Curriculum and Syllabi

B.Tech. AGRICULTURAL ENGINEERING

SEMESTERS I to VIII

Regulations 2022

Programme: B.Tech. AGRICULTURAL ENGINEERING

2022 Regulations

(2022 Batch onwards)

Curriculum for Semesters I to VIII

SEMESTER I

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Courses									
1.	22PH101	Engineering Physics	3	0	2	5	4	60 / 40	BS
2.	22CS101	Problem Solving Techniques I	3	0	2	5	4	60 / 40	ES
3.	22ES101	Innovation and Design Thinking	1	0	2	3	2	0 / 100	ES
Theory Courses									
4.	22MA101	Matrices and Calculus	3	1	0	4	4	60 / 40	BS
5.	22AC101	Heritage of Tamil	1	0	0	1	1	0 / 100	AC
6.	22EEC101	Aptitude and Soft Skills	1	0	0	1	1	0 / 100	EEC
7.	22ME101	Engineering Mechanics	3	0	0	3	3	60 / 40	PC
8.	22ME102	Engineering Graphics	2	0	2	4	3	60 / 40	PC
Mandatory Course									
9.		Student Induction Programme							MC

SEMESTER II

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Courses									
1.	22CH101	Engineering Chemistry	3	0	2	5	4	60 / 40	BS
2.	22CS201	Problem Solving Techniques II	3	0	2	5	4	60 / 40	ES
Theory Courses									
3.	22HS201	Technical English	3	0	0	3	3	60 / 40	HS
4.	22MA201	Numerical Methods	3	1	0	4	4	60 / 40	BS
5.	22HS202	Environmental Science	2	0	0	2	2	60 / 40	HS
6.	22AC201	Tamils and Technology	1	0	0	1	1	0 / 100	AC
7.	22EEC201	Aptitude and Soft Skills II	1	0	0	1	1	0 / 100	EEC
Practical Course									
8.	22ES201	Engineering Practice Laboratory	0	0	4	4	2	40 / 60	ES

SEMESTER III

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Courses									
1.	22CS302	Problem Solving Techniques III	3	0	2	5	4	60/40	ES
2.	22ME301	Strength of Materials	3	0	2	5	4	60/40	PC
3.	22AG301	Principles of Soil science and Engineering	2	0	2	4	3	60/40	PC
4.	22AG302	Fluid Mechanics and	3	0	2	5	4	60/40	PC

		Machinery							
5.	22ME302	Theory of Machines	3	0	2	5	4	60/40	ES
Theory Courses									
6.	22MA301	Transforms and Partial Differential Equations	3	1	0	4	4	60/40	BS
Practical Course									
7.	22EEC301	Industrial Training / Internship - I	0	0	0	2 Weeks	1	0/100	EEC

SEMESTER IV

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Courses									
1.	22AG401	Surveying and Levelling	3	0	2	5	4	60/40	PC
2.	22AG402	Food and dairy engineering	3	0	2	5	4	60/40	PC
Theory Courses									
3.	22MA303	Probability and Statistics	3	1	0	4	4	60/40	BS
4.	22ME402	Engineering Thermodynamics	3	0	0	3	3	60/40	ES
5.	22AG403	Unit Operations in Agricultural Process Engineering	3	0	0	3	3	60/40	PC
Practical Course									
6.	22AG404	CAD and Drawing of Farm Structures	0	0	4	4	2	40/60	PC
Mandatory Course									
7.	22MC405	Disaster Risk Reduction and Management					-	0/100	MC

SEMESTER V

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Courses									
1.	22AG501	Farm Machinery and Equipment	3	0	2	5	4	60/40	PC
2.	22AG502	Irrigation and Drainage Engineering	3	0	2	5	4	60/40	PC
Theory Course									
3.	22AG503	Design of Agricultural Machine Elements	3	0	0	3	3	60/40	PC
4.	22AG504	Soil and Water conservation Engineering	3	0	0	3	3	60/40	ES
Elective Courses									
5.		Open Elective - I					3	60/40	OE
6.		Open Elective - II					3	60/40	OE
Practical Course									
7.	22EEC501	Industrial Training / Internship - II	0	0	0	2 Weeks	1	0/100	EEC
Mandatory Course									
8.	22MC502	Industrial Safety					-	0/100	MC

SEMESTER VI

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Courses									
1.	22AG601	Post Harvest Technology	3	0	2	5	4	60/40	PC

2.	22AG602	Tractors Engine System	2	0	2	4	3	60/40	PC
Elective Courses									
3.		Professional Elective –I					3	60/40	PE
4.		Professional Elective – II					3	60/40	PE
5.		Open Elective-III					3	60/40	OE
6.		Open Elective-IV					3	60/40	OE
Practical Course									
7.	22EEC503	Mini Project	0	0	4	4	2	40 / 60	EEC

SEMESTER VII

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Course									
1.	22AG701	Renewable Energy Resources	2	0	2	4	3	60/40	PC
Theory Course									
2.	22HS702	Human Values and Ethics	3	0	0	3	3	60/40	HS
Elective Courses									
3.		Professional Elective – III					3	60/40	PE
4.		Professional Elective – IV					3	60/40	PE
5.		Open Elective - V					3	60/40	OE
Practical Course									
7.	22AG702	ICT in Agricultural Engineering Lab	0	0	4	4	2	40/60	PC
8.	22EEC701	Project Work – Phase I	0	0	4	4	2	0/100	EEC

SEMESTER VIII

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Course									
1.	22MG801	Industrial Management	3	0	0	3	3	60/40	HS
Elective Course									
2.		Professional Elective – V					3	60/40	PE
Practical Course									
3.	22EEC801	Project Work – Phase II	0	0	20	20	10	60/40	EEC

Total Credits : 164

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SUMMARY

S.No	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1	**HS**		5					3	3	**11**
2	**BS**	8	8	4	4					**24**
3	**ES**	6	6	8	3	3				**26**
4	**PC**	6		11	13	11	7	5		**53**
5	**PE**						6	6	3	**15**
6	**OE**					6	6	3		**15**
7	**EEC**	1	1	1		1	2	2	10	**18**
8	**AC**	1	1							**2**
	Total	**22**	**21**	**24**	**20**	**21**	**21**	**19**	**16**	**164**
9	**MC (Non Credit)**	**~**			**~**	**~**				

HUMANITIES AND SOCIAL SCIENCES (HS)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22HS201	Technical English	3	0	0	3	3	60 / 40	HS
2.	22HS202	Environmental Science	2	0	0	2	2	60 / 40	HS
3.	22HS702	Human Values and Ethics	3	0	0	3	3	60/40	HS
4.	22MG801	Industrial Management	3	0	0	3	3	60/40	HS

BASIC SCIENCES (BS)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PH101	Engineering Physics	3	0	2	5	4	60 / 40	BS
2.	22MA101	Matrices and Calculus	3	1	0	4	4	60 / 40	BS
3.	22CH101	Engineering Chemistry	3	0	2	5	4	60 / 40	BS
4.	22MA201	Numerical Methods	3	1	0	4	4	60 / 40	BS
5.	22MA301	Transforms and Partial Differential Equations	3	1	0	4	4	60/40	BS
6.	22MA303	Probability and Statistics	3	1	0	4	4	60/40	BS

ENGINEERING SCIENCES (ES)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22CS101	Problem Solving Techniques I	3	0	2	5	4	60 / 40	ES
2.	22ES101	Innovation and	1	0	2	3	2	0 / 100	ES

		Design Thinking							
3.	22CS201	Problem Solving Techniques II	3	0	2	5	4	60 / 40	ES
4.	22ES201	Engineering Practice Laboratory	0	0	4	4	2	40 / 60	ES
5.	22CS302	Problem Solving Techniques III	3	0	2	5	4	60/40	ES
6.	22ME302	Theory of Machines	3	0	2	5	4	60/40	ES
7.	22ME402	Engineering Thermodynamics	3	0	0	3	3	60/40	ES
8.	22AG504	Soil and Water conservation Engineering	3	0	0	3	3	60/40	ES

PROFESSIONAL CORE (PC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22ME101	Engineering Mechanics	3	0	0	3	3	60 / 40	PC
2.	22ME102	Engineering Graphics	2	0	2	4	3	60 / 40	PC
3.	22ME301	Strength of Materials	3	0	2	5	4	60/40	PC
4.	22AG301	Principles of Soil science and Engineering	2	0	2	4	3	60/40	PC
5.	22AG302	Fluid Mechanics and Machinery	3	0	2	5	4	60/40	PC
6.	22AG401	Surveying and Levelling	3	0	2	5	4	60/40	PC
7.	22AG402	Food and dairy engineering	3	0	2	5	4	60/40	PC
8.	22AG403	Unit Operations in Agricultural Process Engineering	3	0	0	3	3	60/40	PC
9.	22AG404	CAD and	0	0	4	4	2	40/60	PC

		Drawing of Farm Structures							
10.	22AG501	Farm Machinery and Equipment	3	0	2	5	4	60/40	PC
11.	22AG502	Irrigation and Drainage Engineering	3	0	2	5	4	60/40	PC
12.	22AG503	Design of Agricultural Machine Elements	3	0	0	3	3	60/40	PC
13.	22AG601	Post Harvest Technology	3	0	2	5	4	60/40	PC
14.	22AG602	Tractors Engine System	2	0	2	4	3	60/40	PC
15.	22AG701	Renewable Energy Resources	2	0	2	4	3	60/40	PC
16.	22AG702	ICT in Agricultural Engineering Lab	0	0	4	4	2	40/60	PC

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22EEC101	Aptitude and Soft Skills	1	0	0	1	1	0 / 100	EEC
2.	22EEC201	Aptitude and Soft Skills II	1	0	0	1	1	0 / 100	EEC
3.	22EEC301	Industrial Training / Internship - I	0	0	0	2 Weeks	1	0/100	EEC
4.	22EEC501	Industrial Training / Internship - II	0	0	0	2 Weeks	1	0/100	EEC
5.	22EEC503	Mini Project	0	0	4	4	2	40 / 60	EEC
6.	22EEC701	Project Work – Phase I	0	0	4	4	2	0/100	EEC

7.	22EEC801	Project Work – Phase II	0	0	20	20	10	60/40	EEC

AUDIT COURSES (AC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22AC101	Heritage of Tamil	1	0	0	1	1	0 / 100	AC
2.	22AC201	Tamils and Technology	1	0	0	1	1	0 / 100	AC

NON CREDIT MANDATORY COURSES (NCMC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.		Student Induction Programme							MC
2.	22MC405	Disaster Risk Reduction and Management					-	0/100	MC
3.	22MC502	Industrial Safety					-	0/100	MC

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Professional Electives

Professional Elective I

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG01	Storage and Packaging Technology	3	0	0	3	3	60/40	PE
2.	22PAG02	Process Engineering of Fruits and Vegetables	3	0	0	3	3	60/40	PE
3.	22PAG03	Seed Processing Technology	3	0	0	3	3	60/40	PE
4.	22PAG04	Sustainable Agriculture and Food Security	3	0	0	3	3	60/40	PE
5.	22PAG05	Heat and Mass Transfer for Agricultural Engineers	3	0	0	3	3	60/40	PE

Professional Elective II

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG06	Farm Power and Machinery Management	3	0	0	3	3	60/40	PE
2.	22PAG07	Solar and Wind Energy Engineering	3	0	0	3	3	60/40	PE
3.	22PAG08	Special Farm Equipment	3	0	0	3	3	60/40	PE
4.	22PAG09	Mechanics of Tillage and Traction	3	0	0	3	3	60/40	PE

5.	22PAG10	Energy Auditing and Management	3	0	0	3	3	60/40	PE

Professional Elective III

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG11	Groundwater and Well Engineering	3	0	0	3	3	60/40	PE
2.	22PAG12	Watershed Management	3	0	0	3	3	60/40	PE
3.	22PAG13	Landscape Architecture	3	0	0	3	3	60/40	PE
4.	22PAG14	On-farm water management	3	0	0	3	3	60/40	PE
5.	22PAG15	Protected Cultivation	3	0	0	3	3	60/40	PE

Professional Elective IV

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG16	Agricultural Waste Management	3	0	0	3	3	60/40	PE
2.	22PAG17	Hydrology and Water Resources Engineering	3	0	0	3	3	60/40	PE
3.	22PAG18	Design of Micro-irrigation system	3	0	0	3	3	60/40	PE
4.	22PAG19	Waste and by product utilization	3	0	0	3	3	60/40	PE
5.	22PAG20	Micro Irrigation	3	0	0	3	3	60/40	PE

Professional Elective V

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG21	IT in Agricultural System	3	0	0	3	3	60/40	PE
2.	22PAG22	Automation in Irrigation	3	0	0	3	3	60/40	PE
3.	22PAG23	Agricultural Economics and Farm Management	3	0	0	3	3	60/40	PE
4.	22PAG24	Agricultural Extension	3	0	0	3	3	60/40	PE
5.	22PAG25	System Analysis and Soft Computing in Agricultural Engineering	3	0	0	3	3	60/40	PE

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Open Electives

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22OAG02	Chemistry in Food Industry	3	0	0	3	3	60 / 40	OE
2.	22OAG03	Climate Change and Adaptation	3	0	0	3	3	60 / 40	OE
3.	22OCS03	Cloud Computing	3	0	0	3	3	60 / 40	OE
4.	22OCS13	Data Structures	3	0	0	3	3	60 / 40	OE
5.	22OCS14	Database Management Systems	3	0	0	3	3	60 / 40	OE
6.	22OAG05	Energy Conservation and Management	3	0	0	3	3	60 / 40	OE
7.	22OAG06	Energy Technology	3	0	0	3	3	60 / 40	OE
8.	22OEC11	Foundation Skills In Integrated Product Development	3	0	0	3	3	60 / 40	OE
9.	22OAG08	Fundamentals of Nutrition	3	0	0	3	3	60 / 40	OE
10.	22OHS03	Human Rights	3	0	0	3	3	60 / 40	OE
11.	22OME16	Intellectual Property Rights	3	0	0	3	3	60 / 40	OE
12.	22OBT06	Introduction to Bioenergy and Biofuels	3	0	0	3	3	60 / 40	OE
13.	22OBT07	Microbiology	3	0	0	3	3	60 / 40	OE
14.	22OBT08	Principles of Food Preservation	3	0	0	3	3	60 / 40	OE
15.	22OME24	Process modeling and Simulation	3	0	0	3	3	60 / 40	OE

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
16.	22OME25	Product Design and Development	3	0	0	3	3	60 / 40	OE
17.	22OME29	Refrigeration and Air-Conditioning	3	0	0	3	3	60 / 40	OE
18.	22OAG15	Remote Sensing and GIS for Natural Resource Management	3	0	0	3	3	60 / 40	OE
19.	22OME31	Robotics	3	0	0	3	3	60 / 40	OE
20.	22OME33	Supply Chain Management	3	0	0	3	3	60 / 40	OE

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Verticals

Vertical I : Food Processing

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG26	Refrigeration and cold Storage	3	0	0	3	3	60/40	PE
2.	22PAG27	Food and Dairy Engineering	3	0	0	3	3	60/40	PE
3.	22PAG02	Process Engineering of Fruits and Vegetables	3	0	0	3	3	60/40	PE
4.	22PAG01	Storage and Packaging Technology	3	0	0	3	3	60/40	PE
5.	22PAG28	Food Process Equipment and Design	3	0	0	3	3	60/40	PE
6.	22PAG29	Food Plant Design and Management	3	0	0	3	3	60/40	PE
7.	22PAG30	Emerging Technologies in Food Processing	3	0	0	3	3	60/40	PE

Vertical II : Farm Machinery and Energy

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG06	Farm Power and Machinery Management	3	0	0	3	3	60/40	PE

2.	22PAG31	Testing and Evaluation of farm Machinery and equipment	3	0	0	3	3	60/40	PE
3.	22PAG32	Biochemical and Thermochemical conversion of biomass	3	0	0	3	3	60/40	PE
4.	22PAG19	Waste and by product utilization	3	0	0	3	3	60/40	PE
5.	22PAG33	Human Engineering and Safety in Farm Machinery Operations	3	0	0	3	3	60/40	PE
6.	22PAG34	Precision Farming Equipment	3	0	0	3	3	60/40	PE
7.	22PAG35	Solar and Wind energy system	3	0	0	3	3	60/40	PE

Vertical III : Water Management and Protected cultivation

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG36	Watershed planning and Management	3	0	0	3	3	60/40	PE
2.	22PAG11	Groundwater and Well Engineering	3	0	0	3	3	60/40	PE
3.	22PAG18	Design of Micro-irrigation system	3	0	0	3	3	60/40	PE
4.	22PAG15	Protected Cultivation	3	0	0	3	3	60/40	PE
5.	22PAG14	On-farm water management	3	0	0	3	3	60/40	PE
6.	22PAG37	Irrigation Water	3	0	0	3	3	60/40	PE

		Quality and Waste Water Management							
7.	22PAG38	Climate change and Adaptation	3	0	0	3	3	60/40	PE

Vertical IV : IT and Agricultural Business management

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAG39	Integrated Farming System	3	0	0	3	3	60/40	PE
2.	22PAG40	Agri Business Management	3	0	0	3	3	60/40	PE
3.	22PAG04	Sustainable Agriculture and Food Security	3	0	0	3	3	60/40	PE
4.	22PAG41	Systems Analysis in Agricultural Engineering	3	0	0	3	3	60/40	PE
5.	22PAG21	IT in Agricultural System	3	0	0	3	3	60/40	PE
6.	22PAG42	Automation in Agriculture	3	0	0	3	3	60/40	PE
7.	22PAG13	Landscape architecture	3	0	0	3	3	60/40	PE

22PH101	ENGINEERING PHYSICS	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To make the students effectively achieve an understanding of mechanics and properties of matter.
2. To enable the students to gain knowledge of electromagnetic waves.
3. To introduce the basics of solid-state physics.
4. Equipping the students to successfully understand the importance of optics and Laser.
5. To motivate the students towards the applications of quantum mechanics.
6. To learn problem solving skills related to physics principles and interpretation of experimental data.
7. To determine error in experimental measurements and techniques used to minimize such error.

Course Content:

UNIT I MECHANICS AND PROPERTIES OF MATTER **9**

Mechanics: 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-moment of inertia and its theorem- gyroscope - torsional pendulum.

Elasticity: Elastic modules – Poisson's ratio – relation between them – determination of Young's modulus by uniform and non-uniform bending- I section girders.

UNIT II ELECTROMAGNETIC WAVES **9**

Maxwell's equations (Basics) - Charged particles in uniform and constant electric field – Charged particles in an alternating electric field- polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III SOLID STATE PHYSICS **9**

Elements of crystallography; diffraction methods for structure determination; bonding in solids; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids: nearly free electron and tight binding models; metals, semiconductors and insulators; conductivity, mobility and effective mass; optical, dielectric and magnetic properties of solids; elements of superconductivity: Type-I and Type II superconductors, Meissner effect, London equation.

UNIT IV OPTICS & LASER **9**

Classification of optical materials – carrier generation and recombination processes - insulators and semiconductors (concepts only) - photo current in a P-N diode – solar cell - LED– Laser diodes – Optical data storage techniques.

Laser (Basics) – Einstein's coefficient- Types of Laser- He- Ne Laser - CO_2 laser, Nd-YAG laser, semiconductor laser – MASER Introduction - Holography: Principle and construction -Reconstruction of Holography.

UNIT V QUANTUM MECHANICS & NANODEVICES **9**

Compton effect - The Schrodinger equation (Time dependent and time independent forms)- particle in an infinite potential well: 1D,2D and 3D Boxes.

NanoDevices: Introduction - quantum confinement – quantum structures: quantum wells, wires and dots — band gap of nanomaterials. Tunneling – Single electron phenomena: Coulomb blockade - resonant- tunneling diode – single electron transistor – quantum cellular automata - Quantum system for information processing.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome:

1. Understand the importance of mechanics and properties of matter
2. Express their knowledge in electromagnetic waves.
3. Demonstrate a strong foundational knowledge in solid state physics.
4. Gain the knowledge in optics and Laser.
5. Understand the importance of quantum physics and Nanodevices.
6. Understand the functioning of various physics laboratory equipment.
7. Use graphical models to analyze laboratory data.
8. Use mathematical models as a medium for quantitative reasoning and describing physical reality.

Text Book(s):

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. Brijlal and N. Subramaniam "Properties of Matter", Eurasia Publishing House Limited, 1993.
3. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ. Press.
4. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGrawHill (Indian Edition), 2017.
5. Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020.

Reference Books:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physics – 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. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition) 2009.

Web Links:

1. https://bayanbox.ir/view/7764531208313247331/Kleppner-D.-Kolenkow-R.J.-Introduction-to-Mechanics-2014.pdf
2. https://physicaeducator.files.wordpress.com/2017/11/electricity_and_magnetism-by-purcell-3ed-ed.pdf
3. https://safehandsakola.org/downloads/Physics/Concepts%20of%20Modern%20Physics%20-Arthur%20Beiser.pdf
4. https://web.pdx.edu/~pmoeck/books/Tipler_Llewellyn.pdf
5. https://farside.ph.utexas.edu/teaching/qmech/qmech.pdf
6. https://web.pdx.edu/~pmoeck/phy381/workbook%20nanoscience.pdf

List of Experiments:

1.	Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.	**3**
2.	Uniform bending – Determination of Young's modulus.	**3**
3.	Laser- Determination of the wavelength of the laser using grating.	**3**
4.	Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.	**3**
5.	Melde's string experiment	**3**
6.	Simple harmonic oscillations of cantilever.	
7.	Non-uniform bending - Determination of Young's modulus.	
8.	Laser-Determination of particle size and acceptance angle of the laser.	
9.	Determination of wavelength of mercury spectrum – spectrometer grating.	
10.	Determination of thickness of a thin wire – Air wedge method.	
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

22CS101	PROBLEM SOLVING TECHNIQUES I	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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 Content:

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

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).

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments;

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

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.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

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;

UNIT V FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages;

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome:

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

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.

Web Links:

1. https://www.python.org/

List of Experiments:

1.	Exchange the values of two variables	**3**
2.	Circulate the values of n variables, distance between two points.	**3**
3.	Square root, gcd, Exponentiation.	**3**
4.	Linear search, binary search.	**3**
5.	Simple sorting, histogram, Students marks statement.	**3**
6.	Retail bill preparation.	**3**
7.	Word count, copy file.	**3**
8.	Voter’s age validation, Marks range validation (0-100).	**3**
9.	Mini Project – 1	**3**
10.	Mini Project – 2	**3**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

22ES101	INNOVATION AND DESIGN THINKING	L	T	P	C
		1	0	2	2

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To explain the concept of design thinking for product and service development
2. To explain the fundamental concept of innovation and design thinking
3. To discuss the methods of implementing design thinking in the real world.

Course Content:

UNIT I PROCESS OF DESIGN 3

Understanding Design thinking - Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping.

UNIT II TOOLS OF DESIGN THINKING 3

Real-Time design interaction captures and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design.

UNIT III DESIGN THINKING IN IT 3

Design Thinking to Business Process modelling, Finding pain points.

UNIT IV DT FOR STRATEGIC INNOVATIONS 3

Growth – Story telling representation – Strategic Foresight - Change – Sense Making - experience design - Standardization – Humanization - Creative Culture.

UNIT V DESIGN THINKING WORKSHOP 3

Design Thinking Workshop Empathize, Design, Ideate, Prototype and Test.

TOTAL LECTURE CUM PRACTICAL HPERIODS 15 Periods

Expected Course Outcome:

1. To immerse students into the world of innovation as a systematic process of tackling relevant business and/or social problems.
2. To provide a social and thinking space for the recognition of innovation challenges and the design of creative.
3. To expose the student with state of the art perspectives, ideas, concepts, and solutions related to the design and execution of innovation driven projects using design thinking principles.
4. To develop an advance innovation and growth mindset form of problem identification and reframing, foresight, hindsight and insight generation.

Text Book(s):

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design",Cengage learning (International edition) Second Edition, 2013.
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, 2011.
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Reference Books:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", CengageLearning, Second Edition, 2011.
2. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).

22MA101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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

Course Content:

UNIT I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix – 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 – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS 12

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules (sum, product, quotient, chain rules) – Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 12

Definite and Indefinite integrals – Substitution rule – Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction– Improper integrals – Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL LECTURE CUM TUTORIAL PERIODS 60 Periods

Expected Course Outcome:

1. At the end of the course the students will be able to 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.

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.

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.

Web Links:

1. https://www.pdfdrive.com/higher-engineering-mathematics-d18621876.html
2. https://www.pdfdrive.com/advanced-engineering-mathematics-d166759888.html
3. https://theswissbay.ch/pdf/Gentoomen%20Library/Maths/Calculus/Calculus%20-%20Early%20Transcendentals%206e.pdf

22AC101	HERITAGE OF TAMIL	L	T	P	C
		1	0	0	1

Pre-requisite Nil **Syllabus Version** V 0.1

Course Content:

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 3

Language Families in India - Dravidian Languages – Tamil as aClassical 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 II NARRATION AND SUMMATION 3

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 III DESCRIPTION OF A PROCESS / PRODUCT 3

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

UNIT IV CLASSIFICATION ND RECOMMENDATIONS 3

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 V EXPRESSION 3

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 PERIODS 15 Periods

Text cum Reference Book(s):

1. தமிழக வரலொறு – மக்களும் பண் பொடும் – கக.கக. பிள்ளள (தவளியீடு: தமிழ்நொடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முளனவர்இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – ளவளக நதிக்களரயில் சங்ககொல நகர நொகரிகம் (ததொல்லியல் துளற தவளியீடு)
4. தபொருளந – ஆற்றங்களர நொகரிகம். (ததொல்லியல் துளற தவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: 38 Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22EEC101	APTITUDE AND SOFT SKILLS	L	T	P	C
		1	0	0	1

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To enhance students' cognitive prowess and mental potential.
2. To improve students' mental aptitude relevant to their academic choices, vocational preferences, job profiles and their ability to succeed.
3. To measure a range of skills such as language comprehension, logical thinking and numerical ability.
4. To get familiar with the method of solving aptitude and multi-choice questions.

Course Content:

UNIT I FUNDAMENTALS OF APTITUDE 2

English diagnostic test - EDT - Logical Reasoning-Puzzles - Factors influencing positive mind set- Importance of self-confidence and self-esteem.

UNIT II SPEAKING SKILLS 3

Effective communication – Barriers & Strategies – Day to Day conversation -Improving responding capacity – Extempore speech practice – Speech assessment. Arithmetic aptitude – Simplification.

UNIT III READING SKILLS 2

Reading Op-Ed columns and commentary – skimming and scamming methods -speed reading. Logical Reasoning-verbal analogies.

UNIT IV GREETINGS 2

Greetings and expressions- expressing gratitude and apologies -*expressions* of courtesy. Arithmetic aptitude – Percentages.

UNIT V ETIQUETTE 3

Etiquette- Respect, Consideration & Honesty-oral presentation-role of audio/video visual aids. Logical Reasoning – Non-verbal - Arithmetic aptitude – Introduction to numbers.

TOTAL LECTURE PERIODS 12 Periods

Expected Course Outcome:

1. Students will be able to understand what he is good at and what they can be good at.
2. The vast scope and dynamics of aptitude classes ensured a streamlined process for the students to make career choices, academic pursuits, and professional growth.
3. The soft skills classes make the students scalable and standardized and help the students to outperform a large number of applicants in the market.
4. The soft skills classes help students to identify their leadership styles and work effectively as a team.

Text Book(s):

1. English for Job Seekers (Language and Soft Skills for the Aspiring) by Geetha Rajeevan, C.L.N. Prakash) Cambridge University Press pvt,Ltd.
2. New International Business English by Leo Jones and Richard Alexander. Cambridge University Press pvt,Ltd.
3. Quantitative Aptitude for Competitive Examinations by R S Aggarwal, S. CHAND Publishers.
4. A Modern Approach To Logical Reasoning by R S Aggarwal, S. CHAND Publishers.

