventional, Renewable and Conventional”. Khanna Publishers, Delhi, 2000
4.	Rajput. R.K. “Non- Conventional Energy Sources and Utilization”, S. Chand & Company Pvt. Ltd, New Delhi, 2013.

Course Code	Course Title	L	T	P	J	C
22AGPE18	**MECHANICS OF TILLAGE AND TRACTION**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

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

Course Outcome:

At the end of the Course, Student will be able to:

1. Distinguish various dynamic properties of soil and their methods of measurement.
2. Analyze the concept of soil tool interaction.
3. Interpret traction mechanics and prediction models.
4. Classify different traction devices and their method of selection based on load and furrow type
5. Evaluation of traction device performance and application of GIS in soil dynamics.

Unit-1	**Dynamic Properties of Soil and their Measurement**	**9 hours**
Soil physical properties, engineering properties of soil, soil dynamic characteristics, soil shear strength, soil cohesion, soil-soil friction, soli- metal friction, stress-strain relationships, measurement of soil dynamic properties, direct shear test, triaxial test, unconfined compression test and tensile test, field measurement of soil shear strength: field shear apparatus and vane shear apparatus.		
Unit-2	**Mechanics of Tillage Tools**	**9 hours**
Geometry of soil tool system, mechanics of simple reaction in inclined, vertical, wider and narrow tools, design parameters and performance of tillage tools.		
Unit-3	**Traction Mechanics**	**9 hours**
Mohr- Coulomb's failure criteria, traction performance equations, traction prediction models, dimensional analysis of different variables related to soil-tyre system, soil vehicle models.		
Unit-4	**Introduction of traction devices**	**9 hours**
Tyres, function, types and terminology, tyre selection, tracks, traction device at wetland condition, deflection and traction devices, soil slippage and sinkage of wheels. Ballasting and its methods.		
Unit-5	**Evaluation and prediction of traction performance**	**9 hours**
Design of traction and transport devices. Soil compaction by agricultural vehicles and machines. Variability and application of GIS in soil dynamics.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Soil Dynamics in Tillage and Traction. Gill & Vandenberg.1968. Supdt. Of Documents, U.S. Govt. Printing Office, Washington, D.C.
2.	Sineokov GN. 1965. Design of Soil Tillage Machines. INSDOC, New Delhi.

Reference Books

1.	Terzaghi K & Peck Ralph B.1967. Soil Mechanics in Engineering Practices. JohnWiley &Sons.
2.	Soil Dynamics in Tillage and Traction, by William R. Gill, Glen E. Vanden Berg, Agricultural Research Service,1967.

Course Code	Course Title	L	T	P	J	C
22AGPE19	**TRACTOR AND FARM MACHINERY OPERATION AND MAINTENANCE**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

- To make the students familiarize with different models of tractors, power tillers and their controls
- To impart the knowledge on pertaining to maintenance of tractors and their systems.
- To enable the students, learn about trouble shooting of all tractor systems and remedial measures.
- To impart the knowledge on pertaining to maintenance of Farm machinery equipment.

Course Outcome:

1. Demonstrates various makes and models of 4-wheel and 2-wheel drive tractors with their controls
2. Explain maintenance of various tractors and their systems.
3. Identify troubles in all systems of tractors and also their remedial measures.
4. Identify troubles in all farm machinery also their remedial measures
5. Enables the student to establish a workshop for repairing and maintaince of tractors and farm equipment.

Unit-1	Introduction to functional system	9 hours

Familiarization with different makes and models of agricultural tractors. Identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems. Introduction to tractor maintenance – precautionary and break-down maintenance. Tractor starting with low battery charge. Introduction to trouble shooting in tractors. Familiarization with tools for general and special maintenance.

Unit-2	Introduction to scheduled maintenance and safety handling	9 hours

Introduction to scheduled maintenance after 100, 300, 600, 900 and 1200 hours of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Study of maintenance points to be checked before starting a tractor. Familiarization with controls on a tractor. Safety rules and precautions to be observed while driving a tractor.

Unit-3	Operation and maintenance of tillage implements	9 hours

Operation of a tillage tool (mould-board plough/ disc plough) and their adjustment in the field. Study of field patterns while operating a tillage implement. Hitching & De-hitching of mounted and trail type implement to the tractor. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance of implements – adjustment of functional parameters in tillage

implements.		
Unit-4	**Operation and maintenance of weeding equipments**	**9 hours**
Operation of a Weeding equipment and their adjustment in the field. Repair and maintenance procedure of weeding machinery during operation and off-season. Operation of a Plant protection equipment and their adjustment in the field. Repair and maintenance procedure of plant protection equipment during operation and off-season.		
Unit-5	**Adjustment and maintenance of harvesting equipment**	**9 hours**
Adjustments in a thresher for different crops, maintenance of V-belts on implements. General maintenance of the combine harvesters (track and wheel type). Setting of agricultural machinery workshop.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Ghosh RK and S Swan. Practical Agricultural Engineering.
2.	Jain SC and CR Rai. Farm Tractor Maintenance and Repair.

Reference Books

1.	Farm Tractor Maintenance and Repair. Jain S.C. and Roy C.R. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2.	Southern N. Tractor operation and maintenance

Course Code	Course Title	L	T	P	J	C
22AGPE20	**HYDRAULIC DRIVES AND CONTROL**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

- To make the students for knowing the basic concepts of hydraulic system.
- To provide an understanding of energy transfer in hydraulic actuators and motors.
- To provide the knowledge about controlling components of hydraulic systems.
- To impart the knowledge on designing of hydraulic system and working of various hydraulic devices.

Course Outcome:

1. Understand the fundamental concepts of hydraulic system.
2. Explain basic components in hydraulic system.
3. Identify various hydraulic control valves, accessories and their applications.
4. Analyze the hydraulic circuit design.

5. Explain the maintenance of hydraulic system.

Unit-1	Fundamentals of Hydraulics	9 hours

Fluid power - history, concept and definition. Hydrostatics and hydrodynamics - concepts and definitions. Interrelationships of various terms (properties) used in hydraulics. Governing laws of fluid flow - Pascal's Law, continuity equation. Hydraulic fluid - types, properties and their advantages and limitations. Hydraulic systems - applications, merits and limitations, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements.

Unit-2	Basic components in Hydraulic system:	9 hours

Hydraulic pumps: Pumping theory, classification of pumps- positive and non- positive types gear pump, vane pump, piston pump, pump performance and selection. Variable displacement pumps.
Hydraulic Actuators: Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance.
Hydraulic Motors: Hydraulic rotary actuators, gear motor, vane motor and piston motor. Hydraulic motor performance characteristics - torque, speed, power and flow chart.

Unit-3	Classification of hydraulic control valves	9 hours

Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols, Tractor hydraulics, nudging system.

Hydraulic Accessories: Types, construction, working and applications; strainers and filters, seals (static and dynamic), hydraulic reservoirs, hydraulic accumulators, manifolds, heat exchangers, oil level and pressure indicators

Unit-4	Hydraulic Circuit Design:	9 hours

Hydraulic circuit design and analysis: Simple hydraulic circuits – single and double acting hydraulic cylinders, regenerative circuit, pump unloading circuit, counter balance valve application, hydraulic cylinder sequencing circuits. Cylinder synchronizing circuits, speed control of hydraulic cylinders, speed control of hydraulic motors, accumulators.
Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs).

Unit-5	Application of Hydraulic Devices:	9 hours

Hydraulic devices: Automotive hydraulic brake, industrial fork lift, hydraulic jack, hydraulic press, automotive power steering and hydraulic lift - Working principle, construction and application. Hydraulic hitch, Automatic Draft and Depth Control (ADDC).

Maintenance of hydraulic systems: Hydraulic oils, desirable properties, general type of fluids, sealing devices, reservoir systems, filters and strainers, problems caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control and troubleshooting.	
Total Lecture hours:	**45 hours**
Text Book(s)	
1.	Power Hydraulics by Michael J. Pinches John G. Ashby, Prentice Hall International, 1996.
2.	Fluid Power with applications, Anthony Esposito, Pearson education, Inc., 5th Edition, 2000.
Reference Books	
1.	Pneumatics and Hydraulics, Andrew Parr, Jaico Publishing Co, 2000..
2.	Hydraulics and Pneumatics, Dr. Niranjan Murthy and Dr. R. K. Hegde, Sapna Publications, 2013.

VERTICAL 3: WATER MANAGEMENT AND PROTECTED CULTIVATION

Course Code	Course Title	L	T	P	J	C
22AGPE21	**WATERSHED PLANNING AND MANAGEMENT**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To provide the technical know-how of analysing the degradation of soil and water resources and implementation of the measures for soil and water conservation.
2. To provide a comprehensive treatise on the engineering practices of watershed management for realizing the higher benefits of watershed management

Course Outcome:

1. The students will able to describe the watershed management concepts
2. The students will able to describe the components involved in watershed planning
3. The students will able to describe the methods of water harvesting structures
4. The students will able to design and construct the soil conservation structures
5. The students will able to prioritize and execute the watershed development programme

Unit-1	**INTRODUCTION**	**9 hours**

Watershed – Definition - concept - Objectives – Land capability classification - Watershed Based Land Use Planning-Watershed Characteristics: Classification and Measurement- priority watersheds - land resource regions in India- Importance of Watershed Properties for Watershed Management.

