DHANALAKSHMI SRINIVASAN UNIVERSITY

SAMAYAPURAM (NEAR SAMAYAPURAM TOLL PLAZA),

TIRUCHIRAPALLI – 621 112 TAMIL NADU, INDIA

SCHOOL OF ENGINEERING AND TECHNOLOGY

B. TECH AGRICULTURAL ENGINEERING
FULL SEMESTER WISE CURRICULUM

SEMESTER-I								
S.No.	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1	21ENG01	Basics In Communication	HS	4	3	0	1	3
2	21MAT01	Algebra and Calculus	BS	4	3	1	0	4
3	21CHY01	Engineering Chemistry	BS	3	3	0	0	3
4	21GEN01	Engineering Graphics & Design	ES	5	1	0	4	3
5	21GEN02	Programming for Problem Solving	ES	3	3	0	0	3
6	21NCP01	Yoga	-	2	0	0	0	0
PRACTICAL								
7	21CHYP1	Engineering Chemistry Laboratory	BS	2	0	0	2	1
8	21GENP2	Programming for Problem Solving Laboratory	ES	2	0	0	2	1
		TOTAL		**25**	**13**	**1**	**9**	**18**
SEMESTER-II								
S.No.	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1	21ENG02	Technical Communication	HS	2	2	0	0	2
2	21MAT02	Advanced Calculus and ODE	BS	4	3	1	0	4
3	21PHY01	Engineering Physics	BS	3	3	0	0	3
4	21GEN03	Basic Electrical & Electronics Engineering	ES	3	3	0	0	3
5	21MEC01	Engineering Mechanics	ES	4	3	1	0	4
6	21NCP02	NSS		3	0	0	0	0
PRACTICAL								
7	21PHYP1	Engineering Physics Laboratory	BS	2	0	0	2	1

8	21GENP5	Workshop Practices Laboratory	ES	4	0	0	4	2
9	21ENGP2	Communication Skills Laboratory	HS	2	0	0	2	1
		TOTAL		**27**	**14**	**2**	**8**	**20**
SEMESTER-III								
S.NO	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1	21MAT05	Numerical Solutions	BS	4	3	1	0	4
2	21AGR01	Fundamentals of Soil Science	PC	4	3	0	0	3
3	21AGR02	Surveying & Levelling	PC	4	3	0	0	3
4	21AGR03	Irrigation Systems	PC	3	3	0	0	3
5	21AGR04	Fluid and Applied Hydraulics Engineering	PC	4	3	0	0	3
6	21AGR05	Agricultural Process Engineering	PC	3	3	0	0	3
7	21NCP03	Environmental Science	MC	3	3	0	0	0
PRACTICAL								
8	21AGRP1	Surveying lab	PC	4	0	0	4	2
9	21AGRP2	Hydraulic Engineering Lab	PC	4	0	0	4	2
		TOTAL		**33**	**21**	**1**	**8**	**23**
SEMESTER -IV								
S.NO	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1	21AGR06	Strength of Materials	PC	4	3	1	0	4
2	21AGR07	Drainage Engineering	PC	3	3	0	0	3
3	21AGR08	Mechanics of soil	PC	4	3	0	0	3
4	21AGR09	Agronomy	PC	3	3	0	0	3
5	21AGR10	Ground Water and Well Engineering	PC	3	3	0	0	3
6	21NCP04	Renewable Energy Sources	MC	3	3	0	0	0
PRACTICAL								
7	21AGRP3	Strength of Material Lab	PC	4	0	0	4	2
8	21AGRP4	Agricultural Engineering practice lab	PC	4	0	0	4	2
		TOTAL		**28**	**18**	**1**	**8**	**20**
SEMESTER -V								
S.NO	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								