Reference Books:

1. A New Approach to REASONING Verbal & Non-Verbal Paperback – 1 January 2014 by B.S. Sijwalii & Indu Sijwali.
2. How to prepare for quantitative aptitude for the CAT 6th edition by Arun sharma published on May, 2014 by Mcgraw Hill Education publishers.
3. Magical Book on Quicker Maths by M Tyra and K Kundan.
4. Shortcuts in Reasoning (Verbal, Non-Verbal, Analytical & Critical) for Competitive Exams 3rd Edition by Disha Experts.
5. Everyday Etiquette: How to Navigate 101 Common and Uncommon Social Situations. Published by St. Martin's Griffin; First edition.

22ME101	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To introduce the various system of forces, equilibrium concepts and free body diagram.
2. To understand the concepts of moment and couple system.
3. To make the students to understand the basic properties of solids and hollow sections.
4. To understand the friction effect on rigid bodies.

Course Content:

UNIT I INTRODUCTION TO ENGINEERING MECHANICS 9

Introduction-- Units and dimensions - Laws of mechanics- Lame's theorem, Parallelogram and triangular Law of forces- Vectors - Vectorial representation of forces -Coplanar forces - Resolution and composition of forces- Equilibrium of a particle – Free body diagrams.

UNIT II EQUILIBRIUM OF RIGID BODIES 9

Moments and couples- Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Resolution of a given force into a force acting at a given point and a couple - Reduction of a system of coplanar forces acting on a rigid body into a single force and a single couple - Equilibrium of rigid bodies in two dimensions.

UNIT III REACTIONS AND SUPPORTS 9

Types of supports-Types of loads- Supports reactions of beams-Method of finding support reactions of a beam and plane trusses- Method of joints, Method of section.

UNIT IV CENTRE OF GRAVITY AND MOMENT OF INERTIA 9

Determination of areas and volumes - First moment of area and the determination of centroid of all cross section - Moment of inertia of plane areas - Parallel axis theorem - Polar moment of inertia-Product of inertia- Principal moments of inertia of plane areas- Radius of Gyration.

UNIT V FRICTION 9

Types of friction, Limiting friction, Laws of friction – Static and Dynamic Friction; simple contact friction, ladder friction – wedge friction.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome:

1. Understand the force systems and resultant forces in structures using law of motions.
2. Apply the concept of statics to determine the unknown reactions in 2D.
3. Analyze the reactions in different supports.
4. Calculation of center of gravity and moment of inertia for solids and hollow sections.
5. Determine the friction and the effects by the laws of friction.

Text Book(s):

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11thEdition, 2017.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.
3. Dhiman A.K, Dhiman P, Kulshreshtha D.C, Engineering Mechanics-Statics and Dynamics, McGraw Hill Education, 2017.

Reference Books:

1. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics- Statics and Dynamics", Vikas Publishing

House Pvt.Ltd.New Delhi, 2012.
2. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
3. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
4. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
5. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.

Web Links:

1. e-Krishi Shiksha - Course: Engineering Mechanics (iasri.res.in)
2. Coursera - Introduction to Engineering Mechanics | Coursera
3. Udemy - Engineering Mechanics for 1st Year Engineering Students | Udemy

22ME102	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To develop students in drawing skills for effective communication of concepts, ideas and design of engineering products.
2. To expose students with existing national standards related to technical drawings.

Course Content:

UNIT I PLANE CURVES 12

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 12

Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (Basics).

UNIT III PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS 12

Sectioning of above solids 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.

UNIT V DEVELOPMENT OF SURFACES AND ISOMETRIC 12

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Principles of isometric projection — isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical- Orthographic Projection, conversion of Orthographic view to isometric projection.

TOTAL LECTURE PERIODS 60 Periods

Expected Course Outcome:

1. To Familiarize with the fundamentals and standards of engineering graphics with basic geometrical constructions.
2. To Draw projections of points, lines and plane surfaces.
3. To Draw projections of various geometrical solid shapes with reference to plane surfaces.
4. To Draw projections of sectioned solids and obtain true shape of the section.
5. To visualize the developed surfaces of solids, Isometric projection and conversion.

Text Book(s):

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008

Reference Books:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. 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.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.

6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Web Links:

1. https://www.slideshare.net/ganesasmoorthyraju/unit-1-plane-curves-engineering-graphics
2. https://www.slideshare.net/jayanshugundaniya9/engineering-graphics-projection-of-points-and-lines
3. https://ktuengineeringgraphics.wordpress.com/projections-of-solids
4. https://www.brainkart.com/article/Projection-of-Solids-and-Section-of-Solids_6520
5. https://www.studocu.com/in/document/srm-institute-of-science-and-technology/engineering-graphics-and-design/development-of-surfaces-and-isometric-projection/25573774

Publication of Bureau of Indian Standards:

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

Special points applicable to End Semester 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.

22CH101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	2	4

Course Objectives:

1. To inculcate sound understanding of water softening methods and desalinationTechniques.
2. To make the students conversant with basics of polymer chemistry.
3. To develop an understanding of the basic concepts of phase rule and its applications to singleand two component systems.
4. To facilitate the understanding of different types of fuels, their preparation, properties.
5. To familiarize the students with the operating principles, working processes and applicationsof energy Conversion and storage devices.
6. To induce the students to familiarize with electroanalytical techniques such as, potentiometerand conductometry in the determination of impurities in aqueous solutions.

Course Content:

UNIT I WATER TECHNOLOGY 9

Hardness of water- types - disadvantages of using hard water in industries – estimation of total, permanent and temporary hardness of water by EDTA method -Boiler troubles (scale and sludge)- Boilerfeed water treatment – external conditioning - demineralization process - desalination by reverseosmosis – potable water treatment - breakpoint of chlorination.

UNIT II POLYMER AND COMPOSITES 9

Polymer: types – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Bakelite.**Composites**: definition, types of composites – polymer matrix composites (PMC)– fibre reinforced plastics (FRP) - applications.

UNIT III ALLOYS AND PHASE RULE 9

Alloys: Properties of alloys- significance of alloying, functions and effect of alloying elements-Nichromeand stainless steel (18/8) – heat treatment of steel.

Phase rule: definition of terms with examples, one component system -water system – reducedphase rule – Two component systems – lead-silver system –Pattinson process, Cu-Ni system.

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission – controlled nuclear fission – nuclear fusion – nuclear chain reactions – nuclearenergy –light water nuclear power plant – breeder reactor – solar energy conversion – solar cells – wind energy.**Batteries, fuel cells and super capacitors**: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell- super capacitors.

UNIT V FUELS AND COMBUSTION 9

Fuels: Classification of fuels – coal – proximate and ultimate analysis – carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – petroleum – refining – manufacture of synthetic petrol (Bergius process) – knocking – octane number – diesel oil – cetane number – compressed natural gas (CNG) – liquefied petroleum gases (LPG) – power alcohol and biodiesel.

Combustion of fuels: Calorific values – calculations – theoretical air requirement – ignition temperature – Spontaneous ignition temperature– flue gas analysis (chromatography and gas sensors).

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome:

1. To analyse the quality of water from quality parameter data and propose suitable Treatment methodologies to treat water.
2. Discuss the types of polymer formation and composites.
3. To apply the knowledge of phase rule and alloys for material selection requirements.
4. To recommend suitable fuels for engineering processes and applications.
5. To recognize different forms of energy resources and apply them for suitable applicationsinenergy sectors.
6. To quantitatively analyse the impurities in solution by electro analytical techniques.

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, NewDelhi,2008.
3. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition,2018.

Reference Books:

1. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2ndEdition,2017.
2. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi,2014.
3. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", CambridgeUniversityPress, Delhi, Second Edition, 2019.
4. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers andTechnologists,Springer Science Business Media, New York, 2nd Edition, 2013.

List of Experiments:

1.	Determination of total, temporary & permanent hardness of water byEDTA method.	**3**
2.	Determination of chloride content of water sample by Argentometric method.	**3**
3.	Estimation of copper content of the given solution by Iodometry.	**3**
4.	Determination of alkalinity in water sample.	**3**
5.	Determination of DO content of water sample by Winkler's Method.	**3**
6.	Estimation of Phase change in a solid.	**3**
7.	Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	**3**
8.	Determine strength of given hydrochloric acid using pH meter.	**3**
9.	Determine strength of acids in a mixture of acids using conductivitymeter.	**3**
10.	Determine iron content of the given solution using potentiometer.	**3**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

22CS201	PROBLEM SOLVING TECHNIQES - II	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the constructs of C Language.
2. To develop C Programs using basic programming constructs
3. To develop C programs using arrays and strings
4. To develop modular applications in C using functions
5. To develop applications in C using pointers and structures
6. To do input/output and file handling in C

Course Content:

UNIT I BASICS OF C PROGRAMMING **9**

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process.

UNIT II ARRAYS AND STRINGS **9**

Introduction to Arrays: Declaration, Initialization – One dimensional array –Two dimensional arrays -String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT III FUNCTIONS AND POINTERS **9**

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions –Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

UNIT IV STRUCTURES AND UNION **9**

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures –Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

UNIT V FILE PROCESSING **9**

Files – Types of file processing: Sequential access, Random access – Sequential access file - Randomaccess file - Command line arguments.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. Demonstrate knowledge on C Programming constructs
2. Develop simple applications in C using basic constructs
3. Design and implement applications using arrays and strings
4. Develop and implement modular applications in C using functions.
5. Develop applications in C using structures and pointers.
6. Design applications using sequential and random access file processing.

Text Book(s):

1. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.

Reference Books:

1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, PearsonEducation, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.

List of Experiments:

1.	Write a C program to calculate and display the area of a rectangle using the input valuesentered by the user.	**3**
2.	Write a C program to sort an array of integers using selection sort technique.	**3**
3.	Write a C program to concatenate two strings entered by the user and display the resultant string.	**3**
4.	Write a C program to find the factorial of a number using recursion.	**3**
5.	Write a C program to swap two numbers using call by value and call by reference.	**3**
6.	Write a C program to create a structure named student with the fields roll no, name, and marks in three subjects. Initialize the structure with the values entered by the user and display the details.	**3**
7.	Write a C program to read data from a text file and display it on the screen.	**3**
8.	Write a C program to implement a singly linked list and display its elements.	**3**
9.	Write a C program to open a binary file, write data to it, and read data from it.	**3**
10.	Write a C program to implement a stack using an array and perform push, pop, anddisplay operations.	**3**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipment: (for batch of 30 students)

1.	Standalone Computer	30 nos
2.	TURBO C	-

22HS201	TECHNICAL ENGLISH	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

The Course prepares second semester engineering and Technology students to:

1. Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
2. Foster their ability to write convincing job applications and effective reports.
3. Develop their speaking skills to make technical presentations, participate in group discussions.
4. Strengthen their listening skill which will help them comprehend lectures and talks in their areasof specialisation.

Course Content:

UNIT I INTRODUCTION TECHNICAL ENGLISH 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises. Speaking –Asking for and giving directions- Reading – reading short technical texts from journals- newspapers. Writing- purpose statements – extended definitions – issue- writing instructions
– Checklists-recommendations.

UNIT II READING AND STUDY SKILLS 9

Listening- Listening to longer technical talks and completing exercises based on them-Speaking – describing a process-Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing-Writing-interpreting charts, graphs.

UNIT III TECHNICAL WRITING AND GRAMMAR 9

Listening- Listening to classroom lectures/ talks on engineering/technology -Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading;Writing-Describing a process, use of sequence words.

UNIT IV REPORT WRITING **9**

Listening- Listening to documentaries and making notes. Speaking – mechanics of presentations-Reading – reading for detailed comprehension- Writing- email etiquette- job application – cover letter –Résumé preparation (via email and hard copy)- analytical essays and issue based essays.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS **9**

Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey- Vocabulary Development verbal analogies Language Development- reported speech.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome:

Upon successful completion of the course, students should be able to:

1. At the end of the course learners will be able to:
2. Read technical texts and write area- specific texts effortlessly.
3. Listen and comprehend lectures and talks in their area of specialisation successfully.
4. Speak appropriately and effectively in varied formal and informal contexts.
5. Write reports and winning job applications.

Text Book(s):

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016

2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge UniversityPress: New Delhi, 2016

Reference Books:

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.

2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007

3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015

4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007

5. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014. Students can be asked to read Tagore, Chetan Bhagat and for suplementary reading.

22MA201	NUMERICAL METHODS	L	T	P	C
		3	1	0	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To introduce the basic concepts of solving algebraic and transcendental equations.
2. To introduce the numerical techniques of interpolation in various intervals in real lifesituations.
3. To acquaint the student with understanding of numerical techniques of differentiation andintegration which plays an important role in engineering and technology disciplines.
4. To acquaint the knowledge of various techniques and methods of solving ordinarydifferential equations.
5. To understand the knowledge of various techniques and methods of solving various typesof partial differential equations.

Course Content:

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method– NewtonRaphson method - Solution of linear system of equations - Gauss elimination method – Pivoting
- Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of amatrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 9+3

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided differenceinterpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and
Backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three-point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

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

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+3

Finite difference methods for solving second order two - point linear boundary value problems
- One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – Onedimensional wave equation by explicit method.

TOTAL LECTURE PERIODS 60 Periods

Expected Course Outcome:

Upon successful completion of the course, students should be able to:

1. Understand the basic concepts and techniques of solving algebraic and transcendentalequations.
2. Appreciate the numerical techniques of interpolation and error approximations invarious intervals in real life situations.
3. Apply the numerical techniques of differentiation and integration for engineeringproblems.
4. Understand the knowledge of various techniques and methods for solving first andsecond order ordinary differential equations.
5. Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

Text Book(s):

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

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

Reference Books:

Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, NewDelhi, 2007.

2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education,Asia,6th Edition, New Delhi, 2006.

3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.

4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of IndiaPvt. Ltd, 3rd Edition, New Delhi, 2007.

5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd,5thEdition, 2015.

22HS202	ENVIRONMENTAL SCIENCE	L	T	P	C
		2	0	0	2

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To gain the knowledge about environment, ecological balance and biodiversity.
2. To finding and implementing scientific, technological, economic and political solutions toenvironmental problems.
3. To study the interrelationship between living organism and environment.
4. To appreciate the importance of environment by assessing its impact on the human world;envision the surrounding environment, its functions and its value.
5. To study the dynamic processes and understand the features of the earth's interior andsurface.
6. To study the integrated themes and biodiversity, natural resources, pollution control andwaste management.

Course Content:

UNIT I ENVIRONMENT, ECOSYSTEMS & BIODIVERSITY **6**

Definition, scope and importance of environment – ecosystem – energy flow in the ecosystem – food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) desert ecosystem. Biodiversity – definition, types, value of biodiversity (consumptive use, productive use, social, ethical, aesthetic and option values) – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – conservation of biodiversity: In- situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION **6**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Noise pollution (d) Nuclear hazards. Solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution.

UNIT III NATURAL RESOURCES

6

Forest resources: Use and over-exploitation, deforestation – Water resources: Use and over- utilization of surface and ground water, dams-benefits and problems – Mineral resources: environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity – Energy resources: renewable – solar, wind, biomass and non-renewable energy sources-coal and nuclear energy.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 6

Sustainable development – urban problems related to energy, consumerism and waste products – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns – role of non-governmental organization - environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion - wasteland reclamation - 12 principles of green chemistry.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health.

TOTAL LECTURE PERIODS 30 Periods

Expected Course Outcome:

Upon successful completion of the course, students should be able to:

1. Interfere the importance of environment and explain the concept, structure, functions of ecosystem and summarize different values, threats and the need for conservation of biodiversity.
2. Explain the types of natural resources and its importance of conservation.
3. Classify the types of pollution and propose suitable methods to prevent pollution.
4. Outline the various social issues and possible solutions to protect environment for sustainable Development.
5. Describe the effect of population explosion, trend of population in various countries and understand the role of IT in environment and human health.

Text Book(s):

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education,2004.

Reference Books:

1. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT LTD, New Delhi,2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press,2005.

22AC201	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

Pre-requisite Nil **Syllabus Version** V 0.1

Course Content:

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola 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 V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL LECTURE PERIODS 15 Periods

Text cum Reference Books:

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

22EEC201	APTITUDE AND SOFT-SKILLS 2	L	T	P	C
		1	0	0	1

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

- To enhance Cognitive Abilities improving critical thinking, problem-solving and decision-making skills to achieve better academic and professional outcomes.
- Boosting Soft Skills and Developing interpersonal, communication and time-managementskills to excel in personal and professional relationships.
- Enhancing verbal and written communication skills to promote effective collaboration andbuild relationships.
- Developing self-awareness, empathy, and social skills to navigate complex interpersonalsituations and increase team morale.

Course Content:

UNIT I APTITUDE **3**

Personality Assessment - SWOT analysis - Adaptability and Flexibility - Team building activity -Numerical Reasoning - calculations, identify patterns, and problem solving.

UNIT II SPEAKING SKILLS **3**

Core Components of Effective Communication - Non-Verbal Communication - active listening and written communication - Business English - Communication enhancement activities - Abstract Reasoning - shapes, symbols, or images - Visual Reasoning.

UNIT III READING SKILLS **3**

Vocabulary Building – Comprehension – Fluency - Critical Reading - Reading for Information - Group problem-solving activities - Critical thinking and analysis - Creative problem solving - Decision making and evaluation - Deductive reasoning and connectives - Logical puzzles and games.

UNIT IV FLOW STATE **3**

S.M.A.R.T Goal Setting - Developing action plans - Overcoming Obstacles - Review and Reflection - Habit Building - Identifying Habits - Maintaining Habits - Habit Stacking Arithmeticaptitude - Number system.

UNIT V EMOTIONAL QUOTIENT 3

Emotional Intelligence - Empathy and interpersonal skills - Self-awareness and self-regulation - Motivation and drive - Social awareness and relationship management - Quantitative aptitude - Equations - Word problems.

TOTAL LECTURE PERIODS 15 Periods

Expected Course Outcome:

- Increased efficiency, productivity and performance in academic and professionalsettings.
- Enhanced communication, collaboration and teamwork among students.
- Increased ability to identify, analyze and solve complex problems in personal andprofessional settings.
- Improved self-awareness, emotional intelligence and interpersonal skills leading tobetter personal and professional relationships.

Text Book(s):

- Quantitative Aptitude for Competitive Examinations - 2022/edition-S Chand Publishing-Paperback_Edition-2022.
- Fast Track Objective Arithmetic by Rajesh Verma, January 2018 edition.
- How to Talk to Anyone: 92 Little Tricks for Big Success in Relationships, Publisher:Harper Element; New edition.
- Emotional Intelligence by Daniel Goleman, Bloomsbury Publishing India PrivateLimited; new edition, January 1995.

Reference Books:

- How to Prepare for Quantitative Aptitude for CAT by Arun Sharma, McGraw HillEducation; Eighth edition.
- The Pearson Guide to Quantitative Aptitude for Competitive Examinations by DineshKhattar
- Crucial Conversations by Al Switzler, Joseph Grenny, and Ron McMillan, BrillianceAudio; Abridged, Updated edition, August 2013.
- Nonviolent Communication by Marshall B. Rosenberg, Puddle Dancer Press; 3rdedition, September 2015.

22ES201	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

Pre-requisite **Syllabus Version** V 0.1

GROUP A (CIVIL &MECHANICAL)

List of Experiments: (Civil Engineering)

PLUMBING WORK

1 Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
2 Preparing plumbing line sketches.
3 Laying pipe connection to the suction side of a pump
4 Laying pipe connection to the delivery side of a pump.
5 Connecting pipes of different materials: Metal, plastic and flexible pipes used inhousehold appliances

WOOD WORK:

1 Sawing
2 Planing and
3 Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.
4 Studying joints in door panels and wooden furniture
5 Studying common industrial trusses using models.

WELDING WORK:

1 Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
2 Practicing gas welding.

BASIC MACHINING WORK:

1 (simple)Turning.
2 (simple)Drilling.
3 (simple)Tapping.

ASSEMBLY WORK:

1 Assembling a centrifugal pump.
2 Assembling a household mixer.
3 Assembling an airconditioner.

SHEET METAL WORK:

1 Making of a square tray

FOUNDRY WORK:

1 Demonstrating basic foundry operations.

GROUP B (ELECTRICAL AND ELECTRONICS)

ELECTRICAL ENGINEERING PRACTICES

1 Introduction to switches, fuses, indicators and lamps - Basic switch boardwiring with lamp, fan and three pin socket
2 Staircase wiring
3 Fluorescent Lamp wiring with introduction to CFL and LED types.
4 Energy meter wiring and related calculations/ calibration
5 Study of Iron Box wiring and assembly
6 Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
7 Study of emergency lamp wiring/Water heater

ELECTRONIC ENGINEERING PRACTICESSOLDERING WORK:

1 Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

1 Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

1 Study an elements of smart phone.

2 Assembly and dismantle of LED TV.

3 Assembly and dismantle of computer/ laptop

TOTAL PRACTICAL PERIODS **30 Periods**

Expected Course Outcome: On completion of the course, the student is expected 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 processeslike 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 componentson PCB.

Reference Books:

1. S Gowri & T Jeyapoovan, Engineering Practices Lab Manual, Vikas Publishing-2021.

List of Equipment: (For A Batch of 30 Students)

1. CIVIL ENGINEERING

1.	Assorted components for plumbing consisting of metallic pipes, plasticpipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 Sets.**
2.	Carpentry vice (fitted to work bench)	**15 Nos.**
3.	Standard woodworking tools	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each.**
5.	Rotary Hammer	**2 Nos.**
6.	Demolition Hammer	**2 Nos.**
7.	Circular Saw	**2 Nos.**
8.	Planer	**2 Nos.**
9.	Hand Drilling Machine	**2 Nos.**
10.	Jigsaw	**2 Nos.**

2. MECHANICAL

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

9.	Study-purpose items: centrifugal pump, air-conditioner	**One each**

3. ELECTRICAL

1.	Assorted electrical components for house wiring	**15 Sets.**
2.	Electrical measuring instruments	**10 Sets.**
3.	Study purpose items: Iron box, fan and regulator, emergency lamp	**1 Each.**
4.	Megger (250V/500V)	**1 No.**
5.	Range Finder	**2 Nos.**
6.	Digital Live-wire detector	**2 Nos.**

4. ELECTRONICS

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

22CS302	PROBLEM SOLVING TECHNIQUE-III	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand Object Oriented Programming concepts and basics of Java programming language
2. To know the principles of packages, inheritance and interfaces
3. To develop a java application with threads and generics classes
4. To define exceptions and use I/O streams
5. To design and build Graphical User Interface Application using JAVAFX.

Course Content:

UNIT I INTRODUCTION TO OOP AND JAVA 9

Overview of OOP – Object oriented programming paradigms – Features of Object OrientedProgramming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members- Java Doc comments.

UNIT II INHERITANCE, PACKAGES AND INTERFACES 9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

UNIT III EXCEPTION HANDLING AND MULTITHREADING 9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread andMultiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT IV I/O, GENERICS, STRING HANDLING **9**

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: BasicString class, methods and String Buffer Class.

UNIT V JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS **9**

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu Menu bars – MenuItem

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. Apply the concepts of classes and objects to solve simple problems.
2. Develop programs using inheritance, packages and interfaces.
3. Make use of exception handling mechanisms and multithreaded model to solve real world problems.
4. Build Java applications with I/O packages, string classes, Collections and generics. concepts Integrate the concepts of event handling and JavaFX components and controls for developingGUIbased applications.

Text Book(s):

1. Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, New Delhi,2019
2. Herbert Schildt, "Introducing JavaFX 8 Programming", 1 st Edition, McGraw Hill Education, NewDelhi, 2015

Reference Books:

1. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018.

List of Experiments:

1.	Solve problems by using sequential search, binary search, and quadratic sorting algorithms(selection, insertion).	**3**
2.	Develop stack and queue data structures using classes and objects.	**3**
3.	Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their grossand net salary.	**3**
4.	Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.	**3**
5.	Solve the above problem using an interface	**3**
6.	Implement exception handling and creation of user defined exceptions	**3**
7.	Write a java program that implements a multi-threaded application that has three threads. Firstthread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print thevalue of the cube of the number.	**3**
8.	Write a program to perform file operations.	**3**
9.	Develop applications using JavaFX controls, layouts and menus	**3**
10.	Develop a mini project for any application using Java concepts.	**3**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	Operating Systems: Linux / Windows	30 nos
2.	Front End Tools: Eclipse IDE / Netbeans IDE	-

22ME301	STRENGTH OF MATERIALS	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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

Course Content:

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumertric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION 9

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

UNIT IV DEFLECTION OF BEAMS 9

Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lame's theory.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Understand the properties and behavior in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solidsurface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps.

Text Book(s):

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7thedition, 2018.
2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.

Reference Books:

1. Singh. D.K., "Strength of Materials", Ane Books Pvt Ltd., New Delhi, 2021.
2. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd.,New Delhi, 2015.
3. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, NewDelhi 2019.
4. Vazirani. V.N, Ratwani. M.M, Duggal .S.K "Analysis of Structures: Analysis, Design andDetailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.

22AG301	PRINCIPLES OF SOIL SCIENCE AND ENGINEERING	L	T	P	C
		2	0	2	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

To expose the students to the fundamental knowledge on Soil physical parameters, Permeability – Compaction, Bearing Capacity and types and methods of soil survey and interpretative groupings

Course Content:

UNIT I INTRODUCTION AND SOIL PHYSICS 9

Soil - definition - major components –Soil forming minerals and processes - soil profile -Physical properties - texture – density-porosity-consistence-colour-specific gravity - capillary and noncapillary -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 II SOIL CLASSIFICATION AND SURVEY 9

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

UNIT III PHASE RELATIONSHIP AND SOIL COMPACTION 9

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

UNIT IV ENGINEERING PROPERTIES OF SOIL 9

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

UNIT V BEARING CAPACITY AND SLOPE STABILITY 9

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 methodslope protection measures.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

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.

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:

. 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, NewDelhi, 2007.

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

Web link:

1..https://agrimoon.com/fundamentals-of-soil-science-pdf-book-free-download-icar-ecourse/

2. http://ecoursesonline.iasri.res.in/course/view.php?id=125

3. https://agriyatra.in/icar-ecourse-notes/

List of Experiments:

1.	Identification of rocks and minerals	**4**
2.	Collection and processing of soil samples	**4**
3.	Determination of soil moisture, EC and pH	**4**
4.	Field density determination by Core Cutter and Sand Replacement method	**4**
5.	Specific gravity determination by Pycnometer	**4**
6.	Grain size analysis by using Mechanical shaker	**5**
7.	Determination of Organic carbon	**5**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	IgneousRock	(Any 4)
2.	Sedimentary Rock	(Any 4)
3.	Metamorphic Rock	(Any 4)
4.	Minerals	(Any 4)
5.	Spade or Augers ,Polythene/paper/cloth bags , Aluminum tray	

6. Moisture cans , oven or Desicator

7. EC meter, potassium chloride, 100 ml beaker

8. pH meter, buffer tablet pH 4.0, 7.0 or 9.2, 100 ml beaker

9. Core sampler, aluminum tray, oven, balance upto 20 Kg, knife, spatula Sandpouring cylinder, Calibrating can, Metal tray with a central hole, Dry sand (passing through 600 micron sieve), Balance of capacity 15 kg, Moisture content bins, Glass plate, Metal tray, Scraper tool

10 Sand pouring cylinder, Calibrating can, Metal tray with a central hole, Moisture content bins, Glass plate, Metal tray, Scraper tool

11 A pycnometer, clean and dry cloth

12 complete set of I.S Sieve sizes generally 4.75 mm, 2.36mm, 1.18 mm, 600microns, 150 microns and 75 microns along with a pan and a lid,

13 500 ml conical flasks, Pipette, Burette, Potassium dichromate ($K_2Cr_2O_7$), Ferrous sulfate heptahydrate ($FeSO_4.7\ H_2O$), Sulfuric acid (H_2SO_4) concentrated, Diphenylamine indicator

14 saturated calcum sulphate, Ammonium chloride-Ammonium hydroxide buffer, Erichrome black-T indicator, EDTA,100 ml conical flasks, Pipette, Burette

22AG302	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes(both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Peltonwheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

Course Content:

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportationtheorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor -Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 9

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 9

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Workingprinciples - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT V PUMPS **9**

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicatordiagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

Text Book(s):

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

Reference Books:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd,2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014
4. S K Som, Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.