Unit-2	**WATERSHED PLANNING**	**9 hours**

Importance of Watershed Planning - Utility of Hydrologic Data in Watershed Planning - Watershed Delineation - Planning principles – collection of data – present land use - Preparation of watershed development plan - Estimation of costs and benefits - Financial plan – selection of implementation agency - Monitoring and evaluation system		
Unit-3	**WATERSHED MANAGEMENT**	**9 hours**
Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands		
Unit-4	**WATER CONSERVATION PRACTICES**	**9 hours**
In-situ & Ex-situ moisture conservation principle and practices - Afforestation principle - Micro catchment water harvesting - Ground water recharge – percolation ponds -Water harvesting Design of Water Harvesting Structures - Farm pond - Supplemental irrigation - Evaporation suppression - Seepage reduction		
Unit-5	**WATERSHED DEVELOPMENT PROGRAMME**	**9 hours**
River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.	
2.	Ghanshyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2000.	
Reference Books		
1.	Gurmel Singh et al. 2004. Manual of soil and water conservation practices. Oxford & IBH publishing Co. New Delhi..	
2.	Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi	
3.	Tripathi R.P. and H.P.Singh 2002, Soil erosion and conservation, Willey Eastern Ltd., New Delhi	

Course Code	Course Title	L	T	P	J	C
22AGPE22	**GROUNDWATER AND WELL ENGINEERING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

To acquaint and equip the students with the techniques of groundwater development and management

Course Outcome:

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

Unit-1	**GROUND WATER OCCURRENCE**	**9 hours**

Occurrence of groundwater, temporal and spatial variability of groundwater, methods for groundwater exploration, determination of aquifer parameters, pumping tests, assessment of groundwater potential

Unit-2	**WELL CONSTRUCTION**	**9 hours**

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-3	**GROUNDWATER POLLUTION**	**9 hours**

Groundwater development and quality considerations, groundwater contamination, sources and causes of groundwater pollution, contaminated systems and their rehabilitation, groundwater bioremediation, management of salt water ingress in inland and coastal aquifers.

Unit-4	**GROUNDWATER MANAGEMENT**	**9 hours**

Management of declining and rising water table, Natural and artificial groundwater recharge, Groundwater recharge basins and injection wells. Groundwater management in irrigation command, conjunctive water use, water lifting, different types of pumps, selection of pumps, pump characteristics curve, cost of groundwater pumping, comparative economics of surface and groundwater use for irrigation

Unit-5	**GROUNDWATER DEVELOPMENT POLICIES**	**9 hours**

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 Lecture hours:	**45 hours**

Text Book(s)	
1.	Walton, W.C. 1976. Groundwater Resource Evaluation. Mc Graw Hill. New York
2.	Karanth, K.R. 1987. Groundwater Assessment, Development and Management. Tatamcgraw Hill. New Delhi.
Reference Books	
1.	Michael, A.M. and Khepar, S.D. 1989. Water Well and Pump Engineering. Tata-mcgraw Hill Publ. Co. New Delhi.
2.	Giordano, M. and Villholth, K.G. 2007. The Agricultural Groundwater Revolution Volume 3.
3.	CABI Head Office, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE, UK Ghosh, N.C. and Sharma, K.D. 2006. Groundwater Modelling and Management

Course Code	Course Title	L	T	P	J	C
22AGPE23	**DESIGN OF MICRO-IRRIGATION SYSTEM**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To understand the basic concepts, tools, and skills used to deliver water efficiently and effectively on both a field and garden scale efficiency
2. To learn about the role of irrigation water in agriculture, and the environmental factors that influence the type, frequency, and duration of irrigation
3. To learn about the resources and essential skills needed to determine the proper timing and volume of irrigation, using both qualitative and quantitative methods

Course Outcome:

1. Categorize the different types of pumps and water lifting devices based on the principle, components, and working efficiency
2. Explain the working principle of centrifugal pump as well as its characteristics with efficiencies and design the centrifugal pump including impeller design, casing and other parts of pumps.
3. Estimate water budgets and hydraulics used to develop irrigation schedules through micro irrigation based on crop geometry
4. Design drip and sprinkler irrigation system including, main line, sub main and laterals designs by consider pump capacity
5. Design greenhouse irrigation system and advanced types of irrigation including lift irrigation and automation

Unit-1	MICRO IRRIGATION CONCEPT AND APPLICATIONS	9 hours

Micro irrigation -Merits, demerits, types and components of micro irrigation system- Present status, Scope and potential problem of micro irrigation - Micro-irrigation applications: Hills, arid lands, coastal and wastelands, Financial Assistance for Promotion of Micro Irrigation in India.

Unit-2	**DRIP IRRIGATION DESIGN**	**9 hours**
Drip irrigation - Components- Dripper- types and equations governing flow through drippersWetting pattern- Chemigation application- Pump capacity -Installation- Operation and maintenance of Drip irrigation system. - Design of surface and sub-surface drip irrigation.		
Unit-3	**SPRINKLER IRRIGATION DESIGN**	**9 hours**
Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance- Sprinkler discharge- Water distribution pattern- Droplet size, filtering unit, fertigation - System maintenance		
Unit-4	**ECONOMIC ANALYSIS**	**9 hours**
Standardization and Quality Assurance of Micro Irrigation System Components. Terminologies in Economic Analysis, Optimal Flow Criterion for Economic Drip Irrigation Pipes Selection, Economic Viability of Micro Irrigation in Different Crops.		
Unit-5	**AUTOMATION IN MICRO IRRIGATION**	**9 hours**
Automation, Need for Automation of Irrigation, Merits and Demerits of Automation, Semiautomatic and Fully Automatic Systems of Automation, Components of Automation System, Types of Controls and Automation in Micro Irrigation		
	Total Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books

1.	Modi, P.N., and Seth, S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 1991.
2.	Jack Keller and Rond Belisher., "Sprinkler and Trickle Irrigation", Vannistrand Reinhold, New York, 1990.
3.	Sivanappan R.K., "Sprinkler Irrigation", Oxford and IBH Publishing Co., New Delhi, 1987

Course Code	Course Title	L	T	P	J	C
22AGPE24	**PROTECTED CULTIVATION**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To impart knowledge on the protected cultivation of vegetables, fruits and flower crops.

2. To sensitize the students on hi-tech production technology of fruits and vegetables and flower crops.
3. To learn and practices the various production practices of flower and other high value crops

Course Outcome:

1. The students will be able to describe the different methods of protected cultivation practices available for vegetable crops and flowers
2. The students will be able to assess the technology available for vegetable crops
3. The students will be able to assess the technology available for flower crops
4. The students will be able to assess precision farming techniques using sensors and Geographic information systems for the crops
5. The students will be able to assess the technology available for horticulture crops

Unit-1	**PROTECTED CULTIVATION AND ITS TYPES**	**9 hours**

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-2	**PROTECTED CULTIVATION OF VEGETABLE CROPS**	**9 hours**

Protected cultivation technology for vegetable crops: Hi-tech protected cultivation techniques for tomato, capsicum nursery, cucumber, gherkins strawberry and melons, integrated pest and disease management, post-harvest handling.

Unit-3	**PROTECTED CULTIVATION OF FLOWER CROPS**	**9 hours**

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-4	**PRECISION FARMING TECHNIQUES**	**9 hours**

Concept and introduction of precision Farming: importance, definition, principles and concepts. Role of GIS and GPS. Mobile mapping system and its application in precision farming. Design, layout and installation of drip and fertigation in horticultural crops, role of commuters in developing comprehensive systems needed in site specific management (SSM), georeferencing and photometric correction. Sensors for information gathering, geostatistics, robotics in horticulture, postharvest process management (PPM), remote sensing, information and data management and crop growth models, GIS based modeling,VRT, robotics and drones in agriculture

Unit-5	PRECISION FARMING FOR HORTICULTURAL CROPS	9 hours
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 Lecture hours:	**45 hours**

Text Book(s)

1.	Joe.J.Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.
2.	Paul V. Nelson. 1991. Green house operation and management. Ball publishing USA.

Reference Books

1.	Lyn. Malone, Anita M. Palmer, Christine L. Vloghat Jach Dangeermond. Mapping out world: GIS lessons for Education, ESRI press, 2002
2.	David Reed, Water, media and nutrition for green house crops. Ball publishing USA, 1996
3.	Adams, C.R. K.M. Bandford and M.P. Early, Principles of Horticulture, CBS publishers and distributors, Darya ganj, New Delhi, 1996

Course Code	Course Title	L	T	P	J	C
22AGPE25	**ON-FARM WATER MANAGEMENT**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. Understand the fundamental design of irrigation channels and diversion structures.
2. Study about command area development.
3. Know about availability and utilization of water resources.
4. Impart knowledge on water use efficiency.
5. Get an idea about automation of irrigation systems and water policies.