List of Experiments:

1. Determination of the Coefficient of discharge of given Orifice mete. **4**
2. Determination of the Coefficient of discharge of given Venturi meter. **4**
3. Calculation of the rate of flow using Rota meter. **3**
4. Determination of friction factor for a given set of pipes. **3**
5. Conducting experiments and drawing the characteristic curves of **4**

centrifugal pump

6.	Conducting experiments and drawing the characteristic curves of submergible pump	**4**
7.	Conducting experiments and drawing the characteristic curves of reciprocating pump.	**4**
8.	Conducting experiments and drawing the characteristic curves of Pelton wheel.	**4**

TOTAL PRACTICAL PERIODS	**30 Periods**
TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	Orifice meter setup	1 no
2.	Venturimeter setup	1 no
3.	Rotameter setup	1 no
4.	Pipe Flow analysis setup	1 no
5.	Centrifugal pump/submergible pump	1 no
6.	Reciprocation pump set up	1 no
7.	Pelton Wheel turbine set up	1 no
8.	Stop watch	10 nos
9.	Tachometer	1 no

22ME302	THEORY OF MACHINES	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To study the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
2. To study the basic concepts of toothed gearing and kinematics of gear trains.
3. To Analyzing the effects of friction in machine elements
4. To Analyzing the force-motion relationship in components subjected to external forces andanalyzing of standard mechanisms.
5. To Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanismandthe effect of dynamics of undesirable vibrations.

Course Content:

UNIT I KINEMATICS OF MECHANISMS 9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematicsanalysis in simple mechanisms– cams – classifications – displacement diagrams - layout of plate cam profiles.

UNIT II GEARS AND GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interferenceand undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains –automotive transmission gear trains.

UNIT III FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Sliding and Rolling friction – Bearings and lubrication – Friction clutches - singleplate clutch - multi plate clutch – Belt drives -flat belt drive.

UNIT IV FORCE ANALYSIS 9

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle.

UNIT V BALANCING AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving masses – Balancing machines –free vibrations– longitudinal and transverse vibrations-Equations of motion – natural Frequency –Damped Vibration –Forced vibration.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: At the end of the course the students would be able to

1. Discuss the basics of mechanism.

2. Solve problems on gears and gear trains.

3. Examine friction in machine elements.

4. Calculate static and dynamic forces of mechanisms.

5. Calculate the balancing masses and their locations of reciprocating and rotating masses.Computingthe frequency of free vibration, forced vibration and damping coefficient

Text Book(s):

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford UniversityPress, 2017.

2. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019.

Reference Books:

1. AmitabhaGhosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-WestPvt. Ltd., 1988.

2. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2nd edition,2014.

3. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019.4.Robert

L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.

5.Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

List of Experiments:

1. Transverse vibrations simply supported beam
2. Transverse vibrations -cantilever beam
3. To determine natural frequency of torsional vibration in two rotors system
4. Motorized gyroscope – Study of gyroscopic effect and couple
5. Governor - Determination of range sensitivity, effort etc., for Watts,Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. Single degree of freedom Spring Mass System
8. Balancing of rotating masses.
9. Whirling of shafts – Determination of critical speeds of shafts withconcentrated loads
10. Vibration of Equivalent Spring mass system – un damped and damped vibration.

TOTAL PRACTICAL PERIODS	**30 Periods**
TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	Cam follower setup.	1 nos
2.	Motorised gyroscope.	1 nos
3.	Governor apparatus - Watt, Porter, Proell and Hartnell governors.	1 nos
4.	Whirling of shaft apparatus.	1 nos
5.	Dynamic balancing machine.	1 nos
6.	Two rotor vibration setup.	1 nos
7.	Spring mass vibration system.	1 nos
8.	Torsional Vibration of single rotor system setup.	1 nos
9.	Simply supported beam setup	1 nos
10	Cantilever beam setup	1 nos

22MA301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To introduce the basic concepts of PDE for solving standard partial differential equations.
2. To introduce Fourier series analysis which is central to many applications in engineering apart fromits use in solving boundary value problems.
3. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
4. To acquaint the student with Fourier, transform techniques used in wide variety of situations.
5. To introduce the effective mathematical tools for the solutions of partial differential equations thatmodel several physical processes and to develop Z transform techniques for discrete time systems.

Course Content:

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations - Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3

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

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Fourier series solutions of one- dimensionalwave equation – One dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS 9+3

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of differenceequations – Solution of difference equations using Z - transforms.

TOTAL LECTURE PERIODS 60 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Understand how to solve the given standard partial differential equations.
2. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
3. Appreciate the physical significance of Fourier series techniques in solving one- andtwo-dimensional heat flow problems and one-dimensional wave equations.
4. Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
5. Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems

Text Book(s):

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

Reference Books:

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata Mc Graw Hill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, “Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, “Advanced Engineering Mathematics” Tata Mc Graw Hill Education PvtLtd, Sixth Edition, New Delhi, 2012.
6. Datta.K.B., “Mathematical Methods of Science and Engineering”, Cengage Learning India Pvt Ltd, Delhi, 2013.

22AG401	SURVEYING AND LEVELLING	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

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. To introduce the concepts of Control Surveying. To introduce the basics of Astronomical Surveying

UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING **9**

Definition – Classifications – Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging – Well conditioned triangles – Chain traversing – Compass – Basicprinciples – 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 II LEVELLING **9**

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

UNIT III THEODOLITE SURVEYING **9**

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

UNIT IV CONTROL SURVEYING AND ADJUSTMENT **9**

Horizontal and vertical control – Methods – Triangulation – Traversing – Gale‘s table – Trilateration – Concepts of measurements and errors – Error propagation and Linearization – Adjustment methods - Least square methods – Angles, lengths and levelling network.

UNIT V MODERN SURVEYING **9**

Total Station: Digital Theodolite, 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

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1 Introduce the rudiments of various surveying and its principles.
CO2 Imparts knowledge in computation of levels of terrain and ground features CO3
Imparts concepts of Theodolite Surveying for complex surveying operations CO4
Understand the procedure for establishing horizontal and vertical control CO5
Imparts the knowledge on modern surveying instruments

Text Book(s):

1. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, LakshmiPublications Pvt Ltd, New Delhi, Sixteenth Edition, 2016.
2. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune VidyarthiGriha 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, SeventhEdition, Mc Graw Hill 2001.
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4. S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India2010.
5. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013.
6. C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.

Web Links:

1. https://agrimoon.com/wp-content/uploads/Surveying-and-Leveling.pdf
2. https://www.iare.ac.in/sites/default/files/lecture_notes/SURVEYING%20LECTURE%20NO TES.pdf
3. https://civiltoday.com/surveying/87-surveying-lecture-notes-pdf

List of Experiments:

1. **CHAIN SURVEYING**
   i. Ranging, Chaining and PacingChain traversing
2. **COMPASS SURVEYING**
   i. Triangulation ProblemCompass traversing
3. **PLANE TABLE SURVEYING**
   i. Radiation Intersection - Triangulation problemPlane table traversing
4. **THEODOLITE SURVEYING**
   i. Measurement of horizontal & vertical anglesTangential & Stadia Tacheometry
5. **LEVELLING**
   i. Fly levelling using Dumpy level
   ii. Check levelling
   iii. Block Levelling
   iv. Radial Contouring
6. **DEMONSTRATION OF TOTAL STATION AND GPS**

TOTAL PRACTICAL PERIODS 30 Periods

TOTAL LECTURE CUM PRACTICAL PERIODS 75 Periods

LIST OF EQUIPMENT REQUIRED

- Total Station -3 Nos
- Theodolites- Atleast 1 for every 5 students
- Dumpy level / Filling level- Atleast 1 for every 5 students
- Pocket stereoscope-1
- Ranging rods-1 for a set of 5 students
- Levelling staff-1 for a set of 5 students
- Cross staff-1 for a set of 5 students
- Chains-1 for a set of 5 students
- Tapes-1 for a set of 5 students
- Arrows-1 for a set of 5 students
- Prismatic Compass-5nos
- Surveyor Compass-2nos
- Survey grade or Hand held GPS-3nos
- Plane table surveying

22AG402	FOOD AND DAIRY ENGINEERING	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. 1.To introduce the students to dairy industry, properties and processing of milk, manufactureof dairy products , sanitation and effluent treatment in dairy industry
2. 2.To expose the students to the fundamental knowledge of food, its properties and differentmethods of food processing

Course Content:

UNIT I PROPERTIES AND PROCESSING OF MILK **9**

Dairy Industry – importance and status – Milk Types – Composition and properties of milk-Production of high quality milk - Method of raw milk procurement and preservation - Processing –Staining - Filtering and Clarification - cream separation – Pasteurization – Homogenization - sterilization, UHT processing and aseptic packaging – emulsification - Fortification

UNIT II DAIRY PRODUCTS **9**

Manufacture of Milk Powder - Processing of Milk Products - Condensed Milk - Skim milk - Butter milk - Flavoured Milk, whey, casein, yoghurt and paneer - Manufacture of Butter - Cheese Ghee, ice creams and frozen desserts - standards for milk and milk products - Packaging of Milk and Milk Products - Cleaning and Sanitation - Dairy effluent treatment and disposal .

UNIT III FOOD AND ITS PROPERTIES, REACTION AND KINETICS **9**

Constituents of food - thermal processing of foods - cooking, blanching, sterilization, pasteurization, canning - Interaction of heat energy on food components, reaction kinetics, Arrhenius equation, TDT curves - water activity, sorption behaviour of foods.

UNIT IV PROCESSING AND PRESERVATION OF FOODS **10**

Coffee, Tea processing - Concentration of foods, freeze concentration - osmotic and reverse osmotic concentration - drying and dehydration of food - Tray, tunnel, belt, vacuum and freezedryers - rehydration of dehydrated foods - Fat and oil processing, sources, extraction, methodsand equipment, refining of oils, hydrogenation, manufacture of margarine - Food preservationmethods - preservation by irradiation, microwave and dielectric heating of food.

UNIT V PACKAGING AND QUALITY CONTROL **8**

Food packaging, importance, flexible pouches - retort pouches - aseptic packaging, granules,powder and liquid packaging machines - nanotechnology – principles - applications in food processing – food plant location - Quality control of processed food products - Factors affectingquality.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

- The students will gain knowledge about Dairy and Food process engineering
- Understand the process of manufacturing of dairy products and thermal processingof food.
- Students will understand the importance of quality control and food preservation and packaging.
- To understand the concept of processing and preservation of foods
- To understand the concept of packaging and quality control

Text Book(s):

1. Chandra Gopala Rao. Essentials of Food Process Engineering. B.S. Publications,Hyderabad, 2006.
2. Walstra. P., Jan T. M. Wouters., Tom J. Geurts "Dairy Science and Technology", CRCpress, 2005.
3. Ananthakrishnan, C.P., and Sinha, N.N., "Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi, 1999.

Reference Books:

1. Subbulakshmi.G., and Shobha A. Udipi, Food Processing and Preservation, New AgeInternational Publications, New Delhi, 2007.
2. Toledo, R.T., "Fundamentals of Food Process Engineering", CBS Publishers andDistribution, New Delhi, 1997.
3. Tufail Ahmed., "Dairy Plant Engineering and Management", Kitab Mahal Publishers, Allahabad, 1997.
4. Dairy Science and Technology Handbook, Volumes 1-3, John Wiley & Sons,1993.
5. Charm, S.E., "Fundamentals of Food Engineering", AVI Pub.Co.Inc, New York, 1997.

Web Links:

1. http://ecoursesonline.iasri.res.in
2. https://www.inspirenignite.com
3. https://courseware.cutm.ac.in

List of Experiments:

1.	Estimation of microbial load in food materials.	**4**
2.	Determination of rehydration ratio of dehydrated foods.	**4**
3.	Experiments on detection of Food Adulteration	**4**
4.	Determination of properties of milk	**4**
5.	Experiment on properties of food through microwave oven heating.	**4**
6.	Experiments on cream separator to determine the separation efficiency	**5**
7.	Experiments on construction and operation of butter churn and butterworking accessories	**5**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	Hot air oven-1no.	1no.
2.	Hand refractometer-1 no.	1no.
3.	Dean and Stark`` s apparatus	1 no
4.	Cabinet dryer – 1 no.	1no.
5.	Soxhlet flask -1no.	1 no
6.	Distillation column – 1 no.	1no.
7.	Kjeldahl flask – 1no.	1no
8.	Distillation apparatus – 1 no	1 no
9.	Microwave oven –1 no.	1 no
10	Cream separator	1 no
11	Butter churner -1 no.	1 no

22MA303	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

Pre-requisite	Nil	Syllabus Version	V 0.1

Course Objectives:

1. This course aims at providing the required skill to apply the statistical tools inengineering problems.
2. To introduce the basic concepts of probability and random variables.
3. To introduce the basic concepts of two-dimensional random variables.
4. To acquaint the knowledge of testing of hypothesis for small and large sampleswhich plays an important role in real life problems.
5. To introduce the basic concepts of classifications of design of experiments whichplays very important roles in the field of agriculture and statistical quality control.

Course Content:

UNIT I PROBABILITY AND RANDOM VARIABLES 9+3

Probability – Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 9+3

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table

(test for independent) - Goodness of fit.

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

One way and Two-way classifications - Completely randomized design – Randomized blockdesign – Latin square design.

UNIT V STATISTICAL QUALITY CONTROL **9+3**

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

TOTAL LECTURE PERIODS **60 Periods**

Expected Course Outcome:

Upon successful completion of the course, students will be able to:

1. Understand the fundamental knowledge of the concepts of probability and haveknowledge of standard distributions which can describe real life phenomenon.
2. Understand the basic concepts of one- and two-dimensional random variables andapply in engineering applications.
3. Apply the concept of testing of hypothesis for small and large samples in real lifeproblems.
4. Apply the basic concepts of classifications of design of experiments in the field ofagriculture and statistical quality control.
5. Have the notion of sampling distributions and statistical techniques used inengineering and management problems.

Text Book(s):

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

2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGrawHill, 4th Edition, 2007.

Reference Books:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, CengageLearning, New Delhi, 8th Edition, 2014.

2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and StochasticProcesses", McGraw Hill Education India, 4th Edition, New Delhi, 2010.

3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rdEdition, Elsevier, 2004.

4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problemsof Probability and Statistics", Tata McGraw Hill Edition, 2004.

5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineersand Scientists", Pearson Education, Asia, 8th Edition, 2007.

22ME402	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. Impart knowledge on the basics and application first law of thermodynamics.
2. Impart knowledge on the second law of thermodynamics and entropy concepts
3. Teach the various properties of steam through steam tables and Mollier chart.
4. Impart knowledge on the macroscopic properties of ideal and real gases.
5. Gain knowledge of psychometric properties and its processes

Course Content:

UNIT I BASICS AND FIRST LAW OF THERMODYNAMICS 9

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 II SECOND LAW AND ENTROPY 9

Heat Engine — Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnotcycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles

UNIT IV GAS MIXTURES AND THERMODYNAMIC RELATIONS 9

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.

UNIT V PSYCHROMETRY **9**

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: At the end of the course the students would be able to

1. Apply the zeroth and first law of thermodynamics by formulating temperature scalesand calculating the property changes in closed and open engineering systems.
2. Apply the second law of thermodynamics in analysing the performance of thermaldevices through energy and entropy calculations.
3. Apply the second law of thermodynamics in evaluating the various properties of steamthrough steam tables and Mollier chart
4. Apply the properties of pure substance in computing the macroscopic properties of ideal andreal gases using gas laws and appropriate thermodynamic relations.
5. Apply the psychometric properties , processes

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,9thEdition,2019.

2. Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.

3. Rathakrishnan, E., “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall ofIndiaPvt. Ltd, 2006.

4. Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 10th Edition,WileyEastern, 2019.

5. Venkatesh. A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007

22AG403	Unit Operations In Agricultural Processing	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. The students would be exposed to the fundamental knowledge in Evaporation,
2. To understand the students about the Filtration, Sedimentation, Processing, Sieveanalysis method.
3. Students will understand the Crystallization and Distillation in processing ofagricultural produce.

Course Content:

UNIT I EVAPORATION AND CONCENTRATION **9**

Unit operations in food processing –conservation of mass and energy – overall view of an engineering process-dimensions and units – dimensional and unit consistency – dimensionlessratios-evaporation – definition – liquid characteristics – single and multiple effect evaporationperformance of evaporators and boiling point elevation – capacity – economy andheat balancetypes of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator

UNIT II MECHANICAL SEPARATION **9**

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

UNIT III SIZE REDUCTION **9**

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

UNIT IV CONTACT EQUILIBRIUM SEPARATION **9**

Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – 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 – flowthrough packed towers-extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids

UNIT V CRYSTALLISATION AND DISTILLATION **9**

Crystallization-Equilibrium –Rate of crystal growth stage-Equilibrium crystallization-CrystallizersEquipment-Classification- Construction and operation – Crystallizers-Tank-Agitated batchSwenson-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 equipmentConstruction and operation-Factors influencing the operation.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

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 affectingthe process .
4. Identify the gas-liquid and solid-liquid equilibrium concepts and factors influencingequilibrium separation process.
5. Differentiate crystallization and distillation processes and identify processingequipment.

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 PressLLC, Florida, 2003.

Web Links:

1.AI3302 Unit Operations in Agricultural Processing - Notes, IQ [PDF] (padeepz.net)

2.116_et_m1.pdf (inflibnet.ac.in)

3.(PDF) UNIT OPERATIONS IN FOOD PROCESSING | Mochamad Iqbal - Academia.edu

22AG403	CAD AND DRAWING OF FARM STRUCTURE	L	T	P	C
		0	0	4	2

Pre-requisite Nil **Syllabus Version** V 0.1

List of Experiments:

1.	Design and Drawing of Underground pipeline system	**4**
2.	Design and Drawing of Check dam	**4**
3.	Design and Drawing of Mould board plough	**4**
4.	Design and Drawing of Disk plough	**4**
5.	Design and Drawing of Biogas plant.	**4**
6.	Introduction & demonstration on 3D modeling softwares like Pro/E, Creo,Solid works,Solid Edge etc.	**4**
7.	Planning and Layout of farmstead	**4**
8.	Design of poultry house	**4**
9.	Design of a sheep / goat house	**4**
10.	Design of farm fencing system	**4**
	TOTAL PRACTICAL PERIODS	**60 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. The student will be able to understand the plan and layout of underground pipes, postharvesting units and check dams.
2. The students also will be able to design and draw the componentsusing computer aidedmethods
3. Apply basic concepts to develop construction (drawing) techniques
4. At the end of the course, the student will be able to design and draw allfarm structures connected to agricultural engineering including animal housing, grain storage, small civil structures
5. Understand and demonstrate dimensioning concepts and techniques

Reference Books:

1. Michael, A.M. “Irrigation Theory and Practice”, Vikas Publishing House, New Delhi, 1999.
2. Rai, G.D. “Nonconventional Sources of Energy”, Khanna publishers, New Delhi, 1995.
3. Srivastava, A.C.”Elements of Farm Machinery”, Oxford and IBH Publications Co., NewDelhi, 1990.
4. Vijay Duggal. “A general guide to Computer Aided Design & Drafting, Mailmax Publications, 2000
5. Barre, H.J. and Sammet, L.L. "Farm Structures". John Wiley and Sons Inc. 1950."
6. Neubaur, L. W. and Walker, H.B. "Farm Buildings Design". Prentice Hall Inc., 1961.

List of Equipments: (for batch of 30 students)

1. CAD SOFTWARE

22MC405	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		0	0	0	0

Pre-requisite Nil **Syllabus Version** V 0.1

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
3. To enhance awareness of institutional processes in the country and
4. To develop rudimentary ability to respond to their surroundings withpotential disasterresponse in areas where they live, with due sensitivity

Course Content:

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS **9**

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 II DISASTER RISK REDUCTION (DRR) **9**

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigationand 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 III DISASTER MANAGEMENT **9**

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 IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT **9**

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 operationProcedure for disaster response — Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES **9**

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 PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

- 1 To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction(DRR)
- To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessmentpreventionand risk reduction
- To develop disaster response skills by adopting relevant tools and technology
- Enhance awareness of institutional processes for Disaster response in the country and
- Develop rudimentary ability to respond to their surroundings with potential Disaster responseinareas where they live, with due sensitivity.

Text Book(s):

3. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
4. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches andtsunami, Horizon Press Publications
5. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13:978-9380386423
6. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill IndiaEducation Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

Reference Books:

7. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
8. Government of India, National Disaster Management Policy, 2009.
9. Shaw R (2016), Community based Disaster risk reduction, Oxford University Pres

Web Links:

1. https://www.iare.ac.in/sites/default/files/lecture_notes/dm%20notes.pdf
2. http://www.govtpolytechnicbargarh.in/iticollege/college/iti/SM/6th-civ-DISASTER%20MANAGEMENT.pdf 3. https://www.academia.edu/35943021/Disaster_Management_Notes_and_Questions

22AG501	FARM MACHINERY AND EQUIPMENT	L	T	P	C
		3	0	2	4

Pre-requisite Nil **Syllabus Version** V 0.1

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 ofcomponents of primary and secondary tillage implements

Course Content:

UNIT I FARM MECHANIZATION **9**

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 II IMARY AND SECONDARY TILLAGE IMPLEMENTS **9**

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

UNIT III SOWING AND FERTILIZING EQUIPMENT **9**

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

UNIT IV WEEDING AND PLANT PROTECTION EQUIPMENT **9**

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

UNIT V HARVESTING MACHINERY **9**

Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper andbinder combine harvesters, balers, threshers

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

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

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., NewDelhi.,1996
3. Srivastava, A.C. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi, 1990

Web link:

1. https://agrimoon.com/wp-content/uploads/FARM-POWER-AND-MACHINERY.pdf
2. https://coabnau.in/uploads/1632458485_Ag.Engg.3.2.pdf
3. http://www.jnkvv.org/PDF/04042020122506Notes%20FPM%20COH%20Rehli%20by%20DMK.pdf

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.	**3**
2.	Field operation and adjustments of ploughs	**3**
3.	Field operation and adjustments of harrows	**3**
4.	Field operation and adjustments of cultivators	**3**
5.	Field operation of sowing and planting equipmentand their adjustments	**3**
6.	Field operation of plant protection equipment	**3**
7.	Field operation on mowers and reapers	**3**
8.	Hitching of agricultural implements and trailers	**4**
9.	Visit to agro-manufacturers	**5**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	Tractor	1NO
2.	Disc plough	1 NO
3.	Disc harrow	1 NO
4.	Multi tyne cultivator	1 NO
6.	Seed drill	1 NO
7.	Sprayer	1 NO
8.	Mower	1 NO
9.	Weeder	1 NO

22AG502	IRRIGATION AND DRAINAGE ENGINEERING	L	T	P	C
		3	0	2	4

Pre-requisite	Nil	Syllabus Version	V 0.1

Course Objectives:

3. At the completion of the course the students should be able to understand the necessityof planning an irrigation system to provide water at the right time and right place.
4. To understand the basic concepts for planning, design and management of land drainageworks in cultivated areas.
5. To disseminate the scientific knowledge on water management practices to achievehigher yields and utilization of poor quality waters.

Course Content:

UNIT I WATER RESOURCES AND IRRIGATION REQUIREMENT 9

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 II SOIL, WATER AND PLANT RELATIONSHIP 9

Soil - water - plant relationship - Soil Plant Atmospheric Continuum (SPAC) - Hydrological cycle - Soil water movement - soil moisture constants - Moisture extraction pattern - Absorption of water - Plant water stress and its effect and methods to overcome stress.

UNIT III METHODS OF IRRIGATION 9

Methods of Irrigation – Surface and Subsurface methods – Drip and Sprinkler-Micro irrigation: layout, suitability, merits and demerits -. Fertigation - Water use efficiency - Methods to improveWUE - Conjunctive use of surface and ground water.

UNIT IV CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT 9

Classification of canals- Alignment of canals – Design of irrigation canals– Regime theories - CanalHead 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 forwater distribution and system operation - rotational irrigation system.

UNIT V AGRICULTURAL DRAINAGE 9

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

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. The students will have knowledge and skills on Planning, design, operation and management of reservoir system.
2. The student will gain knowledge on different methods of irrigation including canal irrigation.
3. The students interaction among the components of soil, moisture, crop complex .
4. The students understanding managing the irrigation water in to the field.

Text Book(s):

1. Dilip Kumar Majumdar., "Irrigation Water Management", Prentice-Hall of India, NewDelhi, 2008.
2. Mandal, R.C and P.K. Jana, 2003.Water resource utilization and micro irrigation. Kalyani publishers, 2003, Ludhiyana.
3. Garg, S.K., "Irrigation Engineering," Laxmi Publications, New Delhi, 2008.
4. Ritzema, H.P., "Drainage Principles and Applications", Publication No. 16, InternationalInstitute of Land Reclamation and Improvement, Netherlands, 1994.

Reference Books:

. Murthy, V.V.N. Land and water management, Kalyani publishing, New Delhi, 1998.

2. Bhattacharya, A.K., and Michael, A.M., "Land Drainage – Principles, Methods and Applications",Konark Publishers Pvt. Ltd., New Delhi, 2003.

3.Prihar, S.S and B.S. Sandhu. 2005. Irrigation of field crops – Principles and Practices. ICAR Publications, New Delhi.

Web link:

1. https://uomustansiriyah.edu.iq/media/lectures/5/5_2017_10_16!07_12_23_PM.pdf
2. https://agrimoon.com/wp-content/uploads/Drainage-Engineering-.pdf
3. http://mrecacademics.com/DepartmentStudyMaterials/20201221-ISWPE%20notes.pdf

List of Experiments:

1	To study various instruments in the Meteorological Laboratory	**5**
2	Determination of infiltration rate using double ring and digital infiltrometer	**5**
3	Determination of soil moisture wetting pattern for irrigation scheduling	**5**
4	Design of Drip irrigation system	**5**
5	Design of sprinkler irrigation system	**5**
6	Measurement of flow properties in open irrigated channels (flumes, notches)	**5**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1	Meteorological lab with Cup counter anemometer, Sunshine recorder, Openpan vaporimeter, Stevenson's screen - Dry bulb, wet bulb thermometers, recording and non-recording type	1 no each
2	Double ring infiltrometer	1 no
3	Digital infiltrometer	1 no
4	Parshall flume, cut throat flume	1 no each
5	V notch, Rectangular notch and trapezoidal notch	1 no each
6	Drip irrigation system with all accessories	
7	Sprinkler irrigation system with all accessories	
8	Required number of stop watches	
9	Weighing balance	
10	Catch cans, measuring jars –required numbers	

22AG503	DESIGN OF AGRICULTURAL MACHINE ELEMENTS	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	**Syllabus Version**			V 0.1

Course Objectives:

1. To introduce to the students to the basic concepts involved in the design of basic elements that are common to any agricultural machinery.
2. To get through the detailed design & drawing of various components of agricultural machineries

Course Content:

UNIT I STRESSES IN MACHINE MEMBERS 9

Introduction to DC Circuits - Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm'sLaw - Kirchhoff's Laws - Nodal Analysis, Mesh analysis with Independent sources only (Steady state)
- Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, real power,reactive power and apparent power, power factor.

UNIT II DESIGN OF POWER TRANSMISSION SYSTEMS 9

Selection of V-Belts and pulleys- selection of flat belts and pulleys

UNIT III DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength and rigidity- Design of keys, keyways andsplines- Design of rigid and flexible couplings.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

Design of helical, leaf, disc and torsional springs under constant loads and varying loads

UNIT V DESIGN OF GEARS AND BEARINGS 9

Gears - spur gear and - terminology - strength of gear teeth - Lewis equation - Buckinghamequation. - Failure of gear teeth.- Applications of different types of Gears - Types ofbearings
– and rolling contact types. - selection of rolling contact bearing

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Explain the influence of steady and variable stresses in machine componentdesign.
2. Apply the concepts of design to V belts , Flat belts, chains and sprockets.
3. Apply the concepts of design to shafts, keys and couplings.
4. Apply the concepts of design to energy storing members
5. Apply the concepts of design to Spur Gears and rolling contact Bearings.

Reference Books:

1. Norton R.L, Machine Design – An Integrated Approach, Pearson Publications, 3rd Edition,2006.
2. Srivastava A.K., Goering.C.E. and Rohrbach R.P. Engineering Principles of Agricultural Machines. Revised Printing by American Society of Agricultural Engineers. 1993.
3. Gary Krutz, Lester Thompson and Paul Clear., "Design of Agricultural Machinery", JohnWileyand Sons, New York, 1984.

Web Links:

1.https://mrcet.com/downloads/digital_notes/ME/III%20year/DMM%20NOTES.pdf
2.https://mrcet.com/downloads/digital_notes/ME/III%20year/Machine%20Design%20%E2%80%93%20I.pdf

22AG504	SOIL AND WATER CONSERVATION ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

- To present the concepts of erosion so that students get a sound knowledge about the problems associated with it.
- To enable the students to make use of the principles and concepts to solve issues related to soil and water management

Course Content:

UNIT I SOIL EROSION PRINCIPLES **9**

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

UNIT II ESTIMATION OF SOIL EROSION **9**

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 III EROSION CONTROL MEASURES **9**

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 IV WATER CONSERVATION MEASURES **9**

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

UNIT V SEDIMENTATION **9**

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

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome:

- The students will be to gain fundamental knowledge on the concepts of erosion and sedimentation.
- They will have sufficient knowledge on soil and water conservation measures.
- The students understand the how to estimate the soil erosion & control measures.
- They will have sufficient knowledge about the water conservation measures.

Text Book(s):

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

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

Web Links:

1. https://agrimoon.com/soil-and-water-conservation-engineering-pdf-book/
2. http://ecoursesonline.iasri.res.in/course/view.php?id=54
3. https://sites.google.com/site/agr1058soilwaterconservatione/file-cabinet

22MC601	INDUSTRIAL SAFETY	L	T	P	C
		0	0	0	0

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To Understand the Introduction and basic Terminologies safety.
2. To enable the students to learn about the Important Statutory Regulations andstandards.
3. To enable students to Conduct and participate the various Safety activities in theIndustry.
4. To have knowledge about Workplace Exposures and Hazards.
5. To assess the various Hazards and consequences through various Risk AssessmentTechniques.

Course Content:

UNIT I SAFETY TERMINOLOGIES **9**

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 II STANDARDS AND REGULATIONS **9**

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health AuditIS14489:1998-Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III SAFETY ACTIVITIES **9**

Toolbox 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 IV WORKPLACE HEALTH AND SAFETY **9**

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic gas Release.

UNIT V HAZARD IDENTIFICATION TECHNIQUES **9**

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazardand Operability-Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk

Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and HazardIdentification and Risk Assessment.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. Understand the basic concept of safety.
2. Obtain knowledge of Statutory Regulations and standards.
3. Know about the safety Activities of the Working Place.
4. Analyze on the impact of Occupational Exposures and their Remedies
5. Obtain knowledge of Risk Assessment Techniques.

Text Book(s):

5. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment ManagementSystems Khanna Publisher

6. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk ControlMcGraw-Hill Education

Reference Books:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemannpublications, 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 ofSafety Engineers, USA

22AG601	**POST HARVEST TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Pre-requisite Nil **Syllabus Version** V 0.1

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 Content:

UNIT I FUNDAMENTALS OF POST HARVESTING **9**

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

UNIT II PSYCHROMETRY AND DRYING **9**

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

UNIT III CLEANING AND GRADING **9**

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

UNIT IV SHELLING AND HANDLING **9**

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

UNIT V CROP PROCESSING **9**

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

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. Fundamentals of post harvesting techniques
2. Material handling equipments
3. Different Post Harvest operations
4. Crop processing methods of harvested crops.
5. Fundamentals of various unit operations of Agricultural Processing

Text Book(s):

1. Chakraverty, A.Post harvest technology for Cereals, Pulses and oilseeds.Oxford & IBHpublication Pvt Ltd, New Delhi, Third Edition, 2000.
2. Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing. Vikas publishinghouse 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 Wileyand Sons,New York. 1955.

Web link:

1. https://www.amickau.nic.in
2. http://www.agritech.tnau.ac.in
3. http://www.aau.in
4. https://agriculturistmusa.com
5. https://www.iihr.res.in

List of Experiments:

1.	Determination of moisture content of grains by oven method and moisturemeter.	**3**
2.	Determination of porosity of grains.	**3**
3.	Determination of coefficient of friction and angle of repose of grains**.**	**3**
4.	Testing of groundnut decorticator & maize sheller	**3**
5.	Evaluation of thin layer drier	**3**
6.	Determining the efficiency of screw conveyor	**3**
7.	Evaluation of shelling efficiency of rubber roll sheller	**3**
8.	Determining the oil content of oil seeds.	**4**
9.	Visit to modern rice mill	**5**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	Hot air oven, Grain moisture meter	No 1 each
2.	Porosity apparatus	1 no
3.	Coefficient of friction apparatus	1 no
4.	Angle of repose – round type and L type	No 1 each
5.	Groundnut decorticator and maize sheller	No 1 each
6.	Thin layer dryer	1 no
7.	screw conveyor	1 no
8.	Rubber roll sheller	1 no
9.	Oil expeller	1 no

22AG602	TRACTORS AND ENGINE SYSTEMS	L	T	P	C
		2	0	2	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To introduce the students to the different systems and working principles of tractor,
2. How to use the power tiller, makes of tractors and power tillers.
3. The students will interest about hydraulic system.
4. Transmission system through the clutch &gear box.

Course Content:

UNIT I TRACTORS **6**

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

UNIT II ENGINE SYSTEMS **6**

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

UNIT III TRANSMISSION SYSTEMS **6**

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

UNIT IV HYDRAULIC SYSTEMS **6**

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

UNIT V POWER TILLER, BULLDOZER AND TRACTOR TESTING **6**

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 tillers.

TOTAL LECTURE PERIODS **30 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

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

Text Book(s):

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

Reference Books:

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley EasternPvt. 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.

WEB LINK:

1. Tractor Systems & controls PDF Book free - AgriMoon
2. Course: Farm Power And Machinery (1+1) (iasri.res.in)
3. Agricultural Engineering Notes PDF Download (agrigyan.in)

List of Experiments:

1.	Identification and study of different components of diesel engine	**3**
2.	Identification and study of different components of petrol engine	**3**
3.	Method of working of diesel engine with the help of working models	**3**
4.	Study of hydraulic system and PTO system in a tractor	**3**
5.	Dismantling and assembly of diesel engine	**3**
6.	Dismantling and assembly of petrol engine	**3**
7.	Study of clutch – components and method of working	**3**
8.	Study of gear box – components and method of working	**3**
9.	Study of differential and final drive– components and method of working	**3**
10.	Study of braking system and steering system – components and method ofworking	**3**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**60 Periods**

List of Equipments: (for batch of 30 students)

1.	Working model of diesel engine	1 no
2.	Working model of petrol engine	1 no
3.	Working model of clutch	1 no
4.	Working model of gear box	1 no
5.	Working model of differential	1 no
6.	Working model of final drive	1 no
7.	Working model of brake system	1 no
8.	Working model of steering system	1 no
9.	Condemned diesel engine	1 no
10.	Condemned petrol engine	

22EEC502	MINI PROJECT	L	T	P	C
		0	0	4	2

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparingproject reports and to face reviews and viva voce examination

The students in a group of 3 to 4 works 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 a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by
external and internal examiners constituted by the Head of the Department.

TOTAL PRACTICAL PERIODS 60 Periods

Expected Course Outcome:

On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

22AG701	RENEWABLE ENERGY RESOURCES	L	T	P	C
		2	0	2	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To know the Indian and global energy scenario
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies

Course Content:

UNIT I ENERGY SCENARIO **9**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption -Future energy plans

UNIT II SOLAR ENERGY **9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems SolarPV applications.

UNIT III WIND ENERGY **9**

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT IV BIO-ENERGY **9**

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion- mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration- Carbonisation –Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT V OCEAN AND GEOTHERMAL ENERGY **9**

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermalenergy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

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

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 Books:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGrawHill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", AlphaScience Intl Ltd, 2015.

Twidell, J.W. & Weir A., "Renewable

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1.https://www.vssut.ac.in/lecture_notes/lecture1428910296.pdf

2.https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RES_LECTURE_NOTES_0.pdf

3.https://www.uobabylon.edu.iq/eprints/publication_4_10679_78.pdf

List of Experiments:

1.	Study of different types of biogas plant	**4**
2.	Testing of biogas/producer gas engines	**4**
3.	study of bomb calirimeter	**3**
4.	Automatic weather station – Analysis of wind data and prediction	**4**
5.	Testing of solar water heater	**4**
6.	Testing of natural convection solar dryer	**4**
7.	Study on Solar power and I-V Characteristics	**3**
8.	Testing of solar photovoltaic water pumping system	**4**
	TOTAL PRACTICAL PERIODS	**30 Periods**
	TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	Muffle furnace	1 no
2.	Bomb calorimeter	1 no
3.	Model of biogas plant	1 no
4.	Biogas/ Producer gas dual fuel Engine	1 no
5.	Solar water heater	1 no
6.	Solar dryer	1 no
7.	Solar PV training kit	1 no
8.	Solar PV water pumping system	1 no

22HS703	HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To create an awareness on Engineering Ethics and Human Values.
2. To instil Moral and Social Values and Loyalty
3. To appreciate the rights of others.
4. To create awareness ethics

Course Content:

UNIT I CONCEPTS AND THEORIES OF HUMAN ETHICS **9**

Concepts and theories of human Ethics: Definitions of Ethics, Personal ethics and professional ethics, Morality and law, how are moral standards formed? Religion and Morality, Morality, Etiquette and Professional codes, Indian Ethical Traditions

UNIT II PROFESSIONAL ETHICS **9**

Professional Ethics: Principles of personal Ethics, Principles of Professional ethics, Evolution of Ethics Over the years, Honesty, Integrity and Transparency are the touchstones of Business Ethics, Distinction Between Values and Ethics, Roots of unethical Behaviour, Ethical Decision – Making.

UNIT III ETHICAL DILEMMAS, SOURCES AND THEIR RESOLUTIONS **9**

Ethical Dilemmas, Sources and Their resolutions: What is an Ethical Dilemma, Sources of Ethical Behaviour, Code of Personal Ethics for Employees, How to Resolve an Ethical Problem, How to Resolve Ethical Dilemmas.

UNIT IV ETHICAL DECISION **9**

Ethical Decision – marking in Business: Ethical Models that Guide Decision making, Which Approach to use, Ethical Decision Marking with Cross – holder conflicts and competition, Applying Moral Philosophy to Ethical Decision Making, Kohlberg's Model of Cognitive Moral Development,
Influences on Ethical Decision Making, Personal values and Ethical Decision Marking.

UNIT V INDIVIDUAL FACTORS **9**

Individual factors: Moral Philosophies and values – Moral Philosophy defined, Moral philosophies, Applying Moral Philosophy to Ethical decision Making, Cognitive moral Development, White – Collar Crime, Individual factors in Business Ethics. Human Values for Indian, Lessons from Ancient Indian Education system, The law of Karma, Quality of Working life, Ethics of Vivekananda, Gandhiji, Aurobindo and Tagore.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome:

1. Awareness of types of ethical challenges and dilemmas confronting members of a range of professions (business, media, police, law, medicine, research).
2. Identify and describe relevant theoretical concepts related to professional ethics in engineering.
3. Distinguish among morals, values, ethics, and the law and to explore how they each impact engineering practice.
4. Apply learning from Indian history and ethos to ethical practices in engineering.

Text Book(s):

1. M.Govindarajan, S.Natarajananad, V.S.SenthilKumar “Engineering Ethics includes HumanValues” - PHI Learning Pvt. Ltd-2009
2. Harris, Pritchard and Rabins “Engineering Ethics”, CENGAGE Learning, India Edition, 2009.
3. Mike W. Martin and Roland Schinzinger “Ethics in Engineering” Tata McGraw- Hill–2003.
4. Prof.A.R.Aryasri, DharanikotaSuyodhana “Professional Ethics and Morals” Maruthi Publications.
5. A.Alavudeen, R.KalilRahman and M.Jayakumaran “Professional Ethics and Human Values” – LaxmiPublications.
6. Prof.D.R.Kiran “Professional Ethics and Human Values”
7. PSR Murthy “Indian Culture, Values and Professional Ethics” BS Publication

Reference Books:

1. Business Ethics by AC Fernando

2. Business Ethics by Ferrell, Fraedrich and Ferrell.

3. Ethics in Management and Indian Ethos by Biswanath Gosh

22AG702	ICT in Agricultural Engineering Lab	L	T	P	C
		0	0	4	2

Pre-requisite Nil **Syllabus Version** V 0.1

List of Experiments:

1.	Configuring timers for automatic switching "on and off" of irrigation systems	**6**
2.	Experience with solenoid valves for pressurized irrigation	**6**
3.	Using sensors for Agro meteorological measurements	**6**
4.	Employing Printed Circuit Board (PCB) or Breadboard for controlling or triggering anagricultural system	**6**
5.	Use of mobile apps for controlling or triggering an agricultural system	6
6.	Construction of crop growth functions (best fit) for crop yields simulations	**6**
7	Experience with existing open source crop simulation models	**6**
8	Exposing cloud resources for agricultural applications	**6**
9	Study of MATLAB software	**6**
10	Study and Analysis of temperature variation in crops	**6**
	TOTAL PRACTICAL PERIODS	**60 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

.Knowledge on meteorological measurements

2. Obtain knowledge on triggering an agricultural system

3. Knowledge on Image processing as tool for biotic and abiotic stress identification

4. Ability to conduct Spatial analysis of rainfall data and design water storage reservoirs

Reference Books:

.Antonió José Mendes, Maria Cristina Azevedo Gomes, Maria José Marcelino, 14 December 2015

2. Ali Dalgic, Derya Toksoz, Kemal Birdir, Sevda Birdir, 4 December 2020

3. Anwesha Banerjee. 2011. The ICT in Agricutture: Bridging Bharat with India. Global Media Journal – Indian Edition/ISSN 2249-5835. Winter Issue / December 2011. Vol. 2/No.2. PP. 1-16.

List of Equipments: (for batch of 30 students)

1. Timing devices and small pumps for simulations – required nos.
2. Solenoid valves and layout of drip or sprinkler system – required nos.
4. Digital thermometer – 1 no.
5. Breadboards, relays etc.
6. MATLAB software
7. Open source Crop simulation models – any one for demonstration

22EEC701	Project Work – Phase I	L	T	P	C
		0	0	4	2

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing
project reports and to face reviews and viva voce examination

The students in a group of 3 to 4 works 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 a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by
external and internal examiners constituted by the Head of the Department.

TOTAL PRACTICAL PERIODS 60 Periods

Expected Course Outcome:

On Completion of the project work students will be in a position to take up any challenging
practical problems and find solution by formulating proper methodology.

22MG801	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. Understand the philosophies of management gurus
2. Understand the various types of organization structures and their features, and Their advantages and disadvantages.
3. Learning various Industrial Engineering Practices like Operations Management techniques, work study, statistical quality control techniques, Job evaluation techniques and network analysis techniques.

Course Content:

UNIT I INTRODUCTION TO MANAGEMENT 9

Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two- Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

UNIT II DESIGNING ORGANIZATIONAL STRUCTURES 9

Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT III OPERATIONS MANAGEMENT 9

Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram.

UNIT IV WORK STUDY 9

Work Study: Introduction — definition — objectives — steps in work study — Method study —definition, objectives — steps of method study. Work Measurement — purpose — types of study
— stop watch methods — steps — key rating — allowances — standard time calculations — work Sampling.

UNIT V STATISTICAL QUALITY CONTROL **9**

Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes-Defective-Defect- Charts for attributes-p-chart - c chart (simple Problems), Acceptance Sampling- Single sampling-Double sampling plans-OC curves.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. Able to apply principles of management
2. Able to design the organization structure
3. Able to apply techniques for plant location, design plant layout and value analysis
4. Able to carry out work study to find the best method for doing the work and establishstandard time for a given method
5. Able to apply various quality control techniques and sampling plans, job evaluation andnetwork analysis.

Text Book(s):

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers.

Reference Books:

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia.

22EEC801	Project Work – Phase II	L	T	P	C
		0	0	20	10

Pre-requisite **Syllabus Version** V 0.1

Course Objectives:

To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PRACTICAL PERIODS **300 Periods**

Expected Course Outcome:

On Completion of the project work students will be in a position to take up any challengingpractical problems and find solution by formulating proper methodology.

22PAG01	STORAGE AND PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

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.
4. To study the how to make canning about storage and packaging process.

UNIT I STORAGE ENVIRONMENT AND STORAGE STRUCTURES 9

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 II INTRODUCTION TO PACKAGING 9

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 III CONTROLLED ATMOSPHERE STORAGE AND MODIFIED ATMOSPHERE PACKAGING 9

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 IV CANNING 9

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

UNIT V FLEXIBLE FILMS PACKAGING 9

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 PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storage structures

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

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. Food Packaging Technology, Hand book, 2004. NIIR Board, New Delhi.
3. Pandey, P.H.2002. Post harvest engineering of horticultural crops through objectives. Saroj Prakasam. Allahabad.

Reference Books:

1. Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall, 1992
2. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman), Oxford, UK,1994
3. Ruth H. Matthews: Pulses Ã¢?? Chemistry, Technology and Nutrition Mercel Dekker Inc., USA,1989
4. Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
5. Donald Downing, Complete Course in Canning (3 Volumes) CTI Publications Inc, USA, 1996

Web Links:

1. (PDF) Food packaging (researchgate.net)
2. (PDF) Food Packaging and Storage (researchgate.net)
3. First-Final.pmd (icpe.in)

22PAG02	PROCESS ENGINEERING OF FRUITS AND VEGETABLES	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the basics of Post Harvest Technology of fruits and vegetables through their structure and composition
2. To study the different methods of processing and preservation of fruits and vegetables including drying and dehydration
3. To learn the latest methods of storage of fruits and vegetables
4. To study the cleaning grading and on farm processing.

UNIT I STRUCTURE, COMPOSITION, RIPENING AND SPOILAGE 9

Importance of post harvest technology of horticultural crops – post harvest losses – factors causing losses - structure, cellular components, composition and nutritive value of horticultural crops – fruit ripening – mechanism and equipment - spoilage of perishable commodities – mechanism and factors causing spoilage.

UNIT II CLEANING, GRADING AND ON-FARM PROCESSING 9

Harvesting and washing of fruits and vegetables – cleaning and grading – fruits and vegetables - peeling - equipments – construction and working – pre-cooling – importance, methods, pretreatments and advantages.

UNIT III CONJUNCTIVE USE OF SURFACE AND GROUNDWATER 9

Thermal and non-thermal techniques of preservation of fruits and vegetables and their products - methods - minimal processing of horticultural commodities – fruits and vegetables, advantages - quick freezing preservation - commercial canning of fruits, vegetables and other perishable commodities – processing and concentration of juice - membrane separation process and application - hurdle technology of preservation and techniques.

UNIT IV DRYING AND DEHYDRATION 9

Dehydration of fruits and vegetables – types of dryers, construction and working - methods – fluidized bed dryer, freeze drying, osmotic dehydration and foam mat drying – principles, construction, operation and applications - quality parameters and advantages.

UNIT V STORAGE 9

Storage of fruits and vegetables – storage under ambient conditions, low temperature storage, evaporative cooling – cold storage of horticultural commodities – estimation of cooling load - controlled atmosphere storage – concept and methods –modified atmosphere packaging – gas composition, quality of storage – waxing of fruits – types of wax, equipment and advantages.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome :After completion of the course

1. At the end of this course, the student will be thorough in various methods of processing,
2. the students knowledge how to preservation and storage of fruits and vegetables using latest technologies.
3. To understand the Drying And Dehydration about the fruit and vegetables.
4. The students will be go through the Cleaning, Grading And On-Farm Processing
5. Students know about the Structure, Composition, Ripening And Spoilage

Text Book(s):

1. Fellows. P. 2000. Food Processing Technology – Principles and Practice, second edition, CRC Press, Woodland Publishing Limited, Cambridge, England.
2. Sudheer K. P. and V. Indra.2007. Post harvest Technology of Horticultural Crops. New India Publishing Company, New Delhi.
3. L.R.Verma and V.K.Joshi. 2000. Post Harvest Technology of Fruits and Vegetables – handling, Processing, Fermentation and waste management. Indus Publishing company, New Delhi.

Reference Books:

1. Heid,J.L. and M.A.Joslyn. 1983. Food processing operations. Vol. II. AVI Publishing Co. Inc. Westport, Connecticut.
2. Potter, N.N.1976. Food science. AVI Publishing Co. Inc.Westport, Connecticut, 2nd edition.
3. Sivetz Michael and N.W.Desrosier. 1979. Coffee Technology. AVI Publishing Co. Inc, Westport, Connecticut.
4. Frank.H.Slade. 1967. Food Processing Plant. Volume 1. Leonard Hill Books. London.
5. SudhirGupta.Cold storage unit. Atif printers, LalKuan, Delhi.
6. NIIR board. Modern techniques on food preservation. Asia pacific business press inc. Delhi
7. Humberto vega and Gustavo v Barbosa. 1996. Dehydration of foods. Springer Science, Business Media, Chapman&Hall Publishers, U.K.

Web Links:

1. CPE: Fruits and Vegetables Processing (iasri.res.in)
2. Processed Products from Fruits and Vegetables, Crop Process Engineering | Crop Process Engineering Notes - Agricultural Engg - Agricultural Engineering (edurev.in)
3. UNIT 6 BASIC PRINCIPALS OF COOKING FOOD.pdf (ihmnotes.in)

22PAG03	SEED PROCESSING TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To expose the students to scope and importance of good quality seed production.
2. To acquaint them with the principles and special techniques
3. The students will study about the how to used in the process of production of good quality seed using specific examples.
4. To familiarize them with planning, development and organization of seed programmes.

UNIT I SEED CHARACTERS **9**

Definition and characteristics of seed and how it differs from grain; Propagation of crop plants through true seed and vegetative means; Features of good quality seed; Importance of seed in successful crop production; Floral biology: self and cross pollination; Methods of genetic improvement of crop plants such as selection, hybridization, mutation and polyploidy; Seed legislations promulgated in India from 1966 to date and the purpose of each of these legislations.

UNIT II SEED PRODUCTION AND CERTIFICATION **9**

Multiplication of seed and seed material: systems of seed multiplication, classes of seed, multiplication models, multiplication ratio, field selection, planting ratio, isolation needs and rouging; Harvest and extraction of seed; Methods of hybrid seed production; Genetic deterioration during crop production cycles; Seed certification process: legal basis, pre-requisites for applicability, detailed description of the specific steps of the certification process (with particular emphasis on field inspection).

UNIT III SEED PROCESSING AND TESTING **9**

Components of seed processing in a broader sense; Steps in seed processing in its narrower sense: preliminary cleaning, basic cleaning and grading, and equipment used in each of the steps; Seed treatment; Seed drying; Seed sampling; Seed testing: details of specific tests conducted for different purposes (service, certification and seed law enforcement); Standards prescribed for different crops.

UNIT IV DEVELOPING SEED PROGRAMMES **9**

Types of organizations involved in seed production (public, quasi-governmental, private and cooperative), and their objectives and features; Organizational set up of a seed company; Steps involved in planning and developing a seed programme; Seed marketing activities, and analysis of seed demand and supply; Costing and pricing strategies; Economics of production of different crop seed; Seed packaging; Opportunities for Indian seed companies to have a greater share of world seed market; Visit to seed organizations; Preparing seed projects to obtain credit; Export procedures and formalities; Seed/plant quarantine methods.

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

Principles and special techniques used for seed production in important horticultural crops by selecting representatives of vegetable / flower / fruit / spice / condiment / plantation crops.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome :After completion of the course

1. The students will be able to appreciate the different methods of seed production, processing and testing

2. They will also have the knowledge on different seed programmes
3. The will be understand the seed production in specific crops.
4. The students study about the developing seed programmes
5. They will also have knowledge on seed charcters.

Text Book(s):

1. Singh, S.P., Commercial Vegetable Seed Production, Kalyani Publishers, Chennai, 2001.
2. Agarwal, R.L., Seed Technology, Oxford IBH Publishing Co., New Delhi, 1995.

Reference Books:

1. Subir Sen and Ghosh, N., Seed Science, Kalyani Publishers, Chennai, 1999.
2. Dahiya, B.S., and Rai, K.N., Seed Technology, Kalyani Publishers, Chennai, 1997.
3. George, Raymond, A.T., Vegetable Seed Production, Longman Orient Press, London and New York, 1985.
4. Hand Book of Seedling Evaluation, ISTA, 1979.

Web Links:

1. PRINCIPLES OF SEED TECHNOLOGY :: (GPBR 112) (iasri.res.in)
2. Principles_of_Seed_Technology_Dr_Rudrasen_Singh.pdf (jnkvv.org)
   PRINCIPLES-OF-SEED-TECHNOLOGY.pdf (agrimoon.com)

22PAG04	SUSTAINABLE AGRICULTURE AND FOOD SECURITY	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.
2. To study about the sustainable agriculture & organic farming.
3. To knowledge about the food production and food security
4. Importance of science, food security and ecological balance.

UNIT I LAND RESOURCE AND ITS SUSTAINABILITY **9**

Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation.

UNIT II WATER RESOURCE AND ITS SUSTAINABILITY **9**

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 III SUSTAINABLE AGRICULTURE & ORGANIC FARMING **9**

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 – Natural farming principles – Sustainability in rainfed farming – organic farming – principles and practices.

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

Performance of Major Food Crops over the past decades – trends in food production – Decline in total factor productivity growth – Demand and supply projections – Impact of market force – Rural Land Market – Emerging Water market – Vertical farming - Sustainable food security indicators and index – Indicator of sustainability of food Security – Path to sustainable development.

UNIT V POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY **9**

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 PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storage structures

1. Upon completion of this course, the students will gain knowledge on the need for sustainable agriculture
2. They will be able to comprehend the need for food security on global level and the Nutritional Security.

3. The students will be able to demonstrate how ecological balance is required for sustainability of agriculture.
4. The student will be understanding the food production and food security

Text Book(s):

1. B.K.Desai and Pujari, B.T. Sustainable Agriculture : A vision for future, New India Publishing Agency, New Delhi, 2007.
2. Saroja Raman, Agricultural Sustainability – Principles, Processes and Prospects, CRC Press, 2013

Reference Books:

1. Swarna S.Vepa etal., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999.
3. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
4. M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.

Web Links:

1. (PDF) Sustainable Agriculture for Food Security (researchgate.net)
2. Sustainable Agriculture and Food Security1 - LECTURE NOTES Prof. R. O. Mosi SUSTAINABLE AGRICULTURE - Studocu
3. Sustainable Agriculture - Agriculture Notes (prepp.in)

22PAG05	HEAT AND MASS TRANSFER FOR AGRICULTURAL ENGINEERS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. The course is intended to build up necessary background for heat and mass transfer
2. The understanding of the physical behaviour of the various modes of heat transfer, like, conduction, convection and radiation.
3. To understand the application of various experimental heat transfer correlations in engineering calculations.
4. To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.

UNIT I CONDUCTION **9**

Basic concepts – Mechanism of heat transfer – Conduction, convection and radiation – General differential equation of heat conduction – Fourier law of conduction – Cartesian and cylindrical coordinates – one dimensional steady state heat conduction – Conduction through plane walls, cylinders and spherical systems – Composite systems – Conduction with internal heat generation – Extended surfaces – Unsteady heat conduction – Lumped analysis – Use of Heislers chart.

UNIT II CONVECTION **9**

Basic concepts – Convective heat transfer coefficients – Boundary Layer concept – Types of convection – Forced convection – Dimensional analysis – External flow – Flow over plates, Cylinders and spheres – Internal flow – Laminar and turbulent flow – Combined Laminar and turbulent flow – Flow over bank of tubes – Free convection - Dimensional analysis – Flow over vertical plates, horizontal plate, inclined plate, cylinders and spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **9**

Nusselts theory of condensation – Pool boiling, flow boiling, correlations in boiling and condensation, types of heat exchangers – LMTD method of heat exchanger analysis – Overall heat transfer coefficient – Fouling Factors.