Course Outcome:

1. The students will be able to design irrigation channels and diversion structures.
2. The students will be able to organize the different CADA programme and involved farmers to participate
3. The students will be able to inspect the conjunctive use of water resources by farmers
4. The students will be able to identify water balance between productivity and water use efficiency in agricultural land
5. The students will be able to design the surface and subsurface drainage systems

Unit-1	DESIGN OF IRRIGATION CHANNELS	9 hours

Design of Erodible (earthen), Non-Erodible (lined) & Alluvial channels (pre-fabricated) - Kennedy's and Lacey's Theories; Materials for Lining watercourses and field channel; Water control and Diversion structure - Design - Land grading - Land Levelling methods.		
Unit-2	**COMMAND AREA**	**9 hours**
Command area - Concept - CADA Programmes in Tamil Nadu; Duty of water expression - relationship between duty and delta; Warabandhi - water distribution and Rotational Irrigation System - Participatory irrigation management.		
Unit-3	**CONJUNCTIVE USE OF SURFACE AND GROUNDWATER**	**9 hours**
Availability of water - rainfall, canal supply and groundwater - conjunctive use - crop calendar - Irrigation demand - water requirement and utilization - Prediction of over and underutilization of water - Dependable rainfall - Rainfall analysis by Markov chain method - Probability matrix.		
Unit-4	**WATER BALANCE**	**9 hours**
Groundwater balance model - Weekly water balance - Performance indicators Appropriateness, Adequacy, Dependability, Equity, Reliability, Timeliness and efficiency - conjunctive use plan by optimization; Agricultural productivity indicators - Water use efficiency.		
Unit-5	**DESIGN OF FARM DRAINAGE SYSTEM**	**9 hours**
Agricultural drainage – types and Concept - Issues; Principles of flow through soils - Darcy's law - drainage coefficient -Infiltration theory; Surface drainage - methods - design - Random drainage - Herringbone - Grid iron types -Design of Open Drains. Steady State flow - Dupit's Forchimer assumptions –Hooghoudt's equation; Methods & Design - Mole drains - Drainage wells - Pipe materials -Problem soils - Leaching Requirements; Land reclamation - methods of Reclamation.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Michael, A.M. 2006. "Irrigation Theory and practice", Vikas publishing house, New Delhi	
2.	Michael, A.M. and Ojha, T.P. "Principles of Agricultural Engineering -Vol II ",Jain Brothers, New Delhi,2002.	
Reference Books		
1.	Israelson,"Irrigation principles and practices", John Wiley & sons, New York, 2002.	
2.	Modi, P.N., "Irrigation and water resources and water power engineering", Standard Book House, New Delhi,2002.	
3.	Suresh, R., "Land and water management principles", Standard Publishers & Distributors,New Delhi,2008	

Course Code	Course Title	L	T	P	J	C

22AGPE26	IRRIGATION WATER QUALITY AND WASTE WATER MANAGEMENT	3	0	0	0	3
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To know the basics concepts of irrigation water quality
2. To impart knowledge on water quality for irrigation purposes, besides relevant environmental problems and recycle and reuse concepts.
3. To understand the importance of water quality for irrigation and major uses of water and the role environmental issues

Course Outcome:

1. The students will be able to describe the parameters of water quality
2. The students will be able to describe the concepts of water quality for irrigation
3. The students will be able to describe the water pollution and quality considerations
4. The students will be able to describe the recycling and reuse of water
5. The students will be able to describe the management of water quality

Unit-1	WATER QUALITY	9 hours

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-2	IRRIGATION WATER QUALITY	9 hours

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

Unit-3	WATER POLLUTION	9 hours

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-4	RECYCLING AND REUSE OF WATER	9 hours

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

Unit-5	WATER QUALITY MANAGEMENT	9 hours

Principles of water quality – Water quality classification – Water quality standards - Water quality indices – TMDL Concepts – Water quality models	
Total Lecture hours:	**45 hours**
Text Book(s)	
1.	George Tchobanoglous, Franklin Louis Burton, Metcalf & Eddy, H. David Stense, "Waste water Engineering: Treatment and Reuse", McGraw-Hill, 2002
2.	Vladimir Novonty, "Water Quality: Diffuse pollution and watershed Management", 2nd edition, John Wiley & Sons, 2003
Reference Books	
1.	Mackenzie L Davis, David A Cornwell, "Introduction to Environmental Engineering", McGraw-Hill 2006.
2.	Stum, M and Morgan, A., "Aquatic Chemistry", Plenum Publishing company, USA, 1985
3.	Lloyd, J.W. and Heathcote, J.A., "Natural inorganic chemistry" in relation to groundwater resources, Oxford University Press, Oxford, 1988

Course Code	Course Title	L	T	P	J	C
22AGPE27	**CLIMATE CHANGE AND ADAPTATION**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To know the basics, importance of global warming
2. To know the concept of mitigation measures against global warming
3. To learn about the global warming and climate change

Course Outcome:

1. Demonstrate an understanding of how the threats and opportunities of predicted climate changes will influence specific sectors at global and regional scale
2. Identify the relationship between atmosphere and its components
3. Analyze the impacts of climate change on environment parameters
4. Evaluate the scientific insights underlying the assessment reports of the IPCC, with a focus on impacts, adaptation and mitigation
5. Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts

Unit-1	**EARTHS CLIMATE SYSTEM**	**9 hours**

Role of ozone in environment ozone layer ozone depleting gases Green House Effect, Radiative effects of Greenhouses Gases Hydrological Cycle Green House Gases and Global Warming Carbon Cycle

Unit-2	**ATMOSPHERE AND ITS COMPONENTS**	**9 hours**

Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere- Composition of the atmosphere Atmospheric stability- Temperature profile of the atmosphere - Lapse rates - Temperature inversion - effects of inversion on pollution dispersion.		
Unit-3	**IMPACTS OF CLIMATE CHANGE**	**9 hours**
Causes of Climate change : Change of Temperature in the environment Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem Water Resources Human Health Industry, Settlement and Society Methods and Scenarios Projected Impacts for Different Regions Uncertainties in the Projected Impacts of Climate Change Risk of Irreversible Changes.		
Unit-4	**CLIMATE CHANGES AND ITS CAUSES**	**9 hours**
Climate change and Carbon credits - CDM - Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCCIPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India.		
Unit-5	**CLIMATE CHANGE AND MITIGATION MEASURES**	**9 hours**
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) - Municipal solid Waste (MSW) & Bio waste, Biomedical, Industrial waste International and Regional cooperation.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Sangam Shrestha, Mukand S. Babel and Vishnu Prasad Pandey, 2014, Climate Change and Water Resources, CRC Press an imprint of the Taylor & Francis Group	
2.	Intergovernmental Panel on Climate Change: https://www.ipcc.ch/	
Reference Books		
1.	Adaptation and mitigation of climate Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006	
2.	Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006	
3.	Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes?, Cambridge University Press, 2003	

Course Code	Course Title	L	T	P	J	C
22AGPE28	**MANAGEMENT OF CANAL IRRIGATION SYSTEM**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

- To enable the students to acquire knowledge on irrigation system and its alignment.
- To impart knowledge on canal command area and irrigation terminology.
- To enrich and familiarize the students in design of various water control structures.

Course Outcome:

1. Apply the knowledge on canal classification and its alignment.
2. Determine duty, delta, base period relationships and canal capacity.
3. Design channels using Kennedy's theory and Lacey's regime theory.
4. Differentiate between lined and unlined channels.
5. Explain different irrigation structures.

Unit-1	Canal classification and its alignment.	**9 hours**

Purpose benefits and ill effects of irrigation; typical network of canal irrigation system and its different physical components; canal classification based on source of water, financial output, purpose, discharge and alignment; canal alignment: general considerations for alignment; performance indicators for canal irrigation system evaluation.

Unit-2	Water requirements and canal capacity	**9 hours**

Estimation of water requirements for canal command areas and determination of canal capacity; water duty and delta, relationship between duty, base period and delta, factors affecting duty and method of improving duty.

Unit-3	**Theories and equations on design of channels**	**9 hours**

Silt theory: Kennedy's theory, design of channels by Kennedy's theory and Lacey's regime theory and basic regime equations.

Unit-4	Maintenance of lined and unlined irrigation canals	**9 hours**

Maintenance of unlined irrigation canals, measurement of discharge in canals, rostering (canal running schedule) and planning of warabandhi irrigation system, necessity of canal lining: advantages and disadvantages, types of canal lining and desirable characteristics for the suitability of lining materials; design of lined canals

Unit-5	Water control and diversion structures	**9 hours**

Water control and diversion structures, Functions of distributary head and cross regulators; canal falls, their necessity and factors affecting canal fall; sources of surplus water in canals and types of canal escapes; requirements of a good canal outlet and types of outlet	
Total Lecture hours:	**45 hours**
Text Book(s)	
1.	Irrigation, Water Power and Water Resources Engineering. Arora, K.R. 2001. Standard Publishers Distributors, Delhi
2.	Irrigation Engineering and Hydraulic Structures. Garg, S.K. 2014. Khanna Publishers New Delhi.
Reference Books	
1.	Irrigation Engineering and Hydraulic structures. Sahasrabudhe, S.R. 2011. SK Kataria & Sons Reprint 2015.
2.	Irrigation Theory and Practice by A M Michael, Second Edition, Vikas Publishing house Pvt Ltd., New Delhi.

Course Code	Course Title	L	T	P	J	C
22AGP29	**LAND AND WATER MANAGEMENT APPLICATIONS USING GOOGLE EARTH ENGINE**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

- To equip the students with the knowledge on techniques of Google earth engine applications in land and water resources management.
- To enable the students to use surface water mapping and image processing for Water detection.
- To enable the students with the knowledge on flood and drought mapping.