UNIT IV RADIATION **9**

Basic concepts, law of radiation – Stefan Boltsmann law, Kirchoff law – Block body radiation – Grey body radiation shape factor algebra – Electrical analogy – Radiation shields – introduction to gas radiation.

UNIT V MASS TRANSFER **9**

Basic concepts – Diffusion mass transfer – Fick‟ s Law of diffusion – Steady state molecular diffusion – Convective mass transfer – Momentum, heat and mass transfer analogy – Convective mass transfer correlations.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. To study the conduction of heat transfer
2. The students will be knowledge about the Convection of heat and mass transfer
3. To analysing the phase change heat transfer and heat exchangers to laboratory.
4. To study about radiation in to the mass transfer
5. They will be knowledge about the mass transfer.

Text Book(s):

TEXT BOOKS:

1. Sachdeva, R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International, New Delhi, 1995.
2. Yadav, R., "Heat and Mass Transfer", Central Publishing House, New Delhi, 1995.

Reference Books:

1. Ozisik, M.H., "Heat Transfer", McGraw Hill Book Co., New York, 1994.
2. Nag, P.K., "Heat Transfer", Tata McGraw Hill Book Co., New Delhi, 2002.
3. Holman, J.P., Heat and Mass transfer, Tata McGraw Hill Book Co., New York, 2002.
4. Kothandaraman, C.P., "Fundamentals of Engineering Heat and Mass Transfer", New Age International, New Delhi, 1998.
5. Incropera, F. P., and Dewitt, D. P., "Fundamentals of Engineering Heat and Mass Transfer", John Wiley and Sons, New York, 1998.
6. Velraj, R., "Heat & Mass Transfer", Ane Books, New Delhi, 2004.

Web Links:

1. Heat and Mass Transfer (Agricultural Engg) PDF Book - AgriMoon
2. Heat And Mass Transfer (HMT) Dairy Technology PDF Book - AgriMoon
3. (PDF) Lecture Notes in Mass Transfer (researchgate.net)

22PAG06	FARM POWER AND MACHINERY MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the productivity of farm machines, their maintenance processes
2. To understand the evaluation for right selection and management
3. To provide sufficient knowledge of mechanization status in the country
4. To provide the management techniques for future requirements.

Course Content:

UNIT I INTRODUCTION TO FARM POWER AND DESIGN CRITERIA 9

Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems - Reliability criteria in design and its application.

UNIT II MACHINERY MANAGEMENT 9

Maintenance and scheduling of operations. Replacement of old machines, repair and maintenance of agricultural machinery, inventory control of spare parts, work study, productivity, method study. First order Markov chains and their applications in sales forecasting and in problems of inventory control and modeling of workshop processes and quality control.

UNIT III SYSTEM APPROACH 9

System approach in farm machinery management and application of programming techniques to the problems of farm power and machinery selection.

UNIT IV PLANNING OF MACHINERY 9

Time and motion study. Man-machine task system in farm operations, planning of work system in agriculture. Computer application in selection of power units and to optimize mechanization system.

UNIT V ECONOMIC ANALYSIS 9

Energy conservation - performance and power analysis - cost analysis of machinery - fixed cost and variable costs, effect of inflation on cost; selection of optimum machinery and replacement criteria- Break-even analysis, reliability and cash flow problems; mechanization planning

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. The students will be able to understand the concepts of bio energy sources and its applications.
2. To study the farm power and design criteria of the applications.
3. They will be understand the machinery management system approach.
4. The students will know about the planning of machinery.
5. To discuss and study the machine about the economic analyses .

Text Book(s):

1. Bainer, R. Kepner, R.A. and Barger, E.L. 1978. Principles of farm machinery. John Wiley and Sons. New York.

2. Liljedahl, B: Tumquist, PK: Smith, DW; and Hoki, M. 1989. Tractor and its Power Units. Van Nostrand Reinhold.

Reference Books:

1. Culpin, C. 1978. Farm Machinery. Granada Publishing Ltd., London.
2. Kepner, R.A., Bainer, R. and Barger, E.L. 1987. Principles of Farm Machinery. C.S.B. Publishers and distributors, New Delhi.
3. Smith, H.P. and Wilkes, L.H. 1979. Farm Machinery and Equipment. Tata McGraw-Hill Publishing Co. Ltd., New Delhi

Web Links:

1. . Lecture Notes (.pdf) Farm Power & Machinery Ag. Engg.-243 (hillagric.ac.in)
2. Farm Power and Machinery Management PDF Book - AgriMoon
3. Farm Power and Machinery (agrimoon.com)

22PAG07	SOLAR AND WIND ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To impart knowledge on solar energy systems,
2. To study the wind energy systems and its applications.
3. To knowledge about the solar energy radiation and solar thermal collectors.
4. To improving the solar concentrating collectors.

UNIT I SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS 9

Solar radiation availability - radiation measurement – transmittance - absorptance – Basic earth sun angles - estimation of average solar radiation, radiation on tilted surface - Flat plate collectors - heat transfer correlations - collector efficiency - heat balance – absorber plate – types - selective surfaces. Solar water heaters - types- their performance. Solar driers – types – heat transfer - performance of solar dryers – agro industrial applications.

UNIT II SOLAR CONCENTRATING COLLECTORS 9

Concentrating collectors – types – reflectors - solar thermal power stations – principle and applications - Solar energy storage systems – thermal - sensible and latent heat, chemical, electrical, electro-magnetic energy storage – selection of materials for energy storage - Solar distillation – application - Solar stills - types - Solar pond - performance – characteristics - applications – Solar refrigeration.

UNIT III SOLAR PV TECHNOLOGY 9

Solar photovoltaic technology –introduction – solar cell basics – Types of solar cells and modules – encapsulation – Design of solar PV system – load estimation - batteries – invertors – operation - system controls. Standalone and grid connected systems - PV powered water pumping - Hybrid system - Solar technologies in green buildings.

UNIT IV WIND ENERGY 9

Nature of the wind – power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment -wind power laws - velocity and power duration curves - Betz limit - site selection.

UNIT V WIND MILL TYPES AND APPLICATIONS 9

Wind energy conversion devices - classification, characteristics, applications – Design of horizontal axis wind mill rotor diameter - Wind energy storage - wind farms - wheeling and banking - testing and certification procedures. Water pumping- Hybrid systems – Wind mill safety and environmental aspects.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome : The student will be able to understand

1. The concepts of solar and wind energy resources.

2. The applications of solar and wind energy systems.
3. The study the solar concentrating collectors of the system solar pv technology and wind energy.
4. To analysing the
5. To understand about the wind mill types and applications.

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.

Web Links:

1. SOLAR AND WIND ENERGY (18EE731) (azdocuments.in)
2. (PDF) WIND & SOLAR RENEWABLE ENERGY (researchgate.net)

22PAG08	SPECIAL FARM EQUIPMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To study the special machineries used for agricultural applications.
2. To study the mowers and weeding equipment
3. To study the sprayers and dusters & threshers and harvesters
4. They will be know about the improved ploughs, reversible ploughs.

UNIT I MOWERS AND WEEDING EQUIPMENT **9**

Weeding and intercultural equipment. Junior hoe - guntaka - blade harrow - rotary weeders for upland and low land - selection, constructional features and adjustments - Spading machine – coir pith applicators - Mower mechanism – lawn mowers.

UNIT II SPRAYERS AND DUSTERS **9**

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

UNIT III THRESHERS AND HARVESTERS **9**

Construction and adjustments - registration and alignment. Windrowers, reapers, reaper binders and forage harvesters. Diggers for potato, groundnut and other tubers. Sugarcane harvesters - cotton pickers - corn harvesters - fruit crop harvesters – vegetable harvesters.

UNIT IV THRESHERS AND OTHER MACHINERIES **9**

Thresher – construction and working of multi crop thresher. Forest machinery - shrub cutters - tree cutting machines – post hole diggers – Chaff cutter- flail mowers - lawn mowers – tree pruners

UNIT V SPECIALIZED FARM EQUIPMENT **9**

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

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome : The student will be able to understand

1. The students will have a thorough knowledge on special farm equipment required for various agricultural operations.
2. The students analysing mowers and weeding equipment.
3. To understand the sprayers and dusters & threshers and other machineries.
4. To study about the manure spreaders, sweep weeders.

Text Book(s):

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

Reference Books:

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

Web Links:

1. Farm Machinery and Equipment I (Agricultural Engineering) - AgriMoon
2. Farm Power and Machinery- ICAR eCourse PDF Book - AgriMoon
3. Farm Power and Machinery Management PDF | PDF | Agricultural Machinery | Machines (scribd.com)

22PAG09	MECHANICS OF TILLAGE AND TRACTION	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To impart the fundamental knowledge of mechanics and dynamics in various tillage implements
2. To study the tyres, traction and its applications.
3. To study the dynamics of tillage & traction
4. To study about the Tyre size, tyre lug geometry and their effects, tyre testing.

UNIT I MECHANICS OF TILLAGE **9**

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship.

UNIT II DYNAMICSOF TILLAGE **9**

Design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics performance of tillage tools.

UNIT III TRACTION **9**

Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction.

UNIT IV TYRES **9**

Tyre size, tyre lug geometry and their effects, tyre testing

UNIT V APPLICATIONS **9**

Soil compaction and plant growth, variability and geo statistics, application of GIS in soil dynamics.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome :After completion of the course

1. The students will be able to understand the concepts of mechanics.
2. The students will be able to understand dynamics and traction of implements and their applications.
3. They students will knowledge about the machine& traction and tillage.
4. How to apply about tillage in to the field
5. They students can understand about the applications of GIS in soil dynamics

Text Book(s):

1. Klenin, N.L.; Popov, I.F. and V.A. Sakum, (1985). Agricultural machines. Amerind Pub. Co. NewYork 2. J. B. Liljedahl, P. K. Turnquist, D. W. Smith, & M. Hoki , 1996. Tractors and their power units. Fourth ed. American Society of Agricultural Engineers, ASAE

3. Kepner, R. A., Roy Bainer and E. L. Barger. 1978. Principles of farm machinery. Third edition; AVI Publishing Company Inc: Westport, Connecticut.

Reference Books:

1. Ralph Alcock.1986. Tractor Implements System. AVI Publ.

2. S. C. Jain, Farm Machinery- An Approach.

Web Links:

1. Mechanics of Tillage and Traction PDF Book - AgriMoon
2. Mechanics-of-Tillage-and-Traction.pdf (agrimoon.com)
3. Tank irrigation, Mechanics of Tillage and Traction | Mechanics of Tillage and Traction Notes- Agricultural Engg - Agricultural Engineering (edurev.in)

22PAG10	ENERGY AUDITING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To acquaint and equip the students in energy auditing in industries
2. To study house hold sectors for increasing energy efficiency.
3. To study the energy conservation concepts.

Course Content:

UNIT I ENERGY CONSERVATION CONCEPTS 9

Energy – classification – scenario – energy pricing – energy and environment – energy conservation and its importance – energy strategy for the future – energy conservation act and its features.

UNIT II ENERGY AUDITING AND ECONOMICS 9

Objectives of energy management – principles – energy audit strategy - types – detailed energy audit –steps. Energy performance - bench marking – fuel substitutions – energy audit instruments – material and energy balance – energy conversion – energy index – cost index – financial management – financing options.

UNIT III THERMAL ENERGY AUDIT 9

Energy efficiency in thermal utilities – methodology – stoichiometric analysis of combustion in a boiler – performance evaluation – boiler losses - analysis – feed water treatment – energy conservation opportunities in boilers and steam system – furnaces – insulation and refractories – cogeneration – principles of operation - waste heat recovery systems – case study – analysis

UNIT IV ELECTRICAL ENERGY AUDIT-I 9

Electrical systems – introduction – electricity billing – load management – power factor – improvements and benefits – transformers – distribution losses – analysis – energy audit in electrical utilities methodology – energy conservation opportunities in motors – efficiency – energy efficient motors – motor losses – analysis – energy efficiency in compressed air system

UNIT V ELECTRICAL ENERGY AUDIT - II 9

HVAC and refrigeration system – fans and blowers – fan performance – pumps - lighting system - energy auditing and reporting in industries – replacement of renewable energy technology option – case study in agro-industries

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. The students will acquire the knowledge on fundamentals of economic operation of an
2. The students will be understanding electrical system and understand the basic principles
3. They understand about the energy auditing, types and objectives, instruments used.
4. To study about the electrical energy audit I&II.
5. To understand about the energy conservation auditing and economics.

Text Book(s):

1. Guide books for National Certification Examination for Energy Managers and Energy Auditors, Book 1, 2, 3 & 4. Bureau Energy Efficiency, New Delhi. 2005.
2. Murphy, W.R. and McKay, G. Energy Management. Butterworth & Co., Publishers Ltd., London. 1982.
3. Craig B. Smith. Energy Management Principles, Applications, benefits & savings. Pergamon Press Inc. 1981.
4. Murgai, M.P. and Ram Chandra. Progress in Energy Auditing and Conservation - Boiler Operations, Wiley Eastern Ltd. 1990.

Reference Books:

1. Victor B.Ottaviano,Energy Management. An OTIS Publication. Ottaviano Technical Service Inc. 150. Broad Hollow Road, Melville, New York. 11747.
2. Richard Porter and Tim Roberts, 1985. Energy saving by Waste recycling. Elsevier applied science publishers.
3. Energy Management - Bi-monthly journal published by National Productivity Council, New Delhi

Web Links:

1. iare_EAM_lecture notes.pdf
2. (PDF) Energy Audit & Management (researchgate.net)
3. Energy Conservation & Audit Unit 1 to 5.pdf - ECA - Notes - Teachmint.

22PAG11	GROUNDWATER AND WELL ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To acquaint and equip the students with the techniques of groundwater development and management
2. To study about the ground water occurrence.
3. To understand about the well construction& groundwater pollution.
4. To estimate about the groundwater development policies.

Course Content:

UNIT I GROUND WATER OCCURRENCE **9**

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

UNIT II WELL CONSTRUCTION **9**

Groundwater structures, groundwater development and utilization, types of water wells, design and construction of water wells, drilling methods, well development, well maintenance and rehabilitation, groundwater monitoring, monitoring wells, design and construction of monitoring wells.

UNIT III GROUNDWATER POLLUTION **9**

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

UNIT IV GROUNDWATER MANAGEMENT **9**

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

UNIT V GROUNDWATER DEVELOPMENT POLICIES **9**

Major issues related to groundwater development and management in India, Legal aspects of groundwater exploitation, Diagnostic survey of sick wells/tube wells and their rehabilitation.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

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

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.
3 Michael, A.M. and Khepar, S.D. 1989. Water Well and Pump Engineering. Tata-mcgraw Hill Publ. Co. New Delhi.

Reference Books:

1 Giordano, M. and Villholth, K.G. 2007. The Agricultural Groundwater Revolution Volume 3.
2 CABI Head Office, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE, UK Ghosh, N.C. and Sharma, K.D. 2006. Groundwater Modelling and Management.
3 Madan Kumar Jha and Stefan Peiffer Applications of Remote Sensing and GIS Technologies in Groundwater Hydrology: Past, Present and Future.

1.

Web Links:

1. Lecture Notes | Groundwater Hydrology | Civil and Environmental Engineering | MIT OpenCourseWare
2. Groundwater, Wells and Pumps PDF Book ICAR eCourse - AgriMoon
3. CE29CE 603Lecture Notes - Unit II- Groundwater and Well hydraulics.pdf - Course CE 603: Water Resources Engineering - II Unit II: Ground Water and Well | Course Hero.

22PAG12	WATERSHED MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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

UNIT I INTRODUCTION **9**

Watershed – Definition - concept - Objectives – Land capability classification - priority watersheds - land resource regions in India.

UNIT II WATERSHED PLANNING **9**

Planning principles – collection of data – present land use - Preparation of watershed development plan - Estimation of costs and benefits - Financial plan – selection of implementation agency - Monitoring and evaluation system.

UNIT III WATERSHED MANAGEMENT **9**

Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands

UNIT IV WATER CONSERVATION PRACTICES **9**

In-situ & Ex-situ moisture conservation principle and practices - Afforestation principle - Micro catchment water harvesting - Ground water recharge – percolation ponds -Water harvesting - Farm pond - Supplemental irrigation - Evaporation suppression - Seepage reduction.

UNIT V WATERSHED DEVELOPMENT PROGRAMME **9**

River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storage structures

1. The students will have a thorough knowledge on watershed planning,
2. The students will have to development and management strategies through different soil and water conservation approaches.
3. To study the watershed planning and management.
4. To understand the water conservation practises.

5. To study about the watershed development programme.

Text Book(s):

1. Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.
2. Ghanashyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall of India Private Limited, New Delhi, 2000.

Reference Books:

1. Gurmel Singh et al. 2004. Manual of soil and water conservation practices. Oxford & IBH publishing Co. New Delhi.
2. Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi.
3. Tripathi R.P. and H.P.Singh 2002, Soil erosion and conservation, Willey Eastern Ltd., New Delhi
4. Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi.
5. Tideman, E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.

Web Links:

1. 35_2010_CPE167_Bestbet_options.pdf (icrisat.org).
2. Watershed Management - ClearIAS.
3. Watershed Planning and Management PDF Book Notes Free - AgriMoon.

22PAG13	LANDSCAPE ARCHITECTURE	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the paradigms in landscape architecture in the post-industrial revolution era.
2. To understand the multifaceted dimensions of landscape architecture such as ecology, environment and sustainability.
3. To study the contemporary landscape and the manifestation in the western and Indian contexts.

UNIT I BASICS OF LANDSCAPE ARCHITECTURE 9

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 II LANDSCAPE FORMULATIONS 9

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 III SITE MOBILIZATION 9

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 IV ILLUMINATION 9

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 V IRRIGATION FEATURES 9

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 PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

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.

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.

Web Links:

1. Fundamentals of Landscape Architecture (huduser.gov)
2. Landscape Architecture (PDF) (pdfroom.com)
3. Landscape Architecture | PDF | Landscape Architecture | Gardening (scribd.com)

22PAG14	ON FARM WATER MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the fundamentals of minor irrigation, its types, operation and maintenance and people's participation
2. Command Area Development, On farm structures, policy, operation and maintenance
3. To study about the conjunctive use of surface and groundwater
4. To understand the water balance and their properties.

UNIT I DESIGN OF IRRIGATION CHANNELS **9**

Design of Erodible and Non-Erodible, Alluvial channels- Kennedy‟s and Lacey‟s Theories - Materials for Lining watercourses and field channel - Water control and Diversion structure - Design - Land grading - Land Leveling methods.

UNIT II COMMAND AREA **9**

Command area - Concept – CADA Programmes in Tamil Nadu - Duty of water - expression - relationship between duty and delta - Warabandhi - water distribution and Rotational Irrigation System – case studies.

UNIT III CONJUNCTIVE USE OF SURFACE AND GROUNDWATER **9**

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

UNIT IV WATER BALANCE **9**

Groundwater balance model – Weekly water balance - Performance indicators – Adequacy, Dependability, Equity and efficiency – conjunctive use plan by optimization – Agricultural productivity indicators – Water use efficiency.

UNIT V SPECIAL TOPICS **9**

National water policy - Institutional aspects - Socio-economic perspective- Reclamation of salt affected soils- Seepage loss in command area- Irrigation conflicts- Water productivity – Water pricing.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome :After completion of the course

1. The students will have a clear understanding of various practices of water management on farm.
2. The students will understand about the design of irrigation channels.
3. To study about the commend area and their properties.
4. The students understanding conjunctive use of surface and groundwater.

Text Book(s):

1. Michael, A.M. Irrigation Theory and practice, Vikas publishing house, New Delhi, 2006.

Reference Books:

1. Keller, .J. and Bliesner D.Ron, 2001 Sprinkler and Trickle irrigation, An ari book, Published by Van No strand Rein hold New York.
2. Israelson, 2002, Irrigation principles and practices, John Wiley & sons, New York.
3. Modi, P.N., 2002. Irrigation and water resources and water power engineering, Standard Book House, New Delhi.
4. Michael, A.M. and Ojha, T.P. 2002. Principles of Agricultural Engineering Vol II Jain Brothers, New Delhi.
5. Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi.

Web Links:

1. Agricultural Water Management: Meeting the Challenge - Country Impacts (iaea.org)
2. **https://www.ssi-km.online/wp-content/uploads/2020/05/3.-OFWM-Manual.pdf**

22PAG15	PROTECTED CULTIVATION	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To impact knowledge on the protected cultivation of vegetables, fruits and flower crops.
2. To sensitize the students on hi-tech production technology of fruits, vegetables and flower crops.
3. To study about the precision farming techniques.
4. To impact on the course about precision farming of horticultural crops.

UNIT I PROTECTED CULTIVATION AND ITS TYPES 9

Importance and methods of protected culture in horticultural crops - Importance and scope of protected cultivation – different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house - study of environmental factors influencing green house production – cladding / glazing / covering material – ventilation systems – cultivation systems including nutrient film technique / hydroponics / aeroponic culture – growing media and nutrients – canopy management – micro irrigation and fertigation systems.

UNIT II PROTECTED CULTIVATION OF VEGETABLE CROPS 9

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

UNIT III PROTECTED CULTIVATION OF FLOWER CROPS 9

Protected cultivation technology for flower crops - Hi-tech protected cultivation of cut roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut foliages and fillers – integrated pest and disease management – postharvest handling.

UNIT IV PRECISION FARMING TECHNIQUES 9

Concept and introduction of precision farming – Importance, definition, principles and concepts – Role of GIS and GPS - Mobile mapping system and its application in precision farming – design, layout and installation of drip and fertigation – georeferencing and photometric correction – Sensors for information gathering – UAV - geostatistics – robotics in horticulture - postharvest process management (PPM) – remote sensing.

UNIT V PRECISION FARMING OF HORTICULTURAL CROPS 9

Precision farming techniques for horticultural crops - Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome :After completion of the course

1. The students will be able to appreciate the different methods of protected cultivation practices available for vegetable crops and flowers
2. To understand about the protected & precision farming techniques.
3. To study the precision farming of horticultural crops.

4. A clear understanding of precision farming techniques and its application to horticultural crops is possible

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

Web Links:

1. (PDF) Protected cultivation- importance, scope, and status (researchgate.net)
2. Protected-Cultivation-Post-Harvest-Technology.pdf (agrimoon.com)
3. (PDF) PROTECTED CULTIVATION OF ORNAMENTALS (researchgate.net)

22PAG16	Agricultural Waste Management	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To impart knowledge to students on various methods of agricultural waste management foreco-friendly energy and manure production.

Course Content:

UNIT I INTRODUCTION **7**

Availability of different types of agriculture wastes - its overall characteristics – classification of agro wastes based on their characteristics- its recycling and utilization potential- current constraints in collection and handling of agricultural wastes – its environmental impact

UNIT II COMPOSTING **10**

Definition- Solid waste suitable for composting – Methods of composting - vermicomposting - Mineralization process in composting - Biochemistry of composting – Factors involved – Infrastructure required – maturity parameters – value addition – application methods

UNIT III BIOMASS BRIQUETTING **9**

Definition – potential agro residues and their characteristics for briquetting – fundamental aspects and technologies involved in briquetting – economic analysis of briquetting – setting up ofbriquetting plant- appliances for biomass briquettes

UNIT IV BIOCHAR PRODUCTION **9**

Definition - characteristics of agro wastes suitable for Biochar production – Methods of Biocharproduction – fast and slow pyrolysis – characteristics of Biochar – role of Biochar in soil nutritionand carbon sequestration

UNIT V BIOGAS AND BIO ETHANOL PRODUCTION **10**

Screening of suitable lingo cellulosic substrate for biogas production -determination of bio-energy potential of agro-waste by estimating total solids - volatile solids - Calorific value- per cent totalcarbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion — types of digesters — factors affecting - nutrient value and utilization of biogas slurry. Ethanol production from lingo cellulosic wastes - Processing of Biomass to Ethanol –pre-treatment-fermentation-distillation.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1. The students shall be able to understand the Concept of Agricultural waste management
2. The students will be able to understand the Concept of composting
3. The students shall be able to understand the Concept of Biomass Briquetting
4. The students shall be able to understand the Concept of Bio char Production
5. The students shall be able to understand the Concept of Biogas and Bio Ethanol Production

Text Book(s):

1. Raymond C Loehr, "Agricultural Waste Management problems, processes and approaches". First edition, Academic press, 1974.
2. Diaz,l.F.,M. de Bertoldi and W. Bidlingmaier. 2007. Compost science and technology, Elsevier pub., PP.1-380.
3. Uta Krogmann, Ina Körne and Luis F. Diaz.2010. Solid waste technology and management(Vol 1 and2). Blackwel Pub Ltd., Wiley Online library.
4. Yong Sik Ok, Sophie M. Uchimiya, Scott X. Chang, Nanthi Bolan.," Biochar-productioncharacterization and applications". 2015. CRC press

Reference Books:

1. P.D. Grover & S.K. Mishra, "Biomass Briquetting: Technology and Practices". Published by FAO Regional Wood Energy Development Programme in Asia, Bangkok, Thailand, 1996.
2. Magdalena Muradin and Zenon Foltynowicz, **"**Potential for Producing Biogas from Agricultural Waste in Rural Plants in Poland". *Sustainability*, 2014, *6*, 5065-5074.
3. Biochar production from agricultural wastes via low-temperature microwave carbonization
4. Qian Kang, Lise Appels, Tianwei Tan and Raf Dewil, "Bioethanol from Lignocellulosic Biomass: Current Findings Determine Research Priorities" *The Scientific World Journal*, 2014, Article ID 298153, 13 pages

Web Links:

1. **https://icar.org.in/sites/default/files/Creating-Wealth-From-Agricultural-Waste.pdf**
2. **https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=31493.wba**
3. **https://agrimoon.com/waste-and-by-product-utilization-pdf-book/**

22PAG17	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

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 Content:

UNIT I PRECIPITATION AND ABSTRACTIONS 9

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 II RUNOFF 9

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

UNIT III HYDROLOGICAL EXTREMES 9

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 IV RESERVOIRS 9

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

UNIT V GROUNDWATER AND MANAGEMENT 9

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

TOTAL LECTURE PERIODS 45 Periods

Expected 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

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 InternationalBook 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.

Web Links:

1. https://www.jbiet.edu.in/pdffls/CIVIL-Coursematerial/HWRE.pdf
2. https://www.iare.ac.in/sites/default/files/WRE%20%20Course%20resources.pdf
3. https://www.iitg.ac.in/rkbc/CE311/L%201%20Introduction.pdf

22PAG18	Design of Micro-irrigation system	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

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 Content:

UNIT I MICRO IRRIGATION CONCEPT AND APPLICATIONS 9

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 II DRIP IRRIGATION DESIGN 9

Drip irrigation - Components- Dripper- types and equations governing flow through drippers- Wetting pattern- Chemigation application- Pump capacity -Installation- Operation and maintenance of Drip irrigation system. - Design of surface and sub-surface drip irrigation.

UNIT III SPRINKLER IRRIGATION DESIGN 9

Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance- Sprinkler discharge- Water distribution pattern- Droplet size, filtering unit, fertigation - System maintenance

UNIT IV ECONOMIC ANALYSIS 9

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 V AUTOMATION IN MICRO IRRIGATION 9

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 PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1 Categorize the different types of pumps and water lifting devices based on the principle, components, and working efficiency

CO2 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.

CO3 Estimate water budgets and hydraulics used to develop irrigation schedules through micro irrigation based on crop geometry

CO4 Design drip and sprinkler irrigation system including, main line, sub main and laterals designs by consider pump capacity

CO5 Design greenhouse irrigation system and advanced types of irrigation including lift irrigation and automation

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.
4. Keller.J and D. Karmeli, "Trickle Irrigation Design", Rainbird sprinkler Irrigation anufacturing Corporation, Glendora, California, USA.

Web Links:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=546
2. https://agrimoon.com/micro-irrigation-systems-design-pdf-book/
3. https://ncert.nic.in/vocational/pdf/kvmt101.pdf

22PAG19	Waste and by product utilization	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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

Course Content:

UNIT I INTRODUCTION TO WASTE WATER TREATMENT 9

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 II CHEMICAL PROPERTIES 9

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 III BY-PRODUCTS UTILIZATION 9

Waste utilization in various industries, furnaces and boilers run on agricultural wastes and by-products, 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 IV PROCESSING TECHNIQUES 9

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 V ADVANCED WASTE WATER TREATMENT PROCESSES 9

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 PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1 Types of waste and influences
CO2 Waste water management from any food industry.
CO3 By product utilization from processing plants of cereals, pulses
CO4 Hands on training in wastewater treatment process
CO5 Advance procession techniques for waste water treatment

Text Book(s):

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

NewYork.

Reference Books:

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

Web Links:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=126248
2. https://agrimoon.com/waste-and-by-product-utilization-pdf-book/
3. https://www.science.gov/topicpages/w/waste+product+utilization
4. https://icar.gov.in/content/waste-and-product-utilization

22PAG20	**Micro Irrigation**	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To expose the students to the fundamental knowledge in Pumps for Irrigation use
2. To introduce the concept of micro-irrigation and design a Sprinkler & Drip irrigation system

Course Content:

UNIT I WATER LIFTS AND PUMPS 8

Pump classification Variable displacement pumps–Centrifugal pump- Submersible pump-Vertical Turbine pumps mixed flow – Jet and Airlift pumps-Pump selection and installation- Pump troubles and Remedies.

UNIT II PUMP VALVES 7

Types of valves- Pressure relief valve- Gate valve-Isolated valve- Non return valve- Butterfly valve-Solenoid valves- Automated control valve- selection, repair and maintenance

UNIT III MICRO IRRIGATION CONCEPT AND APPLICATIONS 10

Micro irrigation- Comparison between Traditional and Micro irrigation methods -Merits and demerits of micro-irrigation system, Types and components of micro irrigation system- Scope and potential problem of micro irrigation - Low cost Micro irrigation Technologies- Gravity fed micro irrigation -Care and maintenance of micro-irrigation System- Economics of micro-irrigation system - Automation in micro-irrigation-Surge and cablegation irrigation- Greenhouse irrigation system.

UNIT IV DRIP IRRIGATION DESIGN 10

Drip irrigation - Components- Dripper- types and equations governing flow through drippers-Wetting pattern- Chemigation application- Pump capacity-Installation- Operation and maintenance of Drip irrigation system. - Design of surface and sub-surface drip irrigation.

UNIT V SPRINKLER IRRIGATION DESIGN 10

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

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1 Categorize the different types of pumps and water lifting devices based on the principle, components, and working efficiency

CO2 Explain the working principle of centrifugal pump as well as its characteristics with efficiencies and design the centrifugal pump including impeller design

CO3 Estimate water budgets and hydraulics used to develop irrigation schedules through micro irrigation based on crop geometry

CO4 Design drip and sprinkler irrigation system including, main line, sub main and laterals designs by consider pump capacity

CO5 Design greenhouse irrigation system and advanced types of irrigation including lift irrigation and automation

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, NewDelhi, 1991.
2. Jack Keller and Rond Belisher., “Sprinkler and Trickle Irrigation”, Vannistr and Reinhold,New York, 1990.
3. Sivanappan R.K., “Sprinkler Irrigation”, Oxford and IBH Publishing Co., New Delhi, 1987.
4. Keller.J and D. Karmeli, “Trickle Irrigation Design”, Rainbird Sprinkler IrrigationManufacturing Corporation, Glendora, California, USA.

Web Links:

1. https://agritech.tnau.ac.in/agriculture/agri_irrigationmgt_microirrigation.html
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=124906
3. https://agrimoon.com/micro-irrigation-systems-design-pdf-book/

22PAG21	**IT in Agricultural System**	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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

Course Content:

UNIT I PRECISION FARMING **9**

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS **9**

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 III AGRICULTURAL SYSTEMS MANAGEMENT **9**

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 IV WEATHER PREDICTION MODELS **9**

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 V E-GOVERNANCE IN AGRICULTURAL SYSTEMS **9**

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 PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1 The students shall be able to understand the applications of IT in remote sensing applications such as Drones etc.

CO2 The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages.

CO3 The students will be able to apply IT principles and concepts for management of field operations.

CO4 The students will get an understanding about weather models, their inputs and applications.

CO5 The students will get an understanding of how IT can be used for e-governance in agriculture.

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, EnvironmentalControl and Farm Management in Protected Cultivation”, 1989.

Reference Books:

1. Peart, R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, NewYork, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., “Applications of Seasonal Climate”, Springer,Germany, 2000.

Web Links:

1. **https://egyankosh.ac.in/bitstream/123456789/59847/1/Information%20And%20Communication%20Technology%20%28Ict%29%20And%20Agriculture.pdf**
2. **http://agropedialabs.iitk.ac.in/openaccess/sites/default/files/WS%2014.pdf**
3. **https://agritech.tnau.ac.in/pdf/Strengthening%20ICT.pdf**

22PAG22	**Automation in Irrigation**	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To expose the students to the concept of Irrigation Automation
2. To introduce the concepts of Automatic Systems and IoT applications
3. To train the students to explore and use new technologies in Irrigation

Course Content:

UNIT I INTRODUCTION TO AUTOMATION 9

Automatic Irrigation – Traditional methods of Irrigation – Need for Automation – Comparison between Traditional and Automated Irrigation – Advantages – Disadvantages – Economic Impacts of Automation on Agricultural Firms – Future of Automation.

UNIT II SYSTEMS OF AUTOMATION 7

Automated Irrigation – Pneumatic System – Portable timer system – Timer/Sensor Hybrid/SCADA-Methods of automating Irrigation layout – Machine Learning in Tank Monitoring System.

UNIT III IoT IN IRRIGATION 10

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

UNIT IV SURFACE AND MICRO-IRRIGATION AUTOMATION 11

Automation and control in Surface Irrigation Systems – Equipments – benefits – barriers – Automation Design in Bay, Basin and Furrow Irrigation – Automation in Micro Irrigation – Systemsof Automation and its components – Design – Cost – Operation and maintenance.

UNIT V ASSESSMENT OF PARAMETERS IN IRRIGATION 8

Crop water estimate using Satellite data – Automation of Lysimeter for PET Measurements and Energy based Remote Sensing model – Remote Monitoring design of Automatic Irrigation system

- Cost and Benefits of Automation.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

Student will understand the technologies available for automation

Students can design conventional methods as automated system to be more efficient

Text Book(s):

1. H.R.Haise, E.G.Kruse. et al., 1981. "Automation of Surface Irrigation: 15 years of USDA Research and Development at Fort Collins, Colorado"

Reference Books:

1. Brian Wahlin and Darell Zimbelman, Canal Automation for Irrigation Systems, AmericanSociety of Civil Engineers, 2014
2. Darell D.Zimbelman, Planning, Operation, Rehabilitation and Automation of Irrigation waterdelivery system, American Society of Agricultural Engineers,1987

Web Links:

1. **https://nahep.icar.gov.in/API/Content/Uploads/6d712ac0-dc26-475c-91b6-571a44fd2393/6d712ac0-dc26-475c-91b6-571a44fd2393brochure.pdf**
2. **http://ecoursesonline.iasri.res.in/course/view.php?id=546**

22PAG23	AGRICULTURAL ECONOMICS AND FARM MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To impart the fundamental knowledge and basic concepts of Economics and Farm Management
2. To understand the types of resources and Investment analysis in agriculture sector
3. Farm financial analysis, Investment and Budgeting for farms

Course Content:

UNIT I FARM MANAGEMENT **9**

Agricultural Economics – definition and scope – Farm Management – definition – scope- Classification of farms – Basic concepts in farm management - Relationship between farm management and other basic sciences - Farm layout – Farm records and accounts – Farm appraisal techniques – Valuation .

UNIT II LAWS OF ECONOMICS **9**

Basic laws of economics – demand and supply concepts – law of increasing, diminishing andconstant returns – Equi-marginal returns - Product relationship – Production function – definitionand types – Production function curves – Optimum level of input use – Economies of scale external and internal economies and diseconomies - Cost concepts – types - Opportunity cost – comparison of costs – Factor relationship – concepts.

UNIT III COST CURVES **9**

Principle of substitution – isoquant, isocline, expansion path, ridge line and least cost combinationof inputs-Product-product relationship – Production possibility curve, isorevenue line and optimum combination of outputs – Cost curves –Optimum input and output levels – Factor –factor relationship – Least cost combination of inputs – Estimation of cost of cultivation and cost of production of crops - annual and perennial crops – Preparation of interview schedule and farm visit for data collection.

UNIT IV MANAGEMENT OF RESOURCES **9**

Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks inproduction process – Management of resources – types of resources- land, labour, capital and measurement of their efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis – Investment analysis – Discounting techniques

UNIT V FARM MANAGEMENT AND FINANCIAL ANALYSIS **9**

Farm management- need and analysis – Farm financial analysis – Balance sheet – Income statement – Cash flow analysis – Farm investment analysis – Time comparison principles – Farmplanning – Elements of farm planning – Whole farm planning and partial planning – Farm level management system – Farm budgeting – whole farm budgeting and partial budgeting – Estimationof credit - examples of farm planning and budgeting.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. The students shall be able to understand the Farm Management
2. The students will be able to apply the Law of Economics
3. The students shall be able to understand the Cost Curve
4. The students shall be able to understand the Management of Resources
5. The students shall be able to apply the Financial Analysis of Farm Management

Text Book(s):

1. Johl, S.S., and Kapur, T.R.,Fundamentals of Farm Business Management", Kalyani publishers, Ludhiana, 2007.
2. Subba Reddy, S., Raghu Ram, P., Neelakanta Sastry T.V and Bhavani
3. Devi, I., "Agricultural Economics"Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

Reference Books:

1. Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd.,New Delhi, 2002.
2. Subba Reddy, S., and Raghu Ram, P. „ "Agricultural Finance and Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
3. Sankhayan, P.L. „"Introduction to Farm Management", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001
4. Muniraj, R., "Farm Finance for Development", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2000.

Web Links:

1. **http://hillagric.ac.in/edu/coa/agriecoextedursocio/lectures/AgEcon122FSM.pdf**
2. **https://agrimoon.com/wp-content/uploads/Production-Economics-Farm-Management.pdf**
3. **https://www.fao.org/3/w7365e/w7365e05.htm**

22PAG24	AGRICULTURAL EXTENSION	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To expose the students to different extension methods for communication to take the workfrom lab to field

Course Content:

UNIT I COMMUNICATION AND PROGRAMME PLANNING 9

Communication – meaning – definition – models – elements and their characteristics – types andbarriers in communication. Programme planning – meaning, definition, principles, steps in programme development process, monitoring and evaluation of extension programmes

UNIT II EXTENSION TEACHING METHODS 9

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

UNIT III MODERN COMMUNICATION GADGETS 9

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

UNIT IV DIFFUSION AND ADOPTION 9

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

UNIT V CAPACITY BUILDING 9

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

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. The students shall be able to understand the Communication and Programme Planning
2. The students will be able to apply the Extension Teaching methods
3. The students shall be able to understand the Modern communication Cadgets
4. The students shall be able to understand the Diffusion and Adoption
5. The students shall be able to understand the Capacity Building

Text Book(s):

1. Ray, G.L., 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
2. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. pvt. Ltd,New Delhi

Reference Books:

1. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, Newyork
2. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBHPublishing Co. Pvt. Ltd, New Delhi.

Web Links:

1. **http://ecoursesonline.iasri.res.in/Courses/Extension%20Methodologies%20for%20Transfer%20of%20ag.%20Tech/Data%20Files/pdf.html**
2. **https://agrimoon.com/wp-content/uploads/Dimensions-of-Agriculture-Extension.pdf**
3. **https://www.nabard.org/demo/auth/writereaddata/File/OC%2029.pdf**

22PAG25	System Analysis and Soft Computing in Agricultural Engineering	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To introduce the students to the application of systems concept to agricultural engineeringproblems, planning and management.
2. Soft computing techniques for modeling different problems in the field agricultural engineering

Course Content:

UNIT I SYSTEM CONCEPTS **9**

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

UNIT II LINEAR PROGRAMMING & DYNAMIC PROGRAMMING **9**

Introduction to operations research – Linear programming, problem formulation, graphical solution, solution by simplex method — Sensitivity analysis — application - Bellman`` s optimality criteria problem formulation and solutions – application.

UNIT III SIMULATION **9**

Basic principles and concepts – Random variate and random process – Monte Carlo techniques – Model development – Inputs and outputs – Deterministic and stochastic simulation – Irrigation Scheduling - application.

UNIT IV NEURAL NETWORKS **9**

Neuron, Nerve structure and synapse, Artificial Neuron and its model, Neural network architecture: networks, Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory- Architecture: model, solution, single layer and multilayer perception model; back propagation learning methods, applications

UNIT V FUZZY LOGIC AND GENETIC ALGORITHM **9**

Basic concepts of fuzzy logic, Fuzzy set theory and operations, Properties of fuzzy sets, Membership functions, interference in fuzzy logic, Fuzzy implications and Fuzzy algorithms, Fuzzy Controller, Industrial applications.Genetic Algorithm (GA) - Basic concepts, working principle, procedures, flow chart, Genetic representations, encoding, Initialization and selection, Genetic operators, Mutation - applications

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

CO1 Understand practical knowledge on specialized in different water resources and irrigationsystem.
CO2 Apply the Linear programming for crop planning and scheduling .
CO3 Apply the Dynamic Programming for reservoir release for irrigation management.
CO4 Design a reservoir irrigation system simulation model for efficient water management
CO5 To evaluate the application of optimization techniques used to address the socio-technicalaspects irrigation water management.

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. Robert M Peart and W David Shoup, Agricultural Systems Management – Optimizingefficiency and performance, CRC Press, 2013.
3. 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 McGrawHill, 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.
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
5. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.

Web Links:

1. **https://www.ars.usda.gov/ARSUserFiles/60663500/Publications/Huang/Huangetal09CEA71-107-127.pdf**
2. **https://www.vssut.ac.in/lecture_notes/lecture1423723637.pdf**
3. **https://www.ddegjust.ac.in/studymaterial/pgdca/ms-04.pdf**

22OAG02	Chemistry in Food Industry	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. understand and analyse the energy data of industries
2. carryout energy accounting and balancing
3. conduct energy audit and suggest methodologies for energy savings and
4. utilise the available resources in optimal ways

Course Content:

UNIT I INTRODUCTION **9**

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 II ELECTRICAL SYSTEMS **9**

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 III THERMAL SYSTEMS **9**

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 IV ENERGY CONSERVATION IN MAJOR UTILITIES **9**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets

UNIT V ECONOMICS **9**

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

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.

6. Practical and theoretical knowledge burner design.

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.

Reference Books:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987

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3. https://www.vlab.co.in/
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5. https://demonstrations.wolfram.com/topics.php?EngineeringTechnology#7

22OAG03	Climate Change and Adaptation	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

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 Content:

UNIT I EARTHS CLIMATE SYSTEM 9

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 II ATMOSPHERE AND ITS COMPONENTS 9

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

UNIT III IMPACTS OF CLIMATE CHANGE 9

Causes of Climate change : Change of Temperature in the environment Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem Water Resources Human Health Industry, Settlement and Society Methods and Scenarios Projected Impacts for Different Regions Uncertainties in the Projected Impacts of Climate Change Risk of Irreversible Changes.

UNIT IV CLIMATE CHANGES AND ITS CAUSES 9

Climate change and Carbon credits - CDM - Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCCIPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India.

UNIT V CLIMATE CHANGE AND MITIGATION MEASURES 9

Clean Development Mechanism -Carbon Trading -examples of future Clean Technology - Biodiesel - Natural Compost - Eco-Friendly Plastic - Alternate Energy -Hydrogen - Bio-fuels – Solar Energy - Wind - Hydroelectric Power -Mitigation Efforts in India and Adaptation funding Key Mitigation Technologies and Practices-Energy Supply - Transport - Buildings-Industry-Agriculture - Forestry - Carbon sequestration- Carbon capture and storage (CCS) - Municipal solid Waste (MSW) & Bio waste, Biomedical, Industrial waste International and Regional cooperation.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

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

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

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3. https://www.vlab.co.in/
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22OAG05	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. understand and analyse the energy data of industries
2. carryout energy accounting and balancing
3. conduct energy audit and suggest methodologies for energy savings and
4. utilise the available resources in optimal ways

Course Content:

UNIT I INTRODUCTION **9**

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 II ELECTRICAL SYSTEMS **9**

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 III THERMAL SYSTEMS **9**

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 IV ENERGY CONSERVATION IN MAJOR UTILITIES **9**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets

UNIT V ECONOMICS **9**

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

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.

6. Practical and theoretical knowledge burner design.

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.

Reference Books:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987

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22OAG06	ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Content:

UNIT I INTRODUCTION 9

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 II CONVENTIONAL ENERGY 9

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 III NON-CONVENTIONAL ENERGY 9

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 IV BIOMASS ENERGY 9

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 V ENERGY CONSERVATION 9

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 PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
2. Students will excel as professionals in the various fields of energy engineering
3. Compare different renewable energy technologies and choose the most appropriate based on local conditions.

4. Explain the technological basis for harnessing renewable energy sources.
5. 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.

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.

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22OAG08	Fundamentals of Nutrition	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. The course aims to develop the knowledge of students in the basic area of Food Chemistry.
2. This is necessary for effective understanding of food processing and technology subjects.
3. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

Course Content:

UNIT I OVERVIEW OF NUTRITION 9

Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis;

UNIT II DIGESTION 9

Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

UNIT III CARBOHYDRATES 9

Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners; Importance of blood sugar regulation, Dietary recommendations for NIDDM and IDDM

UNIT IV PROTEINS & LIPIDS 9

Proteins; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods. Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Fat replacements; Food sources, functional role and uses in foods. Health effects and recommended intakes of lipids. Recommended intakes of proteins, Deficiency-short term and long term effects.

UNIT V METABOLISM, ENERGY BALANCE AND BODY COMPOSITION 9

Energy Balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of unsafe weight loss schemes; treatment of obesity; attitudes and behaviours toward weight control. Food and Pharmaceutical grades; toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

TOTAL LECTURE PERIODS 45 Periods

Text Book(s):

1. Chopra, H.K. and P.S. Panesar. " Food Chemistry". Narosa, 2010.

2. Vaclavik, V. A. and Christian E. W. “Essentials of Food Science”. II Edition, Kluwer-Academic, Springer, 2003.
3. Mann, Jim and Stewart Truswell “Essentials of Human Nutrition”. 3rd Edition. Oxford University Press, 2007.
4. Gibney, Michael J., et al., “Introduction to Human Nutrition”. 2nd Edition. Blackwell,2009.
5. Gropper, Sareen S. and Jack L.Smith “Advanced Nutrition and Human Metabolism”. 5th Edition. Wadsworth Publishing, 2008.

Reference Books:

1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. “Nutritive Value of Indian Foods”. NIN, ICMR, 2004.
2. Damodaran, S., K.L. Parkin and O.R. Fennema. “Fennema’s Food Chemistry”. 4th Edition, CRC Press, 2008
3. Belitz,H.-D, Grosch W and Schieberle P. “Food Chemistry”, 3rd Rev. Edition, Springer- Verlag, 2004.
4. Walstra, P. “ Physical Chemistry of Foods”. Marcel Dekker Inc. 2003.
5. Owusu-Apenten, Richard. “Introduction to Food Chemistry”. CRC Press, 2005

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22OAG16	Remote Sensing and GIS for Natural Resource Management	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

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 Content:

UNIT I CONCEPTS OF REMOTE SENSING AND SATELLITES 9

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

UNIT II DATA PRODUCTS AND IMAGE ANALYSIS 9

Data products –based on level of processing- o/p – scale – area/coverage – data availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices.

UNIT III CONCEPTS OF GIS 9

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

UNIT IV DATA INPUT AND ANALYSIS 9

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

UNIT V APPLICATION OF RS AND GIS 9

Crop Acreage estimation - Estimation of Crop Water Requirement – Crop condition - Soil

mapping – classification of soil with digital numbers – soil erosion mapping- reservoir sedimentation using image processing - Inventory of water resources – water quality assessment - Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health - Management Decision Support Systems

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

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

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. 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

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22OBT07	INTRODUCTION TO BIOENERGY AND BIOFUELS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. This course will be focussed on achievement, acquisition of knowledge and enhancement of comprehension of information regarding bioenergy and biofuel technologies and their sustainable applications.

Course Content:

UNIT I CONCEPTS **9**

Biopower, Bioheat, Biofuesl, advanced liquid fuels, drop-in fuels, biobased products

UNIT II FEEDSTOCKS **9**

Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and insdustrial waste.

UNIT III CONVERSION TECHNOLOGIES **9**

Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV BIOFUELS **9**

Pros and cons of Biofuels, Algal biofuels, Cyanobacteria and producers of biofuels, Jatropha as biodiesel producer, Bioethanol, Biomethane, biohydrogen, biobutanol, metabolic engineering of fuel molecules, Engineering aspects of biofuels, Economics of biofuels

UNIT V SUSTAINABILITY & RESILIENCE **9**

Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. demonstrate general knowledge and understanding of some of the basic facts, language, concepts and principles relating to plants

2. Understand composition and properties of plants and the different ways in which plant products have been utilised by humans
3. demonstrate an understanding of the contribution that science can make to informed debate on issues arising from the use of plants and the threats posed to plants and their habitats
4. Make sense of information presented in different ways, including textual, numerical, graphical, multimedia and web-based material.
5. Identify their limited scope in terms of suitable sites, dependence on the elements, capital costs, and cost effectiveness compared with traditional sources.

Text Book(s):

1. Biorenewable Resources – Engineering new products. Robert C Brown. Blackwell Publishing Professional, 2003.
2. Biofuels. Wim Soetaert and Erik Vandamme (Editors) Wiley. 2009.
3. Biomass for Renewable Energy, Fuels and Chemicals. Donald Klass. Academic press. 1998

Reference Books:

1. Introduction to Bioenergy.Vaughn C. Nelson and Kenneth L. Starcher.
2. Bioenergy: Biomass to Biofuels by by Anju Dahiya
3. Bioenergy: Principles and Applications by Yebo Li and Samir Kumar Khanal
4. Bioenergy by Judy D. Wall and Caroline S. Harwood
5. Bioenergy: Sustainable Perspectives by Ted Weyland

22OBT08	MICROBIOLOGY	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To highlight the functions and characteristics of microorganisms
2. To study the growth of microorganisms and the impact of environment on their growth
3. To evaluate explicitly, the metabolic pathways, role of microbes in public health; insight into the physical and chemical control of microorganisms.
4. To enable the students to understand the basic principles involved in the isolation of different kinds of microorganisms and gain accurate handling of microorganisms
5. Students will be taught about the different parts of microscopes and their functions
6. The students will learn to identify the microorganisms using various staining techniques and biochemical tests

Course Content:

UNIT I INTRODUCTION TO MICROBIOLOGY 9

An overview of microbiology including a historical perspective of microbiology-classification, and nomenclature of microorganisms-Basics of Microscopy – light, phase, fluorescent and electron microscopy (SEM and TEM)- principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining, spore staining

UNIT II MICROBIAL STRUCTURE AND MULTIPLICATION 9

Morphology, Structure and Functions of Prokaryotic- and Eukaryotic Cells, Multiplication of bacteria, viruses, algae, protozoa, fungi, yeast with appropriate examples, Life history of actinomycetes and bacteriophage

UNIT III MICROBIAL NUTRITON AND METABOLISM 9

Nutritional requirements of bacteria: Growth curve and Different methods to quantitative bacterial growth, Mathematics of growth generation time and growth rate constant, factors affecting growth. Aerobic and Anaerobic respiration, Microbial metabolism- Entner–Doudoroff and Phosphoketolase pathway

UNIT IV CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms – sterilization: Moist heat, dry heat, radiation and filtration. Disinfection: phenol, alcohol and detergents; Chemotherapy and antibiotics- antibacterial, antifungal agents, anti-viral agents

UNIT V ENVIRONMENTAL MICROBIOLOGY 9

Interaction between Microorganisms – Commensalism, Synergism, Mutualism (symbiosis), Lichen symbiosis, Normal flora of human healthy host, importance of nosocomial infections (hospital borne), mode of transmission of airborne pathogens, food and water borne

infections caused by bacteria and virus, Significance of microbes in food; Industrially important microbial products and processes

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Acquire basic knowledge on the history and development of microbiology
2. Recognize the fundamental concepts in the structure and functions of microbes
3. Understand the classification and nomenclature of microorganism, microscopic, staining and sterilization techniques
4. Identify the appropriate physical and chemical methods to control the growth of microbes
5. Demonstrate proficiency and use of microbial isolation and staining techniques
6. Build skill to prepare media for microbial growth and cultivation techniques of microorganisms
7. Culture, identify, and explain different kinds of microorganisms present in environmental samples

Text Book(s):

1. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.2007
2. Prasad B.N., "A Text Book of Biotechnology", Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal. 2003.

Reference Books:

1. Talaron K, Talaron A, Casida, Pelczar and Reid. Foundations in Microbiology, W.C.Brown Publishers, 2001.
2. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 2001.
3. Lim D, "Microbiology", Second Edition, WCB-Mc Graw Hill, 2001.

22OBT10	PRINCIPLES OF FOOD PRESERVATION	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. The course aims to introduce the students to the area of Food Preservation. This is necessary for effective understanding of a detailed study of food processing and technology subjects.

Course Content:

UNIT I FOOD PRESERVATION AND ITS IMPORTANCE 9

Introduction to food preservation. Wastage of processed foods; Shelf life of food products; Types of food based on its perishability. Traditional methods of preservation

UNIT II METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low

temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods. retort pouch packing, Aseptic packaging.

UNIT III THERMAL METHODS 9

Newer methods of thermal processing; batch and continuous; In container sterilization-canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods

UNIT IV DRYING PROCESS FOR TYPICAL FOODS 9

Rate of drying for food products; design parameters of different type of dryers; properties of airwater mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydrofreezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT V NON-THERMAL METHODS 9

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Be aware of the different methods applied to preserving foods
2. Apply the principles and methods involved in the processing of different foods and discuss the processing of cereals and pulses
3. Discuss pulse processing and preservation techniques.

4. Explain spice processing and preservation techniques.
5. Identify oil seed processing and preservation.

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.
3. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.

Reference Books:

1. Rahman, M. Shafiur. “Handbook of Food Preservation”. Marcel & Dekker, 2006.
2. Zeuthen, Peter and Bogh-Sarensen, Leif. “Food Preservation Techniques”. CRC / Wood Head Publishing, 2003.
3. Ranganna, S. “Handbook of Canning and Aseptic Packaging”. Tata McGraw-Hill, 2000.

22OCS03	CLOUD COMPUTING	L	T	P	C
		2	0	2	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the concept of cloud computing.
2. To appreciate the evolution of cloud from the existing technologies.
3. To have knowledge on the various issues in cloud computing.
4. To be familiar with the lead players in cloud.
5. To appreciate the emergence of cloud as the next generation computing paradigm.

Course Content:

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning

UNIT II CLOUD ENABLING TECHNOLOGIES 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine –– Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Articulate the main concepts, key technologies, strengths and limitations of cloudcomputing.
2. Learn the key and enabling technologies that help in the development of cloud.
3. Develop the ability to understand and use the architecture of compute and storage cloud,service and delivery models.
4. Explain the core issues of cloud computing such as resource management and security.
5. Be able to install and use current cloud technologies.
6. Evaluate and choose the appropriate technologies, algorithms and approaches forimplementation and use of cloud

Text Book(s):

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, FromParallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press, 2017

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, TataMcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, TataMcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in theCloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

List of Experiments:

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on topof windows7 or 8. **3**
2. Install a C compiler in the virtual machine created using virtual box and execute SimplePrograms. **3**
3. Install Google App Engine. Create *hello world* app and other simple web applications usingpython/java. 4
4. Use GAE launcher to launch the web applications. **3**
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is notpresent in CloudSim. 4
6. Find a procedure to transfer the files from one virtual machine to another virtual machine. **3**
7. Find a procedure to launch virtual machine using trystack (Online Openstack DemoVersion). **3**
8. Install Hadoop single node cluster and run simple applications like wordcount.. **3**

TOTAL PRACTICAL PERIODS	**30 Periods**
TOTAL LECTURE CUM PRACTICAL PERIODS	**75 Periods**

List of Equipments: (for batch of 30 students)

1.	PC with latest version	30 nos
2.	Cloud tools from free of open source like open nebula, open stack, Eucalyptus software	30 nos

22OCS13	DATA STRUCTURES	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the concepts of ADTs.
2. To learn linear data structures – lists, stacks, and queues.
3. To understand non-linear data structures – trees and graphs.
4. To understand sorting, searching and hashing algorithms.
5. To apply Tree and Graph structures

Course Content:

UNIT I LISTS 9

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT Radix Sort – Multilists.