Course Outcome:

1. Explain Google earth engine fundamentals.
2. Apply surface water mapping techniques for water detection.
3. Demonstrate precipitation time series analysis for regions and over long periods of time.
4. Classify land cover using land cover mapping and calculating area.
5. Apply remote sensing techniques and implement solutions to water resource management workflows in Earth Engine.

Unit-1	Google Earth Engine Fundamentals:	9 hours
Introduction to the Google Earth Engine platform, Raster and vector data types, Fundamentals of JavaScript programming, Working with Image and Feature Collections, Calculation of		

vegetative and water Indices such as NDVI and NDWI etc., Exporting Raster and Vector Data**.**		
Unit-2	**Surface Water Mapping:**	**9 hours**
Introduction to Water Detection Techniques: Simple Thresholding, Unsupervised Clustering. Introduction to the Global Surface Water (GSW) dataset, Extracting Seasonal and Permanent Waterbodies, Image Processing (Morphological Operations), Image Masking, Raster to Vector Conversion**.**		
Unit-3	**Precipitation Time Series Analysis:**	**9 hours**
Introduction to Gridded Precipitation and Climate Datasets, Map/Reduce Programming Concepts, Calculating Total Rainfall in a Region, Creating Time-series Charts, Exporting a Time-series of Rainfall in a Region, Calculating Long-Term Monthly Average Rainfall.Trend analysis.		
Unit-4	**Land Use Land Cover Mapping:**	**9 hours**
Introduction to Unsupervised Classification using Machine Learning algorithms for Land cover, types of classifiers, Accuracy Assessment, Change detection of LULC, training, testing and validation**.**		
Unit-5	**Flood Mapping and Drought Mapping:**	**9 hours**
Introduction to Radar Remote Sensing, Scattering of Microwaves, Fundamentals of Synthetic Aperture Radar (SAR), Basics of Image formation and visualizing SAR Imagery, Change Detection Methods for Detecting Floods. Introduction to Drought Mapping and Monitoring, Assessment of Long-Term MODIS NDVI Time-Series.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Gandhi, Ujaval, 2021. Google Earth Engine for Water Resources Management Course. Spatial Thoughts.	
2.	Remote Sensing in Hydrology and Water Management. G.A. Shultz and E.T. Engman. Springer, New York, 2000.	
Reference Books		
1.	O. Mutanga and L. Kumar, “Google Earth Engine applications,” Remote Sens., vol. 11, no. 5, pp. 11–14, 2019.	
2.	N. Gorelick, M. Hancher, M. Dixon, S. Ilyushchenko, D. Thau, and R.Moore, “Google earth engine: Planetary-scale geospatial analysis foreveryone,” Remote Sens. Environ., vol. 202, pp. 18–27, Dec. 2017.	

Course Code	Course Title	L	T	P	J	C
22AGPE30	**WATER HARVESTING AND SOIL CONSERVATION STRUCTURES**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

- To enable the students to design and execute the structures for water harvesting.
- To impart the knowledge on cost estimation of various soil and water conservation farm structures.
- To enable the students to design and execute the structures for controlling soil erosion and water erosion in watershed.

Course Outcome:

1. Recommend the short term and long term runoff harvesting at appropriate places in watershed.
2. Design criteria and cost estimation of farm ponds.
3. Explain the functions of soil erosion control structures.
4. Apply the concept hydraulic jump, runoff measuring structures and various permanent gully control structures.
5. Estimate the load analysis on various components of soil conservation structures.

Unit-1	**Water harvesting**	**9 hours**

Principles, importance and uses. Water harvesting techniques – classification based on source, storage and use. Runoff harvesting – short-term and long-term techniques. Short-term harvesting techniques - contour bunds, semicircular hoop, trapezoidal bunds, graded bunds, rock catchment and ground catchment. Long term harvesting techniques- purpose and design criteria

Unit-2	**Structures**	**9 hours**

Farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes. Farm pond - components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction. Percolation pond - site selection, design and construction details. Design considerations of nala bunds.

Unit-3	**Soil erosion control structures**	**9 hours**

Introduction, classification and functional requirements. Design of Gabion structures. Permanent structures for soil conservation and gully control – check dams, drop, chute and drop inlet spillways - design requirements, planning for design, design procedures - hydrologic, hydraulic and structural design and stability analysis.

Unit-4	**Design of spillways**	**9 hours**

Hydraulic jump and its application. Drop spillway - applicability, types - straight drop, box-type inlet spillways - description, functional use, advantages and disadvantages, straight apron and stilling basin outlet, structural components and functions. Chute spillway - description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations. Drop inlet spillway - description, functional use and design criteria.

Unit-5	**Safety measures**	**9 hours**
Loads on head wall, variables affecting equivalent fluid pressure, triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
2.	Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
Reference Books	
1.	Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
2.	Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.

VERTICAL 4- IT AND AGRICULTURAL BUSINESS MANAGEMENT
INTEGRATED FARMING SYSTEM

Course Code	Course Title	L	T	P	J	C
22AGPE31	**INTEGRATED FARMING SYSTEM**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

This course will improve the student skills in the area of farming system research and optimization methodology to design individual integrated farming system in scientific manner

Course Outcome:

1. Understand practical knowledge on specialized in different farming system.
2. Apply the farm wastes with recycle use of different IFS components.
3. Analysis of comparative benefits of the different IFS components
4. Design a farming system model for wetland, garden land and dry land
5. Evaluate the extent of wetland, garden land and dry land Integrated Farming System

Unit-1	**INTRODUCTION OF FARMING SYSTEM**	**9 hours**
Farming system – introduction – scope of farming system – importance – concept – principles of farming system - Types of farming systems – Advantages and limitations - suitability – factors affecting the farming system		
Unit-2	**INTEGRATED FARMING SYSTEM**	**9 hours**
Integrated farming system-historical background - objectives and characteristics advantages of IFS – Components of IFS - Integrated Farming System in Wetland – IFS in garden land –- IFS in dryland and fallow land		
Unit-3	**LIVESTOCK PRODUCTION IN IFS**	**9 hours**
IFS With Goats and Sheep – housing and feeding management – deworming – Young stock management - Dairy Farming in IFS - Fodder production in IFS - IFS With poultry rearing - Duck farming – Rabbit farming – Piggery		
Unit-4	**IFS COMPONENTS**	**9 hours**
Agroforestry – definition – types of agroforestry system – benefits of agroforestry system– Aquaculture – Fish cum agriculture and horticulture – Beekeeping – types and cast of bees – care and management in beekeeping – Sericulture - Mulberry cultivation – Silkworm rearing – Organic farming – Azolla – Small scale nursery		
Unit-5	**RESOURCE RECYCLING IN IFS**	**9 hours**
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 Lecture hours:	**45 hours**

Text Book(s)

1.	Nanda, Sankarsana. Integrated farming system practices: challenges and opportunities. New India Publishing Agency, 2016.
2.	Ravikiran Vasant Mane, Integrated Farming System: A Strategy for Sustainable Farm Production & Livelihood Security, Scitus Academics, 2016

Reference Books

1.	Zaman, Integrated Farming System and Agricultural, New India Publishing Agency, 2019
2.	Nanwal R. K. Farming System and Sustainable Agriculture, Kalyani Publishers, 2017

Course Code	Course Title	L	T	P	J	C
22AGPE32	**AGRICULTURAL BUSINESS MANAGEMENT**	**3**	**0**	**0**	**0**	**3**

Pre-requisite		Syllabus version	v. 1.0

Course Objectives:

1. To introduce the importance of Agri-business management, its characteristics and principles
2. To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

Course Outcome:

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

Unit-1	**CONCEPTS OF AGRICULTURAL BUSINESS**	**9 hours**

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-2	**AGRI – BUSINESS ORGANIZATION**	**9 hours**

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-3	**AGRICULTURAL MARKETING**	**9 hours**

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-4	**AGRICULTURAL BUSINESS FINANCE**	**9 hours**

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-5	**MARKET PROMOTION AND HUMAN RESOURCES**	**9 hours**

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 Lecture hours:	**45 hours**
Text Book(s)	
1.	Himanshu, “Agri Business Management – Problems and prospects”, Ritu Publications, Jaipur, 2005.
2.	Smita Diwase, “Indian Agriculture and Agribusiness Management”, Krishi resource Management Network, Pune 2004.
Reference Books	
1.	Chandra Prasanna, “Projects: Preparation, Appraisal, Budgeting and Implementation”, Tata McGraw Hill Publications, New Delhi, 2001.
2.	Kotler, P., “Marketing Management. Analysis, Planning and Control”, Prentice Hall Inc., New York, 2001.
3.	Rao, V.S.P., and Narayana, P.S., “Principles and Practices of Management”, Konark Publishing Private Limited, New Delhi, 2001.

Course Code	Course Title	L	T	P	J	C
22AGPE33	**SUSTAINABLE AGRICULTURE AND FOOD SECURITY**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.
2. Importance of science, food security and ecological balance.

Course Outcome:

1. Understand methods to sustain land resources.
2. Cognize approaches to sustain water resources and its utilization for agriculture and allied activities.
3. Design and develop new, improved and sustainable systems of agriculture and allied activities.
4. Understand new technologies for improving food security.
5. Comprehend policies to achieve sustainable farming and food security.

Unit-1	**SUSTAINABILITY OF NATURAL RESOURCES**	**9 hours**
Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation. Rainfall forecasting - Adequacy of Rainfall for crop growth		

– Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Ground water & Surface water)		
Unit-2	**SUSTAINABLE AGRICULTURE**	**9 hours**
Sustainable agriculture-definition. Agro-ecosystems - Impact of climate change on Agriculture, Effect on crop yield, effect on Soil fertility – Food grain production at State Level – Indicators of Sustainable food availability – Indicators of food production sustenance.		
Unit-3	**ORGANIC FARMING**	**9 hours**
Natural farming principles – Sustainability in rain fed farming – organic farming – principles and practices. Organic farming-regulation and sustainability – The scale and productivity of organic sustainable systems.		
Unit-4	**SUSTAINABLE FOOD PRODUCTION FOR FOOD SECURITY**	**9 hours**
Performance of Major Food Crops over the past decades – trends in food production – Decline in total factor productivity growth – Demand and supply projections – Impact of market force – Vertical farming – Controlled Environment Agriculture – Genetics diversity – GMO's. Sustainable food security indicators and index – Indicator of sustainability of food Security		
Unit-5	**POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY**	**9 hours**
Food and Crop Production polices – Agricultural credit Policy – Crop insurance –Policies of Natural Resources Use – Policies for sustainable Livelihoods – Virtual water and trade - Sustainable food Security Action Plan.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.	
2.	B.K.Desai and Pujari, B.T. Sustainable Agriculture: A vision for future, New India Publishing Agency, New Delhi, 2007	
Reference Books		
1.	Swarna S. Vepa et al., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.	
2.	Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999	
3.	Tanji, K. K., and Yaron, B. Management of water use in agriculture, Springer Verlag, Berlin, Germany, 1994.	

Course Code	Course Title	L	T	P	J	C

22AGPE34	SYSTEMS ANALYSIS IN AGRICULTURAL ENGINEERING	3	0	0	0	3
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To introduce the students to the application of systems concept to irrigation planning and management.
2. Optimization technique for modeling water resources systems, irrigation management and advanced optimization techniques to cover the socio-technical aspects will be taught.

Course Outcome:

1. Understand practical knowledge on specialized in different water resources and irrigation system.
2. Apply the Linear programming for crop planning and scheduling.
3. Apply the Dynamic Programming for reservoir release for irrigation management.
4. Design a reservoir irrigation system simulation model for efficient water management
5. To evaluate the application of optimization techniques used to address the socio-technical aspects irrigation water management.

Unit-1	SYSTEM CONCEPTS	9 hours

Definition, classification, and characteristics of systems – Scope and steps in systems engineering – Need for systems approach to water resources and irrigation.

Unit-2	LINEAR PROGRAMMING	9 hours

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-3	SIMULATION	9 hours

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-4	DYNAMIC PROGRAMMING	9 hours

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-5	OPTIMIZATION TECHNIQUES	9 hours
Integer and parametric linear programming – Applications to Irrigation water management-Goal programming models with applications.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Vedula, S., and Majumdar, P.P. Water Resources Systems – Modeling Techniques and Analysis Tata McGraw Hill, New Delhi, Fifth reprint, 2010.	
2.	Gupta, P.K., and Man Mohan, "Problems in Operations Research", (Methods and Solutions), Sultan Chand and Sons, New Delhi, 1995.	
Reference Books		
1.	Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, New Delhi, 1997.	
2.	Taha, H.A., "Operations Research", McMillan Publication Co., New York, 1995.	
3.	Hiller, F.S., and Liebermann, G.J., "Operations Research", CBS Publications and Distributions, New Delhi, 1992.	

Course Code	Course Title	L	T	P	J	C
22AGPE35	**IT IN AGRICULTURAL SYSTEM**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To introduce the students to areas of agricultural systems in which IT and computers play a major role.
2. To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models.

Course Outcome:

1. The students shall be able to understand the applications of IT in remote sensing applications such as Drones etc.
2. The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages.
3. The students will be able to apply IT principles and concepts for management of field operations.
4. The students will get an understanding about weather models, their inputs and applications.
5. The students will get an understanding of how IT can be used for e-governance in agriculture

Unit-1	PRECISION FARMING	9 hours

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.		
Unit-2	**ENVIRONMENT CONTROL SYSTEMS**	**9 hours**
Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.		
Unit-3	**AGRICULTURAL SYSTEMS MANAGEMENT**	**9 hours**
Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems		
Unit-4	**WEATHER PREDICTION MODELS**	**9 hours**
Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.		
Unit-5	**E-GOVERNANCE IN AGRICULTURAL SYSTEMS**	**9 hours**
Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.	
2.	H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.	
Reference Books		
1.	Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, New York, 2004	
2.	Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer, Germany, 2000.	

Course Code	Course Title	L	T	P	J	C
22AGPE36	**AUTOMATION IN AGRICULTURE**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To know the operation of various electronic circuits and its applications.
2. To get adequate knowledge about various sensors and robots used in agricultural processes
3. To learn automation techniques in agricultural system

Course Outcome:

1. Exemplify the working operations of electronic devices and processors
2. Interpret the necessity of sensor requirements for precision farming practices
3. Understand the basics of robotics and their applications in agriculture
4. Apply the IOT concepts in cropping practices
5. Interpolate the concept of automation in governing the agricultural systems

Unit-1	**INTRODUCTION**	**9 hours**

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

Unit-2	**PRECISION FARMING**	**9 hours**

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

Unit-3	**ROBOTICS IN AGRICULTURE**	**9 hours**

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

Unit-4	**AUTOMATION USING IoT**	**9 hours**

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

Unit-5	**AUTOMATION OF AGRICULTURE OPERATION**	**9 hours**

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

	Total Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books	
1.	National Research Council, Precision Agriculture in the 21st Century, National Academies Press, Canada, 1997.
2.	Young, S.L. and Pierce, F.J. eds., 2013. Automation: The future of weed control in cropping systems. Springer Science & Business Media
3.	Nof, S.Y. ed., 2009. Springer handbook of automation. Berlin, Heidelberg: Springer Berlin Heidelberg.

Course Code	Course Title	L	T	P	J	C
22AGPE37	LANDSCAPE ARCHITECTURE	3	0	0	0	3
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. To understand the paradigms in landscape architecture in the post-industrial revolution era and to understand the multifaceted dimensions of landscape architecture such as ecology, environment and sustainability.
2. To study the contemporary landscape and the manifestation in the western and Indian Contexts

Course Outcome:

1. To equip the students to do landscape working drawings and preparation of bill of quantities and estimation.
2. To understand the design solutions for larger sites and express the same using models.
3. To understand the different concepts of landscape formulations.
4. To acquire the knowledge of illumination and lighting.
5. To obtain the knowledge on design of water bodies and irrigation systems.

Unit-1	BASICS OF LANDSCAPE ARCHITECTURE	9 hours

Site analysis, synthesis, suitability, landscape zoning and planning with landscape land uses for medium to large scale projects. Evolving an open space structure for the site and suggesting a suitable landscape treatment with respect to ecological, functional, cultural and visual contexts.

Unit-2	LANDSCAPE FORMULATIONS	9 hours

Process for landscape project formulation and landscape design development based on synthesis. Examining how humans occupy exterior space and combines this information with the principles of design to create garden scale models.

Unit-3	SITE MOBILIZATION	9 hours

Site mobilization; Sequence of site activity, site protection measures, site implementation checklist. Design and detailing of hard landscapes: Roads, paving, barriers, edge conditions - functions, types, criteria for selection, design aspects, details.		
Unit-4	**ILLUMINATION**	**9 hours**
Outdoor lighting: Definition of technical terms, types of electrical lighting, types of fixtures, auxiliary fixtures. Principles of design for outdoor illumination, design and type of effects with electrical lighting. Safety precautions and drawbacks of electrical lighting, electrical accessories and their installation. Solar energy and lighting.		
Unit-5	**IRRIGATION FEATURES**	**9 hours**
Water features and Irrigation systems: Design of water features such as swimming pools, cascades, fountains etc., and their technical requirements. Consideration for design and detail of water bodies and natural ponds. Design of irrigation system – landscape area types, Course Overviews and design, water needs and sources, application, methods of installation. Control systems, scheduling and maintenance.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Simonds. J. O. 1961. Landscape Architecture: The Shaping of Man's Natural Environment. F.W. Dodge Cooperation, London Harris.C.W. and Din, N.T. 1997. Time Saver Standards for Landscape Architecture. Mcgraw – Hill International Edition, Arch. Series	
2.	Starke.B. and Simonds, J. O. 2013. Landscape Architecture: A Manual of Site Planning and Design. 5th edition. McGraw-Hill Professional.	
Reference Books		
1.	Shaheer, M., Dua, G.W. and Pal, A.2012. Landscape Architecture in India: A Reader. Indian Journal of Landscape Architecture.	
2.	Reid, G. W. 1993. From Concept to Form: In Landscape Design. John Wiley & Sons.	

Course Code	Course Title	L	T	P	J	C
22AGPE38	**SOFTWARE APPLICATIONS IN SOIL & WATER**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

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Course Outcome:

- Make use of cropwat software for estimation of crop water requirement parameters
- Determine yield and water productivity using AquaCrop.