UNIT II STACKS AND QUEUES 9

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infixto Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues.

UNIT III TREES 9

Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Priority Queue (Heaps) – Binary Heap.

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS 9

B-Tree – B+ Tree – Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal – Depth-first traversal –– Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort –. Merge Sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Define linear and non-linear data structures.
2. Implement linear and non–linear data structure operations.
3. Use appropriate linear/non–linear data structure operations for solving a given problem.
4. Apply appropriate graph algorithms for graph applications.
5. Analyze the various searching and sorting algorithms

Text Book(s):

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007

Reference Books:

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, PearsonEducation, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction toAlgorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft ,Data Structures and Algorithms, 1st edition,Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006

22OCS14	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To learn the fundamentals of data models and to represent a database system using ERdiagrams.
2. To study SQL and relational database design.
3. To understand the internal storage structures using different file and indexingtechniques which will help in physical DB design.
4. To understand the fundamental concepts of transaction processing-concurrencycontrol techniques and recovery procedures.
5. To have an introductory knowledge about the Storage and Query processing Techniques

Course Content:

UNIT I RELATIONAL DATABASES 9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT II DATABASE DESIGN 9

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III TRANSACTIONS 9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV IMPLEMENTATION TECHNIQUES 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V ADVANCED TOPICS 9

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Classify the modern and futuristic database applications based on size and complexity
2. Map ER model to Relational model to perform database design effectively
3. Write queries using normalization criteria and optimize queries
4. Compare and contrast various indexing strategies in different database systems
5. Appraise how advanced databases differ from traditional databases

Text Book(s):

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", SixthEdition, Tata McGraw Hill, 2011.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2011.

Reference Books:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition,Pearson Education, 2006.
2. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-HillCollege Publications, 2015.
3. G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011

22OEC12	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the global trends and development methodologies of various types of products and services
2. To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
3. To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
4. To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
5. To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

Course Content:

UNIT I BASICS OF PRODUCT DEVELOPMENT **9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN **9**

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING **9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT **9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposa

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY **9**

The Industry - Engineering Services Industry - Product Development in Industry versus Academia – The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. CO1:Define, formulate, and analyze a problem
2. CO2:Solve specific problems independently or as part of a team
3. CO3:Gain knowledge of the Innovation & Product Development process in the Business Context CO4:Work independently as well as in teams
4. CO5:Manage a project from start to finish

Text Book(s):

1. Book specially prepared by NASSCOM as per the MoU.
2. 2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. 3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005

Reference Books:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. 2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. 3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. 4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

22OME18	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To give an idea about IPR, registration and its enforcement.

Course Content:

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTOto WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 9

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 9

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Know about the Intellectual Property - Patents, Copyrights
2. Gain the ability to register practical and industrial design patents
3. Know about agreements and legislations related to IPRs
4. Implement to digital products and law
5. manage enforcement of IPRs

Text Book(s):

1. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
2. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

Reference Books:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGrawHill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

22OME26 PROCESS MODELING AND SIMULATION

L	T	P	C
3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To give an overview of various methods of process modeling, different computational techniques for simulation.
2. To train highly speacialized human resources.

Course Content:

UNIT I INTRODUCTION **9**

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS **9**

Degree of freedom analysis, single and network of process units, systems yielding linear and non- linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations

UNIT III UNSTEADY STATE LUMPED SYSTEMS **9**

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems

UNIT IV STEADY STATE DISTRIBUTED SYSTEM **9**

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems

UNIT V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES **9**

Numerical control (NC) machine tools - CNC: types, constitutional details, special features - design considerations of CNC machines for improving machining accuracy - structural members - slide ways - linear bearings - ball screws - spindle drives and feed drives. Part programming fundamentals - manual programminG

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Understood the development of process models based on conservation principles 2.
2. To develop process data and computational techniques to solve the process models

Text Book(s):

1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.

2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

Reference Books:

1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.
2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967

Web Links:

1. https://www.processmodel.com/
2. http;//inderscience.com/
3. https://www.bpsimulator.com/
4. https://www.lprosim.net/
5. http://www.simulatelive.com/

22OME27	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	**Syllabus Version**			V 0.1

Course Objectives:

1. To prepare students to excel in new product design and development through application of knowledge and practical skills II.

2. To provide students with a solid foundation in mathematical modeling of engineering problems required for bringing new products fast into the market III.

3. To provide students with required scientific and engineering knowledge so as to comprehend, analyze, design and create innovative products and solutions for real life problems

Course Content:

UNIT I INTRODUCTION **9**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications

UNIT II CONCEPT GENERATION AND SELECTION **9**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology -benefits.

UNIT III PRODUCT ARCHITURE **9**

Implications – Product change – variety – component standardization – product performance -manufacturability – product development management – establishing the architecture – creation -clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications

UNIT IV PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS **9**

Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks- Baseline Project Planning - Accelerating the project - Project execution – Postmortem project evaluation

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT **9**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome: On completion of the course, the student is expected to

1 The student will be able to design some products for the given set of applications.

2. The knowledge gained through prototyping technology will help the student to make a prototype of a problem.

3. The students will be able to design produc and development can be achieved.

Text Book(s):

1. Kari T.Ulrich and Steven D.Eppinger, Product Design and Development, McGraw-Hill International Edns. 1999

Reference Books:

1. Kemnneth Crow, Concurrent Engg./Integrated Product Development, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, New york, NY

Web Links:

1. https://online cources.nptel.ac.in/
2. https://wwwpivotint.com/
3. https://www.pdd-resources.com/
4. https://in.linkedin.com/
5. https://industri.fatek.unpatti.ac.id/

22OME31	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. Introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
3. To study the Vapour absorption and air refrigeration systems.
4. To learn the psychrometric properties and processes.
5. To study the air conditioning systems and load estimation.

Course Content:

UNIT I INTRODUCTION **9**

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM **9**

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS **9**

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic- Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES **9**

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION **9**

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system;Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors,Actuators & Safety controls.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Explain the basic concepts of Refrigeration
2. Explain the Vapor compression Refrigeration systems and to solve problems
3. Discuss the various types of Refrigeration systems
4. Calculate the Psychrometric properties and its use in psychrometric processes
5. Explain the concepts of Air conditioning and to solve problems

Text Book(s):

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

Reference Books:

1. ASHRAE Hand book, Fundamentals, 2010
2. JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann,2007
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4. Stoecker,W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.
5. A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput | 1 January 2013

22OME33	ROBOTICS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the functions of the basic components of a Robot.
2. To study the use of various types of End of Effectors and Sensors
3. To impart knowledge in sensors
4. To study about machine vision system
5. To learn Robot safety issues and economics.

Course Content:

UNIT I FUNDAMENTALS OF ROBOT **9**

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification-Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS **9**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors.

UNIT IV MACHINE VISION **9**

Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS **9**

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors
2. Illustrate the different types of robot drive systems as well as robot end effectors.
3. Apply the different sensors in robotics to improve the ability of robots.
4. Explain the concepts of image processing techniques

5. Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

Text Book(s):

1. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2012.
2. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”,Prentice Hall, 2003.

Reference Books:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
3. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
4. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
5. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co., 1992.

Web Links:

1. https://easyengineering.net/
2. https://learnengineering.in/
3. https://www.notesforgeeks.in/
4. https://www.academia.edu/

22OME35	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

To provide an insight on the fundamentals of supply chain networks, tools and techniques.

Course Content:

UNIT I INTRODUCTION 9

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN 9

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions

UNIT III LOGISTICS IN SUPPLY CHAIN 9

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY 9

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. understand the Supply chain Management and Strategies
2. familiarize the Role of network Design in Supply Chain
3. gain knowledge related to logistics in supply chain
4. analyse the supply chain co-ordination and obstacles
5. manage Customer Relationship and E-Business

Text Book(s):

1. Sunil Chopra, Peter Meindl and Kalra, “Supply Chain Management, strategy, Planning, and Operation”, Pearson Education, 2010.

Reference Books:

1. Jeremy F.Shapiro, “Modeling the Supply Chain”, Thomson Duxbury, 2002.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, “Logistics”, PHI 2002.
4. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press, 2000.

22OHS03	HUMAN RIGHTS	L	T	P	C
		3	0	0	3

Pre-requisite	Nil	Syllabus Version	V 0.1

Course Objectives:

To educate engineering students about different facets of human rights.

Course Content:

UNIT I HUMAN RIGHTS ORIGIN AND DEVELOPMENT 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II EVOLUTION AND CONCEPT 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III THEORIES AND PERSPECTIVES 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV HUMAN RIGHTS IN INDIA 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V HUMAN RIGHTS OF DISADVANTAGED PEOPLE 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disability persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome:

Engineering students will acquire the basic knowledge of human rights.

Text Book(s):

1. Dr.P.ALLI, C.B.SELVALAKSHMI, K.SANTHA SHEELA, T.GRACESHALINI, Pages: 108Edition: 2022, Technical Publications
2. Dr Mridula MIshra, Human Rights: Refugee Problem in India, Publisher : Vij Books India Private Limited; 1st edition (20 January 2011).

Reference Books:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

22PAG26	REFRIGERATION AND COLD STORAGE	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. Introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
3. To study the Vapour absorption and air refrigeration systems.
4. To learn the psychrometric properties and processes.
5. To study the air conditioning systems and load estimation.

Course Content:

UNIT I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic- Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system;Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors,Actuators & Safety controls.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Explain the basic concepts of Refrigeration
2. Explain the Vapor compression Refrigeration systems and to solve problems
3. Discuss the various types of Refrigeration systems
4. Calculate the Psychrometric properties and its use in psychrometric processes
5. Explain the concepts of Air conditioning and to solve problems

Text Book(s):

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

Reference Books:

1. ASHRAE Hand book, Fundamentals, 2010
2. JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann,2007
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4. Stoecker,W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.
5. A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput | 1 January 2013

22AG402	FOOD AND DAIRY ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite	Nil	Syllabus Version	V 0.1

Course Objectives:

1. 1.To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products , sanitation and effluent treatment in dairy industry
2. 2.To expose the students to the fundamental knowledge of food, its properties anddifferent methods of food processing

Course Content:

UNIT I PROPERTIES AND PROCESSING OF MILK **9**

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

–Staining - Filtering and Clarification - cream separation – Pasteurization – Homogenization -sterilization, UHT processing and aseptic packaging – emulsification - Fortification

UNIT II DAIRY PRODUCTS **9**

Manufacture of Milk Powder - Processing of Milk Products - Condensed Milk - Skim milk - Butter milk - Flavoured Milk, whey, casein, yoghurt and paneer - Manufacture of Butter - Cheese Ghee, ice creams and frozen desserts - standards for milk and milk products - Packaging of Milk and Milk Products - Cleaning and Sanitation - Dairy effluent treatment and disposal .

UNIT III FOOD AND ITS PROPERTIES, REACTION AND KINETICS **9**

Constituents of food - thermal processing of foods - cooking, blanching, sterilization, pasteurization, canning - Interaction of heat energy on food components, reaction kinetics, Arrhenius equation, TDT curves - water activity, sorption behaviour of foods.

UNIT IV PROCESSING AND PRESERVATION OF FOODS **10**

Coffee, Tea processing - Concentration of foods, freeze concentration - osmotic and reverse osmotic concentration - drying and dehydration of food - Tray, tunnel, belt, vacuum and freezedryers - rehydration of dehydrated foods - Fat and oil processing, sources, extraction, methodsand equipment, refining of oils, hydrogenation, manufacture of margarine - Food preservationmethods - preservation by irradiation, microwave and dielectric heating of food.

UNIT V PACKAGING AND QUALITY CONTROL 8

Food packaging, importance, flexible pouches - retort pouches - aseptic packaging, granules,powder and liquid packaging machines - nanotechnology – principles - applications in food processing – food plant location - Quality control of processed food products - Factors affectingquality.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

- The students will gain knowledge about Dairy and Food process engineering
- Understand the process of manufacturing of dairy products and thermal processingof food.
- Students will understand the importance of quality control and foodpreservation and packaging.
- To understand the concept of processing and preservation of foods
- To understand the concept of packaging and quality control

Text Book(s):

1. Chandra Gopala Rao. Essentials of Food Process Engineering. B.S. Publications,Hyderabad, 2006.
2. Walstra. P., Jan T. M. Wouters., Tom J. Geurts "Dairy Science and Technology", CRCpress, 2005.
3. Ananthakrishnan, C.P., and Sinha, N.N., "Technology and Engineering of Dairy PlantOperations, Laxmi Publications, New Delhi, 1999.

Reference Books:

1. Subbulakshmi.G., and Shobha A. Udipi, Food Processing and Preservation, New AgeInternational Publications, New Delhi, 2007.
2. Toledo, R.T., "Fundamentals of Food Process Engineering", CBS Publishers and Distribution, New Delhi, 1997.
3. Tufail Ahmed., "Dairy Plant Engineering and Management", Kitab Mahal Publishers,Allahabad, 1997.
4. Dairy Science and Technology Handbook, Volumes 1-3, John Wiley & Sons, 1993.
5. Charm, S.E., "Fundamentals of Food Engineering", AVI Pub.Co.Inc, New York, 1997.

Web Links:

1. http://ecoursesonline.iasri.res.in
2. https://www.inspirenignite.com
3. https://courseware.cutm.ac.in

22PAG02	PROCESS ENGINEERING OF FRUITS AND VEGETABLES	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To understand the basics of Post-Harvest Technology of fruits and vegetables throughtheir structure and composition
2. To study the different methods of processing and preservation of fruits and vegetablesincluding drying and dehydration
3. To learn the latest methods of storage of fruits and vegetables
4. To study the cleaning grading and on farm processing.

UNIT I STRUCTURE, COMPOSITION, RIPENING AND SPOILAGE **9**

Importance of post-harvest technology of horticultural crops – post harvest losses – factors causing losses - structure, cellular components, composition and nutritive value of horticultural crops – fruit ripening – mechanism and equipment - spoilage of perishable commodities – mechanism andfactors causing spoilage.

UNIT II CLEANING, GRADING AND ON-FARM PROCESSING **9**

Harvesting and washing of fruits and vegetables – cleaning and grading – fruits and vegetables -peeling - equipment's – construction and working – pre-cooling – importance, methods,
Pretreatments and advantages.

UNIT III CONJUNCTIVE USE OF SURFACE AND GROUNDWATER **9**

Thermal and non-thermal techniques of preservation of fruits and vegetables and their products -methods - minimal processing of horticultural commodities – fruits and vegetables, advantages - quick freezing preservation - commercial canning of fruits, vegetables and other perishable commodities – processing and concentration of juice - membrane separation process and application - hurdle technology of preservation and techniques.

UNIT IV DRYING AND DEHYDRATION **9**

Dehydration of fruits and vegetables – types of dryers, construction and working - methods – fluidized bed dryer, freeze drying, osmotic dehydration and foam mat drying – principles, construction, operation and applications - quality parameters and advantages.

UNIT V STORAGE **9**

Storage of fruits and vegetables – storage under ambient conditions, low temperature storage,evaporative cooling – cold storage of horticultural commodities – estimation of cooling load - controlled atmosphere storage – concept and methods –modified atmosphere packaging – gascomposition, quality of storage – waxing of fruits – types of wax, equipment and advantages.

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome :After completion of the course

1. At the end of this course, the student will be thorough in various methods of processing,
2. The students' knowledge how to preservation and storage of fruits and vegetables usinglatest technologies.
3. To understand the Drying and Dehydration about the fruit and vegetables.
4. The students will be go through the Cleaning, Grading And On-Farm Processing
5. Students know about the Structure, Composition, Ripening And Spoilage

Text Book(s):

1. Fellows. P. 2000. Food Processing Technology – Principles and Practice, second edition, CRCPress, Woodland Publishing Limited, Cambridge, England.
2. Sudheer K. P. and V. Indra.2007. Post-harvest Technology of Horticultural Crops. New IndiaPublishing Company, New Delhi.
3. L.R.Verma and V.K.Joshi. 2000. Post-Harvest Technology of Fruits and Vegetables – handling,Processing, Fermentation and waste management. Indus Publishing Company, New Delhi.

Reference Books:

1. Heid,J.L. and M.A.Joslyn. 1983. Food processing operations. Vol. II. AVI Publishing Co. Inc.Westport, Connecticut.
2. Potter, N.N.1976. Food science. AVI Publishing Co. Inc.Westport, Connecticut, 2nd edition.
3. Sivetz Michael and N.W.Desrosier. 1979. Coffee Technology. AVI Publishing Co. Inc, Westport,Connecticut.
4. Frank.H.Slade. 1967. Food Processing Plant. Volume 1. Leonard Hill Books. London.
5. SudhirGupta.Cold storage unit. Atif printers, LalKuan, Delhi.
6. NIIR board. Modern techniques on food preservation. Asia pacific business press inc. Delhi
7. Humberto vega and Gustavo v Barbosa. 1996. Dehydration of foods. Springer Science, BusinessMedia, Chapman&Hall Publishers, U.K.

Web Links:

1. CPE: Fruits and Vegetables Processing (iasri.res.in)
2. Processed Products from Fruits and Vegetables, Crop Process Engineering | Crop ProcessEngineering Notes - Agricultural Engg - Agricultural Engineering (edurev.in)
3. UNIT 6 BASIC PRINCIPALS OF COOKING FOOD.pdf (ihmnotes.in)

22PAG01	STORAGE AND PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

1. To study about the different storage structures
2. To learn about the different packaging materials and various methods of packaging toimprove the shelf life of the products
3. To understand the concepts of Controlled Atmosphere Storage and Modified AtmospherePackaging.
4. To study the how to make canning about storage and packaging process.

UNIT I STORAGE ENVIRONMENT AND STORAGE STRUCTURES **9**

Storage losses in agricultural commodities. Physical properties of grain affecting storability Factorsof 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 II INTRODUCTION TO PACKAGING **9**

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 transmissionrates.

UNIT III CONTROLLED ATMOSPHERE STORAGE AND MODIFIEDATMOSPHERE PACKAGING **9**

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 IV CANNING **9**

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

UNIT V FLEXIBLE FILMS PACKAGING **9**

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 onpackages, Bar codes, Nutrition labeling and legislative requirements. Sensors and IoT in Food packaging.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

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

Text Book(s):

1. Sahay, K.M. and K.K.Singh. 1996. Unit operations of agricultural processing. Vikas PublishingHouse Pvt. Ltd., New Delhi.

2. Food Packaging Technology, Hand book, 2004. NIIR Board, New Delhi.

3. Pandey, P.H.2002. Post-harvest engineering of horticultural crops through objectives. SarojPrakasam. Allahabad.

Reference Books:

1. Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall,1992
2. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK,1994
3. Ruth H. Matthews: Pulses Ã¢?? Chemistry, Technology and Nutrition Mercel Dekker Inc.,USA,1989
4. Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
5. Donald Downing, Complete Course in Canning (3 Volumes) CTI Publications Inc, USA, 1996

Web Links:

1. (PDF) Food packaging (researchgate.net)
2. (PDF) Food Packaging and Storage (researchgate.net)
3. First-Final.pmd (icpe.in)

22PAG28	FOOD PROCESS EQUIPMENT AND DESIGN	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

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

UNIT I PROCESS EQUIPMENT DESIGN **9**

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

UNIT II DESIGN PROCEDURE **9**

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

UNIT III HEAT EXCHANGER **9**

Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchangerProblems on tubular heat exchanger, shell and tube type heat exchanger and plate heat exchanger

UNIT IV CONVEYING SYSTEM **9**

Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers. Design of milling equipment.

UNIT V CAD **9**

Optimization of design with respect to process efficiency, energy and cost, Computer AidedDesign

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

CO1 Analyse the various process equipment design.
CO2 Understand the design procedure the development of vessels and cleaners.
CO3 Analyse the different types heat exchanger methods
CO4 Apply the different methods of conveying system
CO5 Optimize the variables using CAD for the process equipment design.

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 & IBHpublishing Co. Ltd., New Delhi.
3. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. KalyaniPublishers, New Delhi.
4. Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. VikasPublishing house Pvt. Ltd. New Delhi

Reference Books:

1. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
2. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman and hall, London
3. McCabe, W.L., Smith J.C. and Harriott, P. Unit operations of Chemical Engineering. McGrawHill.
4. Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd Edition.Academic Press, London

Web Links:

4. (PDF) Food packaging (researchgate.net)
5. (PDF) Food Packaging and Storage (researchgate.net)
6. First-Final.pmd (icpe.in)

22PAG29	Food Plant Design and Management	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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

UNIT I PLANT LAYOUT-INTRODUCTION **9**

Design considerations of processing agricultural and food products. Plant design concepts and general design considerations: Plant layout, plant location, location factors and their interaction with plant location, location theory models, and computer aided selection of the location. Human factors in design, selection of materials of construction and standard component, design standards and testing standards.

UNIT II PROCESS ECONOMICS OF PLANT LAYOUT **9**

Feasibility analysis and preparation of feasibility report: plant size, factors affecting plant size and their interactions, estimation of break-even and economic plant size; Product and process design, process selection, process flow charts, Plant utilities, electricity, water, steam, air, raw material requirements and computer aided development of flow charts.

UNIT III DEVELOPMENT AND PRESENTATION OF LAYOUT **9**

Hygienic design aspects and worker's safety, functional design of plant building and selection of building materials, estimation of capital investment, analysis of plant costs and profitability's, management techniques in plant design including applications of network analysis, preparation of project report and its appraisal

UNIT IV FOOD PROCESSING PLANT & EQUIPMENT LAYOUT **9**

Plant layout and design of bakery and biscuit industries; fruits and vegetables processing industriesincluding 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 V PROJECT EVALUATION AND COST ESTIMATION 9

Preparation of flow sheets for material movement and utility consumption in food plants; Application of Program Evaluation and Review Technique (PERT) 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 PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

CO1 Design and construct the well-equipped food processing plant for effective processing

CO2 List the start — to — end facilities, infrastructure, utilities, investments along with thegovernment regulations and specifications for plant layout

CO3 Evaluate and estimate the capital investments and methods of cost estimation of designingfood plants

CO4 Assess the overall production cost, profitability and factors involved in the cost estimation ofproducts manufactured

CO5 Analyze the problems involved in deciding the level of manufacture of a food product

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 Scienceand Technology)", CRC Press, 2005.
3. Towler, G. and Sinnott, R.K. Chemical Engineering design principles, practice andEconomics of Plant and Procese. 2nd Edition. Elsevier.2012

Reference Books:

1. Theunis C. Robberts . Food plant engineering system. II Edition, CRC Press, Washington,2013.
2. M Moore, Mac Millan, Plant Layout & Design. Lames, New York, 1971.
3. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ),Prentice

Web Links:

1. (PDF) Food packaging (researchgate.net)
2. (PDF) Food Packaging and Storage (researchgate.net)
3. First-Final.pmd (icpe.in)

22PAG30	EMERGING TECHNOLOGIES IN FOOD PROCESSING	L	T	P	C
		3	0	0	3

Pre-requisite	Nil	**Syllabus Version**	V 0.1

Course Objectives:

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

UNIT I HIGH PRESSURE PROCESSING **9**

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 applicationsof high pressure processing - High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

UNIT II PULSED ELECTRIC FIELDS PROCESSING **9**

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 III FOOD IRRADIATION **9**

Introduction - Fundamentals of food Irradiation - Type and sources of radiation, dosimetry, mode ofaction of ionizing radiation - Direct and indirect effect, radiation effect on food constituents, Dose requirement for different products and regulations.

UNIT IV ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES **9**

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 V ALTERNATIVE THERMAL PROCESSING TECHNIQUES 9

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 PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

CO1 Design and construct the well-equipped food processing plant for effective processing

CO2 List the start — to — end facilities, infrastructure, utilities, investments along with thegovernment regulations and specifications for plant layout

CO3 Evaluate and estimate the capital investments and methods of cost estimation of designingfood plants

CO4 Assess the overall production cost, profitability and factors involved in the cost estimation ofproducts manufactured

CO5 Analyze the problems involved in deciding the level of manufacture of a food product

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.
3. Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010.

Reference Books:

1. 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
2. Amit K. Jaiswal, Food Processing Technologies: Impact on Product Attributes. CRC Press, 2017

Web Links:

4. (PDF) Food packaging (researchgate.net)
5. (PDF) Food Packaging and Storage (researchgate.net)
6. First-Final.pmd (icpe.in)

22PAG06	Farm Power and Machinery Management	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

- To expose the student with the mechanization status in the country and managementtechniques for future requirements.

UNIT I FARM MECHANIZATION **9**

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 II COST ANALYSIS **9**

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 III MACHINERY SELECTION **9**

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 IV FARM MACHINERY OPERATION AND MANAGEMENT **9**

Operations and adjustments of Land preparation, planting, intercultural, plant protection andharvesting machinery — management of machinery.

UNIT V CUSTOM HIRING MODELS **9**

Establishment of CHC-operationalization – Custom hiring models – case studies of custom hiring

Custom hiring project formulation – ownership vs custom hiring services- Economic viability ofcustom hiring service units — Replacement of farm machinery

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

CO1 have knowledge about the present status of farm mechanization
CO2 be able to optimally select machinery for varying uses.
CO3 be able to plan for mechanization of the farm.
CO4 be able to estimate the cost of machinery.
CO5 be able to create custom hiring centres

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, KalyaniPublishers , 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.

Web Links:

7. (PDF) Food packaging (researchgate.net)
8. (PDF) Food Packaging and Storage (researchgate.net)
9. First-Final.pmd (icpe.in)

22PAG31	TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

- Learn out testing of tractors and all other agricultural equipment and machinery

UNIT I TESTING OF AGRICULTURAL TRACTORS **9**

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

UNIT II TESTING OF TILLAGE AND SOWING EQUIPMENT **9**

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

UNIT III TESTING OF INTERCULTURAL EQUIPMENT **9**

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

UNIT IV TESTING OF COMBINE HARVESTER **9**

Types of grain combines - combine systems - test items - procedure for laboratory testing - materials for field test - observations during field tests - sample analysis- data analysis - summary of performance parameters - analysis of field test data

UNIT V SAFETY TESTING OF AGRICULTURAL MACHINERY **9**

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

TOTAL LECTURE PERIODS **45 Periods**

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

CO1 Understand the basics of testing procedures and standards of tractor testing

CO2 Understand the testing procedures and standards of tillage, sowing equipment

CO3 Understand the testing procedures and standards of intercultural equipment

CO4 Understand the testing procedures and standards of harvesting equipment

CO5 Understand the safety standards and testing procedures

Text Book(s):

1. Metha M.L., SR.Verma, K Mishra and VK Sharma. 1995. Testing and Evaluation of AgriculturalMachinery, National Agricultural Technology Information Centre, Ludhiana
2. Indian Standards Test Codes related to tractors, power tillers and agricultural implements

Reference Books:

1. Anonymous. 1983. RNAM Test Codes & Procedures for Farm Machinery. Technical Series 12.
2. Nebraska Tractor Test Codes for Testing Tractors, Nebraska, USA.

22PAG32	BIOCHEMICAL AND THERMOCHEMICAL CONVERSION OF BIOMASS	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

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

UNIT I BIOMASS CHARACTERIZATION **9**

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 II BIOCHEMICAL CONVERSION **9**

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 III THERMO CHEMICAL CONVERSION BY COMBUSTION **9**

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 IV THERMOCHEMICAL CONVERSION BY GASIFICATION AND PYROLYSIS **9**

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 V COGENERATION AND WASTE HEAT RECOVERY **9**

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 PERIODS 45 Periods

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

CO1 Biomass identification and classes

CO2 Biomass characters and biochemical conversion.

CO3 Thermo chemical conversion techniques and cogeneration from waste

CO4 To know about application of biomass conversion

CO5 Analyse the energy generated from waste

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 andConventional. Khanna Publishers, New Delhi.
3. Horlock JH, 1987. Cogeneration - Heat and Power, Thermodynamics and Economics, OxfordPress.