- Evaluate surface irrigation methods using Surdev software.
- Explain the usage of Surfer software for preparation of contour maps.
  Explain watershed delineation using ArcSWAT software

Unit-1	**Cropwat**	**9 hours**

Conventions used in manual: Crop water requirement, soil moisture deficit, Reference crop 138 vapotranspiration Introduction, Installation, User interface and menu system: main route through the programme, Data needed for calculation, data file names & directories; Main menu options: File menu, Input data menu, schedule menu; Tables & graphs; Save report menu; options menu; help menu; Scehduling scenarious; User defined irrigations; Capillary rise and percolation: User adjustments; Exporting results files to a spreadsheet.

Unit-2	**AquaCrop**	**9 hours**

Introduction: The aquacrop model, Practical applications, The calculation scheme of Aquacrop, Input requirement, Limitations. Climate: Required weather data to run AquaCrop, Reference Evapotranspiration, Determination of Reference Evapotranspiration, Import climatic data. Soil: Soil water retention and soil water movement, soil profile characteristics, Depth & quality of the groundwater table. Crop: Crop parameters, Stress coefficients, crop development (step 1), Crop transpiration (Step 2), Biomass production (step 3), Yield formation (step 4), Water productivity. Management: Irrigation management, Field management, Calibration of soil fertility. Simulation: Initial conditions at start of simulation period, Start of the growing cycle, Soil salinity, Effect of climate change, Evaluation of simulations.

Unit-3	**Surdev**	**9 hours**

Introduction, Parameters and variables involved: a) Field parameters b) Decision variables c) Evaluation variables. Surdev package: Hardware requirements and installation procedure; Menus, keyboard usage, & function keys, Calculation, Files. Basedev, Bordev & Furdev: Menu structure, Input windows, Output window, Error messages, Assumptions & limitations, Program usage, Sample problems. Program applications.

Unit-4	**Surfer**	**9 hours**

Introduction; Tutorial; Data files & worksheet; Creating grid files; Introduction to variograms; Grid editor; Grid operations; Base maps; Contour maps; Post & classed post maps; 3D surface maps; 3D wireframe maps, color relief maps; Grid values maps; Watershed maps; Vector maps; Pont cloud maps; Viewshed layers; Downloading layers from a server; Map properties; Map features; 3D view; Map tools; Layer tools; Coordinate system; Creating and editing features; Common properties; Selecting & arranging objects; Changing the view; Importing, exporting & printing; Options, defaults & customizations; Automating surfer.

Unit-5	**ArcSWAT**	**9 hours**

Introduction; Installing the interface; Preparing input; ArcSWAT toolbar items; Managing projects; Help menu; Migrating from ArcSWAT 1.x to ArcSWAT 2.x; Watershed Delineation; HRU Analysis; Import weather data; Creation of input; Input modification; SWAT Simulation; SWAT database editors; create, process & run example dataset	
Total Lecture hours:	**45 hours**
Text Book(s)	
1.	Introduction; Installing the interface; Preparing input; ArcSWAT toolbar items; Managing projects; Help menu; Migrating from ArcSWAT 1.x to ArcSWAT 2.x; Watershed Delineation; HRU Analysis; Import weather data; Creation of input; Input modification; SWAT Simulation; SWAT database editors; create, process & run example dataset
2.	Dirk Raes, FAO. 2017 AquaCrop training handbook I. Understanding AquaCrop. FAO Publishers.
Reference Books	
1.	Jurriens M, Zerihun D, Boonstra J and Feyen J. 2001. SURDEV: Surface Irrigation Software, Design operation and evaluation of basin, border and furrow irrigation. ILRI publications, Waheningen, The Netherlands
2.	https://www.fao.org/3/i6051e/i6051e.pdf http://downloads.goldensoftware.com/guides/Surfer12_Users_Guide_Preview.pdf http://colinmayfield.com/public/PDF_files/ArcSWAT_Documentation.pdf

Course Code	Course Title	L	T	P	J	C
22AGPE39	**FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

- Understand the management concepts
- Applications of concepts in practical aspects of business
- Development of managerial skills for engineers
- Organizations develop and maintain competitive advantage
- Business decisions are made using various tools and techniques to remain competitive

Course Outcome:

1. Understand the significance of management in particular profession
2. Understand the various management functions
3. The students can explore the management practices in their domain area
4. Understand the management concepts
5. Analyze the concepts of management

Unit-1	Introduction to Management:	**9 hours**
Evolution of Management, Nature & Scope-Functions of ManagementRole of Manager-levels of Management-Managerial Skills - Challenges-Planning-Planning ProcessTypes of Plans-MBO		
Unit-2	**Organization Structure & HRM:**	**9 hours**
Organization Design-Organizational Structure-Departmentation– DelegationCentralization - Decentralization-Recentralization-Organizational Culture- Organizational climate-Organizational change Human Resource Management-HR Planning - Recruitment & Selection - Training & DevelopmentPerformance appraisal - Job satisfaction-Stress Management Practices		
Unit-3	**Operation Management**:	**9 hours**
Introduction to Operations Management-Principles and Types of Plant Layout-Methods of production (Job Batch and Mass production) - Method study and Work Measurement-Quality Management - TQM-Six sigma - Deming's Contribution to Quality - Inventory Management – EOQ - ABC Analysis - JIT System-Business Process Reengineering (BPR)		
Unit-4	**Marketing Management:**	**9 hours**
Introduction to Marketing-Functions of Marketing-Marketing vs. SellingMarketing Mix - Marketing Strategies - Product Life Cycle - Market Segmentation -Types of Marketing - Direct Marketing-Network Marketing - Digital Marketing-Channels of Distribution - Supply Chain Management (SCM)		
Unit-5	**Project Management**	**9 hours**
Introduction to Project Management-steps in Project Management - Project Planning - Project Life Cycle-Network Analysis-Program Evaluation & Review Technique (PERT)-Critical Path Method (CPM) - Project Cost Analysis - Project Crashing - Project Information Systems		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
2.	Fundamentals of Management, Stephen P.Robbins, Pearson Education, 2009.

Reference Books

1.	Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.

2.	Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.

MANDATORY COURSES I

Course Code	Course Title	L	T	P	J	C
22MCT001	**INTRODUCTION TO WOMEN AND GENDER STUDIES**	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version		v. 1.0		

Unit-1	**CONCEPTS**	**9 hours**
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.		
Unit-2	**FEMINIST THEORY**	**9 hours**
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.		
Unit-3	**WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL**	**9 hours**
Rise of Feminism in Europe and America. Women's Movement in India		
Unit-4	**GENDER AND LANGUAGE**	**9 hours**
Linguistic Forms and Gender. Gender and narratives		
Unit-5	**GENDER AND REPRESENTATION**	**9 hours**
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media		
	Total Lecture hours:	**45 hours**

Course Code	Course Title	L	T	P	J	C
22MCT002	**ELEMENTS OF LITERATURE**	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

Course Outcome:

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

1. COURSE CONTENTS

Introduction to Elements of Literature

1. Relevance of literature

a) Enhances Reading, thinking, discussing and writing skills.
b) Develops finer sensibility for better human relationship.
c) Increases understanding of the problem of humanity without bias.
d) Providing space to reconcile and get a cathartic effect.

2. Elements of fiction

a) Fiction, fact and literary truth.
b) Fictional modes and patterns.
c) Plot character and perspective.

3. Elements of poetry

a) Emotions and imaginations.
b) Figurative language.
c) (Simile, metaphor, conceit, symbol, pun and irony).
d) Personification and animation.
e) Rhetoric and trend.

4. Elements of drama

a) Drama as representational art.
b) Content mode and elements.
c) Theatrical performance.
d) Drama as narration, mediation and persuasion.
e) Features of tragedy, comedy and satire.

2.READINGS:

a) An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
b) An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
c) The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.
d) The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
e) The Elements of Drama, J.L.Styan, Literary Licensing, 2011

3. OTHER SESSION:

3.1*Tutorials:
3.2*Laboratory:
3.3*Project: The students will write a term paper to show their understanding of a particular piece of literature

4.*ASSESSMENT:

4.1HA:
4.2Quizzes-HA:
4.3Periodical Examination: one
4.4Project/Lab: one (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. 4.5Final Exam:
Text Book(s)
1. To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

Course Code	Course Title	L	T	P	J	C
22MCT003	**FILM APPRECIATION**	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version			v. 1.0	

Course Objectives:

1. In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

Theme - A: The Component of Films

A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

B-1: Film language, form, movement etc.
B-2: Early cinema… silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation

Theme – D: Development of Films

D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

E-1: The early era
E-2: The important films made by the directors
E-3: The regional films

E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

Total Lecture hours:	**45 hours**

Course Code	Course Title	L	T	P	J	C
22MCT004	**WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA**	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To enjoy life happily with fun filled new style activities that help to maintain health also
2. To adapt a few lifestyle changes that will prevent many health disorders
3. To be cool and handbill every emotion very smoothly in every walk of life
4. To learn to eat cost effective but healthy foods that are rich in essential nutrients
5. To develop immunity naturally that will improve resistance against many health disorders

Course Outcome:

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health

Unit-1	HEALTH AND ITS IMPORTANCE	9 hours

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

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-2	DIET	9 hours

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-3	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	9 hours

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 (TriDosha 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-4	MENTAL WELLNESS	9 hours

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral 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-5	**YOGA**	**9 hours**

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

Total Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books

1.	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
2.	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

Course Code	Course Title	L	T	P	J	C
22MCT007	INDUSTRIAL SAFETY	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To Understand the Introduction and basic Terminologies safety.
2. To enable the students to learn about the Important Statutory Regulations and standards.
3. To enable students to Conduct and participate the various Safety activities in the Industry.
4. To have knowledge about Workplace Exposures and Hazards
5. To assess the various Hazards and consequences through various Risk Assessment techniques.

Course Outcome:

on completion of this course the student will be able:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques

Unit-1	SAFETY TERMINOLOGIES	**9 hours**
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS		
Unit-2	STANDARDS AND REGULATIONS	**9 hours**
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006		
Unit-3	SAFETY ACTIVITIES	**9 hours**
Tool box Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment		
Unit-4	WORKPLACE HEALTH AND SAFETY	**9 hours**
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane SafetyToxic gas Release		
Unit-5	HAZARD IDENTIFICATION TECHNIQUES	**9 hours**
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2.	L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

Reference Books

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

5.	Society of Safety Engineers, USA

MANDATORY COURSES II

Course Code	Course Title	L	T	P	J	C
22MCT012	**DISASTER RISK REDUCTION AND MANAGEMENT**	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
2. To acquaint with the skills for planning and organizing disaster response

Course Outcome:

- To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
- To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
- To develop disaster response skills by adopting relevant tools and technology
- Enhance awareness of institutional processes for Disaster response in the country
- Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

Unit-1	HAZARDS, VULNERABILITY AND DISASTER RISKS	9 hours

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

Unit-2	DISASTER RISK REDUCTION (DRR)	9 hours

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources

Unit-3	DISASTER MANAGEMENT	9 hours

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management –

Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)		
Unit-4	**TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT**	**9 hours**
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management		
Unit-5	**DISASTER MANAGEMENT: CASE STUDIES**	**9 hours**
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Taimpo (2016), Disaster Management and Preparedness, CRC Publications	
2.	Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications	
3.	Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13: 978-9380386423	
4.	Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]	
Reference Books		
1.	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005	
2.	Government of India, National Disaster Management Policy, 2009.	
3.	Shaw R (2016), Community based Disaster risk reduction, Oxford University Press	

Course Code	Course Title	L	T	P	J	C
22MCT009	**HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA**	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version			v. 1.0	
Unit-1	**CONCEPTS AND PERSPECTIVES**				**9 hours**	

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India		
Unit-2	**HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA**	**9 hours**
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.		
Unit-3	**SCIENCE AND TECHNOLOGY IN ANCIENT INDIA**	**9 hours**
Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.		
Unit-4	**SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA**	**9 hours**
Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest		
Unit-5	**SCIENCE AND TECHNOLOGY IN COLONIAL AND POST INDEPENDENCE INDIA**	**9 hours**
Science and the Empire Indian response to Western Science Growth of techno-scientific institutions Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology		
	Total Lecture hours:	**45 hours**

Course Code	Course Title	L	T	P	J	C
22MCT010	**POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY**	**3**	**0**	**0**	**0**	**0**
Pre-requisite	Desirable: Universal Human Values	Syllabus version		v. 1.0		

Course Objectives:

1. This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions

Course Outcome:

- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared

COURSE TOPICS:

- Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each) (Refs: A Nagaraj, M K Gandhi, JC Kumarappa)
- Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (5 lectures) (Refs: Adam smith, J S Mill)
- Fascism and totalitarianism. World war I and II. Cold war. (2 lectures)
- Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models. (Refs: Marx, Lenin, Mao, M N Roy) (5 lectures)
- Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)
- Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. (6 lectures) (Refs: M K Gandhi, Schumacher, Kumarappa)
- Essential elements of Indian civilization. (3 lectures) (Refs: Pt Sundarlal, R C Mazumdar, Dharampal)
- Technology as driver of society, Role of education in shaping of society. Future directions. (4 lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)
- Conclusion (2 lectures)

Total Lecture hours:	**45 hours**

Course Code	Course Title	L	T	P	J	C
22MCT011	**STATE, NATION BUILDING AND POLITICS IN INDIA**	**3**	**0**	**0**	**0**	**0**
Pre-requisite		Syllabus version		v. 1.0		

Course Objectives:

1. The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

Course Outcome:

- It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

Unit-1	**STATE AND POLITICS**	**9 hours**
Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world		
Unit-2	**ORGANS OF STATE**	**9 hours**
Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary,		
Unit-3	**1857 REVOLT**	**9 hours**
The idea of India. 1857 and the national awakening.		
Unit-4	**INC**	**9 hours**
1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India. Goals, objective and philosophy. Why a federal system? National integration and nation-building.		
Unit-5	**CURRENT SCENARIOS**	**9 hours**
Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi
2.	Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012
3.	Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition
4.	Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
5	Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.

6.	M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
7.	Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

OPEN ELECTIVES

OFFERED BY DEPARTMENT OF AGRICULTURAL ENGINEERING

OPEN ELECTIVES – I

Course Code	Course Title	L	T	P	J	C
22AGOE01	**TRADITIONAL INDIAN FOODS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version			v. 1.0	

Course Objectives:

To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

Course Outcome:

1. To understand the historical and traditional perspective of foods and food habits
2. To understand the processing methods of grains
3. To understand the traditional food processing pattern
4. To understand the commercial values of traditional foods
5. To gain knowledge on health benefits of traditional food

Unit-1	**HISTORICAL AND CULTURAL PERSPECTIVES**	**9 hours**

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts

Unit-2	**TRADITIONAL METHODS OF FOOD PROCESSING**	**9 hours**

Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, 200 yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sundrying, osmotic drying, brining, pickling and smoking.

Unit-3	TRADITIONAL FOOD PATTERNS	9 hours
Typical breakfast, meal and snack foods of different regions of India.Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods,pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods		
Unit-4	**COMMERCIAL PRODUCTION OF TRADITIONAL FOODS**	**9 hours**
Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.		
Unit-5	**HEALTH ASPECTS OF TRADIONAL FOODS**	**9 hours**
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005	
2.	Davidar, Ruth N. “Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.	

Course Code	Course Title	L	T	P	J	C
22AGOE02	**BIODIVERSITY CONSERVATION**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version		v. 1.0		
Course Objectives:						
The identification of different aspects of biological diversity and conservation techniques						
Course Outcome:						
Upon successful completion of this course, students will: 1. An insight into the structure and function of diversity for ecosystem stability. 2. Understand the concept of animal diversity and taxonomy 3. Understand socio-economic issues pertaining to biodiversity 4. An understanding of biodiversity in community resource management. 5. Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development						

Unit-1	**INTRODUCTION**	**9 hours**
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application		
Unit-2	**INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY**	**9 hours**
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.		
Unit-3	**MICROBIAL DIVERSITY**	**9 hours**
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis		
Unit-4	**MEGA DIVERSITY**	**9 hours**
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.		
Unit-5	**CONSERVATIONS OF BIODIVERSITY**	**9 hours**
In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	A textbook of Botany: Angiosperms- Taxonomy, Anatomy, Economic Botany & Embryology. S. Chand, Limited, Pandey, B. P. January 2001
2.	Principles of Systematic Zoology, Mcgraw-Hill College, Ashlock, P.D., Latest Edition.
3.	Microbiology, MacGraw Hill Companies Inc, Prescott, L.M., Harley, J.P., and Klein D.A. (2022)
4.	Microbiology, Pearson Publisher, Gerard J. Tortora, Berdell R. Funke, Christine L.Case, 13th Edition 2019

Course Code	Course Title	L	T	P	J	C
22AGOE03	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	0	3
Pre-requisite	NIL	Syllabus version			v. 1.0	

Course Objectives:

At the end of the course, the student is expected to

- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

Course Outcome:

1. Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
2. Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
3. Skills on combustion thermodynamics and kinetics.
4. Apply calculation and design tube still heaters.
5. Studied different heat treatment furnace.

Unit-1	INTRODUCTION	9 hours

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing

Unit-2	ELECTRICAL SYSTEMS	9 hours

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination

Unit-3	THERMAL SYSTEMS	9 hours

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

Unit-4	ENERGY CONSERVATION IN MAJOR UTILITIES	9 hours

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets		
Unit-5	**ECONOMICS**	**9 hours**
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.	
2.	Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988	
3.	Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22AGOE04	**DRINKING WATER SUPPLY AND TREATMENT**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version			v. 1.0	
Course Objectives:						
To equip the students with the principles and design of water treatment units and distribution system.						
Course Outcome:						
1. An understanding of water quality criteria and standards, and their relation to public health 2. The ability to design the water conveyance system 3. The knowledge in various unit operations and processes in water treatment 4. An ability to understand the various systems for advanced water treatment 5. An insight into the structure of drinking water distribution system						
Unit-1	**SOURCES OF WATER**					**9 hours**
Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.						
Unit-2	**CONVEYANCE FROM THE SOURCE**					**9 hours**

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.		
Unit-3	**WATER TREATMENT**	**9 hours**
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –- sand filters - Disinfection - –Construction, Operation and Maintenance aspects.		
Unit-4	**ADVANCED WATER TREATMENT**	**9 hours**
Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects		
Unit-5	**WATER DISTRIBUTION AND SUPPLY**	**9 hours**
Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.	
2.	Punmia B.C, Arun K.Jain, Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 2016.	
3.	Rangwala "Water Supply and Sanitary Engineering", February 2022	
4.	Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.	
Reference book(s)		
1.	Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954	
2.	Babbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984	

Course Code	Course Title	L	T	P	J	C
22AGOE05	**RENEWABLE ENERGY TECHNOLOGIES**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version			v. 1.0	
Course 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

Course Outcome:

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

Unit-1	ENERGY SCENARIO	**9 hours**

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-2	SOLAR ENERGY	**9 hours**

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-3	WIND ENERGY	**9 hours**

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-4	BIO-ENERGY	**9 hours**

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

Unit-5	OCEAN AND GEOTHERMAL ENERGY	**9 hours**

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 Lecture hours:	**45 hours**
Text Book(s)		
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 book(s)		
Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.		
Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.		