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

22PAG19	WASTE AND BY PRODUCT UTILIZATION	L	T	P	C
		3	0	0	3

Pre-requisite Nil **Syllabus Version** V 0.1

Course Objectives:

To expose the students with different byproducts of food industry and waste water management of any industry

UNIT I INTRODUCTION TO WASTE WATER TREATMENT **9**

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 II CHEMICAL PROPERTIES **9**

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

UNIT III BY-PRODUCTS UTILIZATION **9**

Waste utilization in various industries, furnaces and boilers run on agricultural wastes and by- products, 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 IV PROCESSING TECHNIQUES **9**

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 V ADVANCED WASTE WATER TREATMENT PROCESSES **9**

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 PERIODS **45 Periods**

Expected Course Outcome : Possess the knowledge on Storage environment and storagestructures

CO1 Types of waste and influences

CO2 Waste water management from any food industry.

CO3 By product utilization from processing plants of cereals, pulses

CO4 Hands on training in wastewater treatment process

CO5 Advance procession techniques for waste water treatment

Text Book(s):

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

Reference Books:

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

22PAG33 HUMAN ENGINEERING AND SAFETY IN FARM MACHINERY OPERATIONS

LT P C
3 0 0 3

COURSE OBJECTIVE:

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

UNIT I ERGONOMICS 9

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

UNIT II PHYSIOLOGICAL FUNCTIONS 9

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

UNIT III ENERGY EXPENDITURE 9

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

UNIT IV ANTHROPOMETRY 9

Anthropometry – introduction- Types of data- Principles of applied anthrophometry - concept of percentile – Normal distribution – Estimating the range – Minimum and Maximum dimensions- Cost benefit analysis - applications of anthropometric data. Anthropometric consideration in tool / equipment design.

UNIT V HUMAN SAFETY 9

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

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ernest and Mc Cormick, E.L. (1970). *Human factors in engineering and design.* Mc Graw HillCo., 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.

REFERENCES

1. Astrand, O.P and Rodhal, J. (1977). *Work Physiology.* Mc Graw hill Co. New York.
2. https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/risk_management/ss_ha ndbook/media/Chap17_1200.pdf
3. http://www.derby.ac.uk/online/course/ergonomics-msc
4. http://www.online.colostate.edu/certificates/ergonomics/
5. http://www.cdc.gov/nchs/data/nhanes/nhanes3/cdrom/nchs/manuals/anthro.pdf

COURSE OUTCOMES:

CO1 Understand the importance of human factors and their application in system development.

CO2 Know the effect of visual, auditory and factual displays in human performance.

CO3 Understand the importance of optimum work-rest cycles in endurance.

CO4 Be able to ideally design the work space in accordance to anthropometry.

CO5 Have the general understanding safety features and regulation acts in farm machinery.

22PAG34 PRECISION FARMING EQUIPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn about the fundamentals of precision farming principles and application of precisionfarming equipment

UNIT I ROLE OF ELECTRONICS IN AGRICULTURAL ENGINEERING 9

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 II SENSORS, MICROCONTROLLER AND ACTUATOR FOR PRECISION AGRICULTURE 9

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

UNIT III PRECISION FARMING CONCEPTS AND PRECISION FARMING MACHINERY 9

Precision farming concepts- Map based system- Real time system — Combination Map and realtime 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 IV SITE-SPECIFIC MANAGEMENT SYSTEM 9

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

UNIT V UNMANNED VEHICLES AND IOT IN AGRICULTURE 9

UAV -Drones- Types - applications — rules and regulations — Autonomous ground vehicles — 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 : 45 PERIODS

TEXT BOOKS

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 CropManagement. 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.
6. Kepner, R.A., Bainer, R. and Berger, E.L. 1978. Principles of Farm Machinery.AVI Publ.
7. Sahay, K.M. and Singh, K.K. 1994. Unit Operation of Agricultural Processing. Vikas Publ.House.
8. Michael, A.M. 2007. Irrigation: Theory and Practice. Vikash Publishing House Pvt. Ltd., NewDelhi.
9. Rai G.D. 1994. Non-conventional sources of energy. Khanna Publishers, Delhi

COURSE OUTCOMES:

CO1 Understand the role of electronics in precision farming

CO2 Analyse the principles and applications of sensors, micro controllers and actuators in precision farming equipment

CO3 Understand the precision farming concepts and machinery

CO4 Understand about site specific management system and unmanned vehicles & IoT applications

CO5 Analyse the application of sensors and electronics in farm machinery

22PAG35 SOLAR AND WIND ENERGY SYSTEM

L T P C

3 0 0 3

COURSE OBJECTIVES::

- To learn about the fundamental aspects of solar energy availability, solar energy conversiontechnologies
- To understand about the fundamental aspects of wind energy availability and wind powergenerators
- To acquire the knowledge on the alternate sources of energy such as geothermal energy,wave energy, tidal energy, OTEC energy, fuel cells and energy storage

UNIT I SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS 9

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 II SOLAR CONCENTRATING COLLECTORS AND PV TECHNOLOGY 9

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 III WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND 9

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 IV WIND MILL DESIGN AND APPLICATIONS 9

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 V ALTERNATE ENERGY SOURCES 9

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: 45 PERIODS

TEXT BOOKS

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**".** PHIlearning Pvt. Ltd, New Delhi. 2008.

REFERENCES

1. Solanki, C.S. "Solar Photovoltaic Technology and Systems", PHI learning Pvt. Ltd., NewDelhi, 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 andConventional". Khanna Publishers, Delhi, 2000.
4. Rajput. R.K. "Non- Conventional Energy Sources and Utilization", S. Chand & CompanyPvt. Ltd, New Delhi, 2013.

COURSE OUTCOMES:

CO1 Understand the basics of solar energy and solar thermal energy conversion technologies and compare direct mode and indirect mode solar dryers

CO2 Analyse the principles and applications of solar thermal power stations, solar pond, and solarstills

CO3 Understand the wind power laws and calculate the torque and power characteristics of windenergy

CO4 Design wind mills and test the units for certification

CO5 Understand the principles of geothermal energy, wave energy, tidal energy, OTEC energy,fuel cells and analyse their applications

22PAG36 WATERSHED PLANNING AND MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

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

UNIT-I INTRODUCTION **9**

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-II WATERSHED PLANNING **9**

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-III WATERSHED MANAGEMENT **9**

Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands

UNIT-IV WATER CONSERVATION PRACTICES **9**

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-V WATERSHED DEVELOPMENT PROGRAMME **9**

River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based ruraldevelopment — infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development.

TOTAL: 45 PERIODS

TEXT BOOKS :

1 Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.

2. Ghanshyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of IndiaPrivate Limited, New Delhi, 2000.

REFERENCES:

1 Gurmel Singh et al. 2004. Manual of soil and water conservation practices. Oxford & IBHpublishing 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., NewDelhi

4 Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi

5 Tideman, E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.

COURSE OUTCOMES (COS)

CO1 The students will able to describe the watershed management concepts

CO2 The students will able to describe the components involved in watershed planning

CO3 The students will able to describe the methods of water harvesting structures

CO4 The students will able to design and construct the soil conservation structures

CO5 The students will able to prioritize and execute the watershed development programme

22PAG11 GROUNDWATER AND WELL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

- To acquaint and equip the students with the techniques of groundwater development andmanagement

UNIT I GROUND WATER OCCURRENCE 9

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

UNIT II WELL CONSTRUCTION 9

Groundwater structures, groundwater development and utilization, types of water wells, designand construction of water wells, drilling methods, well development, well maintenance and rehabilitation, groundwater monitoring, monitoring wells, design and construction of monitoring wells

UNIT III GROUNDWATER POLLUTION 9

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

UNIT IV GROUNDWATER MANAGEMENT 9

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

UNIT V GROUNDWATER DEVELOPMENT POLICIES 9

Major issues related to groundwater development and management in India, Legal aspects of groundwater exploitation, Diagnostic survey of sick wells/tube wells and their rehabilitation.

TOTAL: 45 PERIODS

TEXT BOOK :

1 Walton, W.C. 1976. Groundwater Resource Evaluation. Mc Graw Hill. New York.

2 Karanth, K.R. 1987. Groundwater Assessment, Development and Management. Tata-mcgraw Hill. New Delhi.

3 Michael, A.M. and Khepar, S.D. 1989. Water Well and Pump Engineering. Tata-mcgraw HillPubl. Co. New Delhi.

REFERENCES

1 Giordano, M. and Villholth, K.G 2007. The Agricultural Groundwater Revolution Volume 3.

2 CABI Head Office, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE, UK Ghosh, N.C.and Sharma, K.D. 2006. Groundwater Modelling and Management.

3 Madan Kumar Jha and Stefan Peiffer Applications of Remote Sensing and GIS Technologiesin Groundwater Hydrology: Past, Present and Future.

COURSE OUTCOMES

CO1 The students will be able to describe the concepts of aquifer parameters

CO2 The students will be able to describe the components involved in Groundwater structures

CO3 The students will be able to describe the Groundwater development and quality considerations

CO4 The students will be able to describe the Management of declining and rising water table

CO5 The students will be able to prioritize and execute the Groundwater development programme

22PAG18 DESIGN OF MICRO-IRRIGATION SYSTEM

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts, tools, and skills used to deliver water efficiently andeffectively on both a field and garden scale efficiency
- To learn about the role of irrigation water in agriculture, and the environmental factors thatinfluence the type, frequency, and duration of irrigation
- To learn about the resources and essential skills needed to determine the proper timing andvolume of irrigation, using both qualitative and quantitative methods

UNIT I MICRO IRRIGATION CONCEPT AND APPLICATIONS 9

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 II DRIP IRRIGATION DESIGN 9

Drip irrigation - Components- Dripper- types and equations governing flow through drippers- Wetting pattern- Chemigation application- Pump capacity -Installation- Operation and maintenanceof Drip irrigation system. - Design of surface and sub-surface drip irrigation.

UNIT III SPRINKLER IRRIGATION DESIGN 9

Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance- Sprinkler discharge- Water distribution pattern- Droplet size, filtering unit, fertigation - System maintenance

UNIT IV ECONOMIC ANALYSIS 9

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 V AUTOMATION IN MICRO IRRIGATION 9

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

FOR FURTHER READING

Project preparations: Design and draw the layout of a drip/sprinkler irrigation system for 10 acres, preparation of project proposal for the installation and commissioning of irrigation systems

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1 Modi, P.N., and Seth, S.M., "Hydraulics and Fluid Mechanics", Standard Book House, NewDelhi, 1991.
2 Jack Keller and Rond Belisher., "Sprinkler and Trickle Irrigation", Vannistrand Reinhold, New York, 1990.
3 Sivanappan R.K., "Sprinkler Irrigation", Oxford and IBH Publishing Co., New Delhi, 1987.
4 Keller.J and D. Karmeli, "Trickle Irrigation Design", Rainbird sprinkler Irrigation anufacturingCorporation, Glendora, California, USA.

COURSE OUTCOMES

CO1 Categorize the different types of pumps and water lifting devices based on the principle, components, and working efficiency

CO2 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.

CO3 Estimate water budgets and hydraulics used to develop irrigation schedules through micro irrigation based on crop geometry

CO4 Design drip and sprinkler irrigation system including, main line, sub main and laterals designs by consider pump capacity

CO5 Design greenhouse irrigation system and advanced types of irrigation including lift irrigation and automation

22PAG15 **PROTECTED CULTIVATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the protected cultivation of vegetables, fruits and flower crops.
- To sensitize the students on hi-tech production technology of fruits and vegetables andflower crops.
- To learn and practices the various production practices of flower and other high value crops

UNIT I PROTECTED CULTIVATION AND ITS TYPES 9

Importance and methods of protected culture in horticultural crops. Importance and scope of protected cultivation, different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house. Study of environmental factors influencing greenhouse production, cladding / glazing / covering material, ventilation systems, cultivation systems including nutrient film technique / hydroponics / aeroponic culture, growing media and nutrients, canopy management, micro irrigation and fertigation systems.

UNIT II PROTECTED CULTIVATION OF VEGETABLE CROPS 9

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

UNIT III PROTECTED CULTIVATION OF FLOWER CROPS 9

Protected cultivation technology for flower crops: Hi-tech protected cultivation of cut roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut foliages and fillers, integrated pest and disease management, postharvest handling

UNIT IV PRECISION FARMING TECHNIQUES 9

Concept and introduction of precision Farming: importance, definition, principles and concepts. Role of GIS and GPS. Mobile mapping system and its application in precision farming. Design, layout and installation of drip and fertigation 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 V PRECISION FARMING FOR HORTICULTURAL CROPS 9

Precision farming techniques for horticultural crops: Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

TOTAL: 45 PERIODS

TEXTBOOKS:

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

REFERENCES

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 anddistributors, Darya ganj, New Delhi, 1996 CO-PO Mapping —

COURSE OUTCOMES

CO1 The students will be able to describe the different methods of protected cultivation practices available for vegetable crops and flowers
CO2 The students will be able to assess the technology available for vegetable crops
CO3 The students will be able to assess the technology available for flower crops
CO4 The students will be able to assess precision farming techniques using sensors and Geographic information systems for the crops
CO5 The students will be able to assess the technology available for horticulture crops

22PAG14 **ON-FARM WATER MANAGEMENT**

L T P C

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I DESIGN OF IRRIGATION CHANNELS 9

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 II COMMAND AREA 9

Command area - Concept - CADA Programmes in Tamil Nadu; Duty of water expression - relationship between duty and delta; Warabandhi - water distribution and Rotational Irrigation System - Participatory irrigation management.

UNIT III CONJUNCTIVE USE OF SURFACE AND GROUNDWATER 9

Availability of water - rainfall, canal supply 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 IV WATER BALANCE 9

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 V DESIGN OF FARM DRAINAGE SYSTEM 9

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'sForchimer assumptions -Hooghoudt's equation; Methods & Design - Mole drains - Drainage wells - Pipe materials -Problem soils - Leaching Requirements; Land reclamation - methods of Reclamation.

TOTAL: 45 PERIODS

TEXT BOOKS

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.

REFERENCES

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 BookHouse, New Delhi,2002.
3. Suresh, R., “Land and water management principles”, Standard Publishers & Distributors,New Delhi,2008

COURSE OUTCOMES (COS)

CO1 The students will be able to design irrigation channels and diversion structures.

CO2 The students will be able to organize the different CADA programme and involved farmers to participate

CO3 The students will be able to inspect the conjunctive use of water resources by farmers

CO4 The students will be able to identify water balance between productivity and water use efficiency in agricultural land

CO5 The students will be able to design the surface and subsurface drainage systems.

22PAG37 **IRRIGATION WATER QUALITY AND WASTE WATER MANAGEMENT**

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To know the basics concepts of irrigation water quality
- To impart knowledge on water quality for irrigation purposes, besides relevant environmentalproblems and recycle and reuse concepts.
- To understand the importance of water quality for irrigation and major uses of water and therole environmental issues.

UNIT I WATER QUALITY **9**

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

UNIT II IRRIGATION WATER QUALITY **9**

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

UNIT III WATER POLLUTION **9**

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

UNIT IV RECYCLING AND REUSE OF WATER **9**

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

UNIT V WATER QUALITY MANAGEMENT **9**

Principles of water quality – Water quality classification – Water quality standards - Water qualityindices – TMDL Concepts – Water quality models

TOTAL: 45 PERIODS

TEXT BOOKS:

1. George Tchobanoglous, Franklin Louis Burton, Metcalf & Eddy, H. David Stense, "Waste waterEngineering: Treatment and Reuse", McGraw-Hill, 2002
2. Vladimir Novonty, "Water Quality: Diffuse pollution and watershed Management", 2nd edition,John Wiley & Sons, 2003
3. Mackenzie L Davis, David A Cornwell, "Introduction to Environmental Engineering", McGraw-Hill 2006.
4. Stum, M and Morgan, A., "Aquatic Chemistry", Plenum Publishing company, USA, 1985
5. Lloyd, J.W. and Heathcote, J.A., "Natural inorganic chemistry" in relation to groundwater resources, Oxford University Press, Oxford, 1988

COURSE OUTCOMES

CO1 The students will be able to describe the parameters of water quality

CO2 The students will be able to describe the concepts of water quality for irrigation

CO3 The students will be able to describe the water pollution and quality considerations**CO4** The students will be able to describe the recycling and reuse of water

CO5 The students will be able to describe the management of water quality

22PAG38 CLIMATE CHANGE AND ADAPTATION

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COURSE OBJECTIVES:

- To know the basics, importance of global warming
- To know the concept of mitigation measures against global warming
- To learn about the global warming and climate change

UNIT I EARTHS CLIMATE SYSTEM **9**

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 II ATMOSPHERE AND ITS COMPONENTS **9**

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

UNIT III IMPACTS OF CLIMATE CHANGE **9**

Causes of Climate change: Change of Temperature in the environment melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem Water Resources Human Health Industry, Settlement and Society Methods and Scenarios Projected Impacts for Different Regions Uncertainties in the Projected Impacts of Climate Change Risk of Irreversible Changes.

UNIT IV CLIMATE CHANGES AND ITS CAUSES **9**

Climate change and Carbon credits - CDM - Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCCIPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India.

UNIT V CLIMATE CHANGE AND MITIGATION MEASURES **9**

Clean Development Mechanism -Carbon Trading -examples of future Clean Technology - Biodiesel - Natural Compost - Eco-Friendly Plastic - Alternate Energy -Hydrogen - Bio-fuels - Solar Energy - Wind - Hydroelectric Power -Mitigation Efforts in India and Adaptation funding Key Mitigation Technologies and Practices-Energy Supply - Transport - Buildings- Industry- Agriculture

- Forestry - Carbon sequestration- Carbon capture and storage (CCS) - Municipal solid Waste (MSW) & Bio waste, Biomedical, Industrial waste International and Regional cooperation.

FOR FURTHER READINGS

Sequestration of carbon through renewable energy technologies

COURSE OUTCOMES

CO1 Demonstrate an understanding of how the threats and opportunities of predicted climate changes will influence specific sectors at global and regional scale

CO2 Identify the relationship between atmosphere and its components

CO3 Analyze the impacts of climate change on environment parameters

CO4 Evaluate the scientific insights underlying the assessment reports of the IPCC, with a focuson impacts, adaptation and mitigation

CO5 Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts

TOTAL: 45 PERIODS

TEXTBOOKS

1. Sangam Shrestha, Mukand S. Babel and Vishnu Prasad Pandey, 2014, Climate Change andWater Resources, CRC Press an imprint of the Taylor & Francis Group.
2. Intergovernmental Panel on Climate Change: https://www.ipcc.ch/

REFERENCES

1. Adaptation and mitigation of climate Scientific Technical Analysis, Cambridge UniversityPress, 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

22PAG39 INTEGRATED FARMING SYSTEM

L T P C
3 0 0 3

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

UNIT I INTRODUCTION OF FARMING SYSTEM 9

Farming system – introduction – scope of farming system – importance – concept – principles of farming system - Types of farming systems – Advantages and limitations - suitability – factors affecting the farming system

UNIT II INTEGRATED FARMING SYSTEM 9

Integrated farming system-historical background - objectives and characteristics advantages of IFS — Components of IFS - Integrated Farming System in Wetland — IFS in garden land —- IFS indryland and fallow land

UNIT III LIVESTOCK PRODUCTION IN IFS 9

IFS With Goats and Sheep – housing and feeding management – deworming – Young stock management - Dairy Farming in IFS - Fodder production in IFS - IFS With poultry rearing - Duck farming — Rabbit farming — Piggery

UNIT IV IFS COMPONENTS 9

Agroforestry — definition — types of agroforestry system — benefits of agroforestry system– Aquaculture – Fish cum agriculture and horticulture – Beekeeping – types and cast of bees – care and management in beekeeping – Sericulture - Mulberry cultivation – Silkworm rearing – Organicfarming — Azolla — Small scale nursery

UNIT V RESOURCE RECYCLING IN IFS 9

Resource recycling in wetland IFS - Resource flow in crop + dairy + biogas + spawn + silviculture In IFS - Biogas production through IFS — Resource recycling in crop + goat IFS - Uses and features of biogas - Structure and function of Dheenabandhu Gas plant - Vermicompost - Preparation of vermicompost from farm residue – Mushroom production in IFS.

TOTAL: 45 PERIODS

TEXTBOOKS

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

REFERENCES

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 OUTCOMES

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

22PAG40 AGRICULTURAL BUSINESS MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

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

UNIT I CONCEPTS OF AGRICULTURAL BUSINESS 9

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

UNIT II AGRI – BUSINESS ORGANIZATION 9

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

UNIT III AGRICULTURAL MARKETING 9

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

UNIT IV AGRICULTURAL BUSINESS FINANCE 9

Forms of agri-business organizations - Role of lead bank in agribusiness finance - Financial management. Acquiring capital- Budget analysis. Concepts and determinants- Business project scheduling of raw material procurement - production management - launching products (branding, placement) - Input marketing promotion activities.

UNIT V MARKET PROMOTION AND HUMAN RESOURCES 9

Agricultural products - marketing promotion activities - product pricing methods. District Industries Centre - Consumer survey - Agricultural inputs retailing - Market potential assessment - types of distribution channels - Return on Investment - Personnel management. Recruitment, selection and training - Technology in Agri Business

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Himanshu, “Agri Business Management – Problems and prospects”, Ritu Publications, Jaipur,2005.
2. Smita Diwase, “Indian Agriculture and Agribusiness Management”, Krishi resourceManagement Network, Pune 2004.

REFERENCES:

1. Chandra Prasanna, “Projects: Preparation, Appraisal, Budgeting and Implementation”, TataMcGraw Hill Publications, New Delhi, 2001.
2. Kotler, P., “Marketing Management. Analysis, Planning and Control”, Prentice Hall Inc., NewYork, 2001.
3. Rao, V.S.P., and Narayana, P.S., “Principles and Practices of Management”, Konark Publishing Private Limited, New Delhi, 2001.
4. Tripathy, P.C., and Reddy, P.N., “Principles of Management”, Tata McGraw Hill Publications, New Delhi, 2000.

COURSE OUTCOMES

CO1 Understand the concepts and fundamentals of management with reference to agribusiness. **CO2** Gain knowledge about organization and functioning of different institutions involved inagriculture marketing
CO3 Understand the different concepts of inventory management of agricultural inputs
CO4 Expose students to various concepts of financing Agri Business
CO5 Have the knowledge of marketing agricultural products and the techniques involved

22PAG04 SUSTAINABLE AGRICULTURE AND FOOD SECURITY L T P C
3 0 0 3

COURSE OBJECTIVES:

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

UNIT I SUSTAINABILITY OF NATURAL RESOURCES 9

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 II SUSTAINABLE AGRICULTURE 9

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 III ORGANIC FARMING 9

Natural farming principles – Sustainability in rain fed farming – organic farming – principles and practices. Organic farming-regulation and sustainability – The scale and productivity of organicsustainable systems.

UNIT IV SUSTAINABLE FOOD PRODUCTION FOR FOOD SECURITY 9

Performance of Major Food Crops over the past decades – trends in food production – Decline intotal 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 V POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE ANDFOOD SECURITY 9

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: 45 PERIODS

TEXTBOOKS:

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 PublishingAgency, New Delhi, 2007.

REFERENCES:

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 sustainableagriculture, Scitech Publications, Chennai, 1999.
3. Tanji, K. K., and Yaron, B. Management of water use in agriculture, Springer Verlag, Berlin,Germany, 1994.

COURSE OUTCOMES:

CO1 Understand methods to sustain land resources.
CO2 Cognize approaches to sustain water resources and its utilization for agriculture and allied activities.
CO3 Design and develop new, improved and sustainable systems of agriculture and allied activities.
CO4 Understand new technologies for improving food security.
CO5 Comprehend policies to achieve sustainable farming and food security.

22PAG41 SYSTEMS ANALYSIS IN AGRICULTURAL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

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

UNIT I SYSTEM CONCEPTS 9

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

UNIT II LINEAR PROGRAMMING 9

Introduction to operations research – Linear programming, problem formulation, graphical solution,solution by simplex method – Sensitivity analysis, application to design and operation of reservoir, single and multipurpose development plans – Irrigation water allocation-Cropping pattern optimization.

UNIT III SIMULATION 9

Basic principles and concepts – Random variate and random process – Monte Carlo techniques – Model development – Inputs and outputs – Single and multipurpose reservoir simulation models – Deterministic and stochastic simulation – Irrigation Scheduling.

UNIT IV DYNAMIC PROGRAMMING 9

Bellman's optimality criteria, problem formulation and solutions — Application to design and operation of reservoirs, Single and multipurpose reservoir development plans — Applications in Irrigation management.

UNIT V OPTIMIZATION TECHNIQUES 9

Integer and parametric linear programming — Applications to Irrigation water management-Goalprogramming models with applications.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Vedula, S., and Majumdar, P.P. Water Resources Systems — Modeling Techniques andAnalysis 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.

REFERENCES

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 OUTCOMES

CO1 Understand practical knowledge on specialized in different water resources and irrigationsystem.

CO2 Apply the Linear programming for crop planning and scheduling.

CO3 Apply the Dynamic Programming for reservoir release for irrigation management.

CO4 Design a reservoir irrigation system simulation model for efficient water management

CO5 To evaluate the application of optimization techniques used to address the socio-technicalaspects irrigation water management.

22PAG21 IT IN AGRICULTURAL SYSTEM

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the students to areas of agricultural systems in which IT and computers play amajor role.
- To also expose the students to IT applications in precision farming, environmental controlsystems, agricultural systems management and weather prediction models.

UNIT I PRECISION FARMING 9

Precision agriculture and agricultural management — Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS 9

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 III AGRICULTURAL SYSTEMS MANAGEMENT 9

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 IV WEATHER PREDICTION MODELS 9

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 V E-GOVERNANCE IN AGRICULTURAL SYSTEMS 9

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: 45 PERIODS

TEXTBOOKS:

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, EnvironmentalControl and Farm Management in Protected Cultivation”, 1989.

REFERENCES:

1. Peart, R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, NewYork, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., “Applications of Seasonal Climate”, Springer,Germany, 2000.

COURSE OUTCOMES:

CO1 The students shall be able to understand the applications of IT in remote sensing applicationssuch as Drones etc.

CO2 The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages.

CO3 The students will be able to apply IT principles and concepts for management of field operations.

CO4 The students will get an understanding about weather models, their inputs and applications.

CO5 The students will get an understanding of how IT can be used for e-governance in agriculture.

22PAG42 AUTOMATION IN AGRICULTURE

L T P C

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION **9**

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 II PRECISION FARMING **9**

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

UNIT III ROBOTICS IN AGRICULTURE **9**

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

UNIT IV AUTOMATION USING IoT **9**

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

UNIT V AUTOMATION OF AGRICULTURE OPERATION **9**

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

TOTAL: 45 PERIODS

TEXTBOOKS

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.

REFERENCES

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

COURSE OUTCOMES

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

22PAG13 LANDSCAPE ARCHITECTURE

L T P C

3 0 0 3

COURSE OBJECTIVES::

- 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.
- To study the contemporary landscape and the manifestation in the western and Indian contexts.

UNIT I BASICS OF LANDSCAPE ARCHITECTURE 9

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 II LANDSCAPE FORMULATIONS 9

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 III SITE MOBILIZATION 9

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 IV ILLUMINATION 9

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 V IRRIGATION FEATURES 9

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: 45 PERIODS

COURSE OUTCOMES:

CO1 To equip the students to do landscape working drawings and preparation of bill of quantitiesand estimation.
CO2 To understand the design solutions for larger sites and express the same using models.
CO3 To understand the different concepts of landscape formulations.
CO4 To acquire the knowledge of illumination and lighting.
CO5 To obtain the knowledge on design of water bodies and irrigation systems.

TEXT BOOKS

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 andDesign. 5th edition. McGraw-Hill Professional.

REFERENCES

1. Shaheer, M., Dua, G.W. and Pal, A.2012. Landscape Architecture in India: A Reader. IndianJournal of Landscape Architecture.
2. Reid, G. W. 1993. From Concept to Form: In Landscape Design. John Wiley & Sons.