OPEN ELECTIVES – II

Course Code	Course Title	L	T	P	J	C
22AGOE06	**REMOTE SENSING CONCEPTS**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version		v. 1.0		

Course Objectives:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

Course Outcome:

1. Understand the concepts and laws related to remote sensing
2. Understand the interaction of electromagnetic radiation with atmosphere and earth material
3. Acquire knowledge about satellite orbits and different types of satellites
4. Understand the different types of remote sensors
5. Gain knowledge about the concepts of interpretation of satellite imagery

Unit-1	REMOTE SENSING AND ELECTROMAGNETIC RADIATION	**9 hours**

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive - Radiation Quantities

Unit-2	EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL	**9 hours**

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.		
Unit-3	ORBITS AND PLATFORMS	**9 hours**
Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit		
Unit-4	SENSING TECHNIQUES	**9 hours**
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites		
Unit-5	DATA PRODUCTS AND INTERPRETATION	**9 hours**
Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.	
2.	George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018	

Course Code	Course Title	L	T	P	J	C
22AGOE07	**INTRODUCTION TO FOOD PROCESSING**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version		v. 1.0		
Course Objectives:						
The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.						

Course Outcome:

1. Be aware of the different methods applied to processing foods.
2. Be aware of the different methods of handling and storage of foods
3. To gain knowledge on large scale food processing techniques
4. To understand food spoilage
5. To understand food hygiene

Unit-1	PROCESSING OF FOOD AND ITS IMPORTANCE	**9 hours**

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-2	METHODS OF FOOD HANDLING AND STORAGE	**9 hours**

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.

Unit-3	LARGE-SCALE FOOD PROCESSING	**9 hours**

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

Unit-4	FOOD WASTES IN VARIOUS PROCESSES	**9 hours**

Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

Unit-5	FOOD HYGIENE	**9 hours**

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 Lecture hours:	**45 hours**
Text Book(s)		
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.	
2.	Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002	
3.	Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22AGOE08	**DRONE TECHNOLOGIES**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version		v. 1.0		

Course Objectives:

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

Course Outcome:

1. Know about a various type of drone technology, drone fabrication and programming.
2. Execute the suitable operating procedures for functioning a drone
3. Select appropriate sensors and actuators for Drones
4. Develop a drone mechanism for specific applications
5. Createthe programs for various drones

Unit-1	INTRODUCTION TO DRONE TECHNOLOGY	**9 hours**

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

Unit-2	DRONE DESIGN, FABRICATION AND PROGRAMMING	**9 hours**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection

Unit-3	DRONE FLYING AND OPERATION	**9 hours**
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environmentDrone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications		
Unit-4	DRONE COMMERCIAL APPLICATIONS	**9 hours**
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing		
Unit-5	FUTURE DRONES AND SAFETY	**9 hours**
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.
2.	Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016

Reference book(s)

1	John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016
2	Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22AGOE09	**GEOGRAPHICAL INFORMATION SYSTEM**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	Syllabus version			v. 1.0	

Course Objectives:

To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

Course Outcome:

1. Have basic idea about the fundamentals of GIS.
2. Understand the types of data models.
3. Get knowledge about data input and topology

4. Gain knowledge on data quality and standards
5. Understand data management functions and data output

Unit-1	FUNDAMENTALS OF GIS	**9 hours**

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

Unit-2	SPATIAL DATA MODELS	**9 hours**

Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models

Unit-3	DATA INPUT AND TOPOLOGY	**9 hours**

Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input – Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration

Unit-4	DATA QUALITY AND STANDARDS	**9 hours**

Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards – Interoperability - OGC - Spatial Data Infrastructure

Unit-5	DATA MANAGEMENT AND OUTPUT	**9 hours**

Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GISdistributed GIS.

Total Lecture hours:	**45 hours**

Text Book(s)

1.	Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2.	Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

Reference book(s)

1.	Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

Course Code	Course Title	L	T	P	J	C
22AGOE10	BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT	**3**	**0**	**0**	**0**	**0**
Pre-requisite	NIL	Syllabus version		v. 1.0		

Course Objectives:

1. To introduce the interdisciplinary approach of water management.
2. To develop knowledge base and capacity building on IWRM

Course Outcome:

On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

- CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
- CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.
- CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
- CO4 Illustrate the recent trends in water management.
- CO5 Understand the implementation hitches and the institutional frameworks.

Unit-1	OVERVIEW OF IWRM	**9 hours**

Facts about water - Definition – Key challenges - Paradigm shift - Water management Principles - Social equity - Ecological sustainability – Economic efficiency - SDGs - World Water Forums.

Unit-2	WATER USE SECTORS: IMPACTS AND SOLUTION	**9 hours**

Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management

Unit-3	WATER ECONOMICS	**9 hours**

Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies

Unit-4	RECENT TREANDS IN WATER MANAGEMENT	**9 hours**

River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change

Unit-5	IMPLEMENTATION OF IWRM	**9 hours**

Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.	
Total Lecture hours:	**45 hours**
Text Book(s)	
1.	Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2.	Mollinga P. et al. " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006
Reference Books	
1.	Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.
2.	IWRM Guidelines at River Basin Level (UNESCO, 2008).
3.	Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrm/Tutorial_text.pdf
4.	Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.
5.	The 17 Goals, United Nations, https://sdgs.un.org/goals.

Course Code	Course Title	L	T	P	J	C
22AGOE11	Energy Technology	**3**	**0**	**0**	**0**	**0**
Pre-requisite	NIL	Syllabus version			v. 1.0	

Course Objectives:

1. To introduce the various types of renewable fuels
2. To compare renewable technologies with fossil fuels and among themselves
3. To identify current developments in renewable energy technologies

Course Outcome:

On completion of the course, the students will be able to

- CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
- CO2: Students will excel as professionals in the various fields of energy engineering
- CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.
- CO4: Explain the technological basis for harnessing renewable energy sources.
- CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

Unit-1	INTRODUCTION	**9 hours**

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources		
Unit-2	CONVENTIONAL ENERGY	**9 hours**
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.		
Unit-3	NON-CONVENTIONAL ENERGY	**9 hours**
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy		
Unit-4	BIOMASS ENERGY	**9 hours**
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.		
Unit-5	ENERGY CONSERVATION	**9 hours**
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2.	Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3.	Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4.	Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

Reference Books

1.	Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.

2.	El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3.	Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

Course Code	Course Title	L	T	P	J	C
22AGOE12	FUNDAMENTALS OF FOOD ENGINEERING	3	0	0	0	0
Pre-requisite	NIL	Syllabus version		v. 1.0		

Course Objectives:

The course aims to

1. acquaint and equip the students with different techniques of measurement of engineering properties.
2. make the students understand the nature of food constituents in the design of processing equipment

Course Outcome:

At the end of the course the students will be able to

- CO1 understand the importance of food polymers
- CO2 understand the effect of various methods of processing on the structure and texture of food materials
- CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

Unit-1	BASIC PROPERTIES OF FOOD MATERIALS	9 hours

Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

Unit-2	DRYING AND DEHYDRATION	9 hours

Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foam-mat dryers

Unit-3	SIZE REDUCTION	9 hours

Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

Unit-4	MIXING	9 hours

Theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory

of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for lo.w- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.		
Unit-5	**MECHANICAL SEPARATIONS**	**9 hours**
Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Intitute of Food Science & Technology, Nz. Warren L. McCabe, Julian Smith, Peter Harriott. 2004	
2.	Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA. Christie John Geankoplis. 2003.	
Reference Books		
1.	Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.	
2.	George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.	
3.	J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed.	

Course Code	Course Title	L	T	P	J	C
22AGOE13	**FOOD SAFETY AND QUALITY REGULATIONS**	**3**	**0**	**0**	**0**	**0**
Pre-requisite	**NIL**	Syllabus version			v. 1.0	

Course Objectives:

1. To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
2. To help become skilled in systems for food safety surveillance
3. To be aware of the regulatory and statutory bodies in India and the world
4. To ensure processed food meets global standard

Course Outcome:

1. Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
2. Awareness on regulatory and statutory bodies in India and the world

Unit-1	**INTRODUCTION TO FOOD SAFETY AND SECURITY**	**9 hours**

Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

Unit-2	**FOOD QUALITY**	**9 hours**

Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

Unit-3	**RISK ASSESSMENT**	**9 hours**

Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

Unit-4	**INDIAN AND GLOBAL REGULATIONS**	**9 hours**

: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

Unit-5	**CODEX ALIMENTARIUS COMMISSION**	**9 hours**

Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

Total Lecture hours:	**45 hours**

Text Book(s)

1.	Handbook of food toxicology by S. S. Deshpande, 2002
2.	The food safety information handbook by Cynthia A. Robert, 2009

Reference Books

1.	Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979

2.	Microbiological safety of Food by Hobbs BC, 1973
3.	Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003