1	21AGE11	Soil &Water conservation Engineering	PC	3	3	0	0	3
2	21AGE12	Post Harvest Engineering	PC	3	3	0	0	3
3	21AGE13	Dairy & Food Process Engineering	PC	4	3	1	0	4
4	21NCP05	Essence of Indian Traditional Knowledge	MC	3	3	0	0	0
5		Professional Elective-1	PE	3	3	0	0	3
6		Professional Elective-2	PE	3	3	0	0	3
PRACTICAL								
7	21AGEP5	Diary and Food Engineering Lab	PC	4	0	0	4	2
8	21AGEP6	Soil Mechanics Laboratory	PC	4	0	0	4	2
9	21ENGP3	Professional Communication Lab	HS	2	0	0	2	1
TOTAL				**29**	**18**	**1**	**10**	**21**
SEMESTER -VI								
S.NO	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1	21AGE16	Micro Irrigation system	PC	4	3	1	0	4
2	21AGE17	Farm machinery and Equipment	PC	4	3	1	0	4
3	21AGE18	Building Materials	PC	3	3	0	0	3
4		Professional Elective-3	PE	3	3	0	0	3
5		Professional Elective-4	PE	3	3	0	0	3
PRACTICAL								
6	21AGEP7	Farm machinery and equipment Lab	PC	4	0	0	4	2
7	21AGEP8	Industrial Mini project	EEC	0	0	0	1	1
TOTAL				**21**	**15**	**2**	**5**	**20**
SEMESTER -VII								
S.NO	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1	21AGE19	Solid Waste Management	PC	3	3	0	0	3
2	21AGE20	Tractor and Power units	PC	3	3	0	0	3
3		Professional Elective-5	PE	3	3	0	0	3
4	21UHV02	Universal Human Values - II	HS	3	2	1	0	3
5		Open Elective-1	OE	3	3	0	0	3
6	21GEN06	Disaster Management	HS	3	3	0	0	3
PRACTICAL								
7	21AGEP9	Building Materials and Structural Drawing Lab	PC	4	0	0	4	2

8	21AGEP10	Industrial Training (4 weeks During VI Semester –Summer)	EEC	0	0	0	0	2
		TOTAL		**22**	**18**	**0**	**4**	**22**
SEMESTER -VIII								
S.NO	**COURSE CODE**	**COURSE TITLE**	**Subject category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1		Professional Elective-6	PE	3	3	0	0	3
2		Open Elective-2	OE	3	3	0	0	3
PRACTICAL								
2	21AGEP11	PROJECT WORK	PC	20	0	0	20	10
		TOTAL		**26**	**6**	**0**	**20**	**16**
		TOTAL PRGRAMME CRDITS						**160**
PROFESSIONAL ELECTIVE-1								
1	21AGE21	Design of structures	PE	3	3	0	0	3
2	21AGE22	Food packaging Technology	PE	3	3	0	0	3
3	21AGE23	Seed Technology	PE	3	3	0	0	3
4	21AGE24	Agricultural Extension	PE	3	3	0	0	3
5	21AGE25	On Farm Water Management	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE-2								
1	21AGE26	Green Energy	PE	3	3	0	0	3
2	21AGE27	Technology in Agricultural Systems	PE	3	3	0	0	3
3	21AGE28	Tillage and traction Engineering	PE	3	3	0	0	3
4	21AGE29	Storage and Packaging Technology	PE	3	3	0	0	3
5	21AGE30	Special Farm Equipment	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE-3								
1	21AGE31	Heat and Mass Transfer	PE	3	3	0	0	3
2	21AGE32	Tractor systems and controls	PE	3	3	0	0	3
3	21AGE33	Hydrology and water shed Management	PE	3	3	0	0	3
4	21AGE34	Energy Auditing and Management	PE	3	3	0	0	3
5	21AGE35	Climate Change and Adaptation	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE-4								
1	21AGE36	Air Pollution Control	PE	3	3	0	0	3
2	21AGE37	Remote sensing and GIS	PE	3	3	0	0	3

3	21AGE38	Ergonomics and Safety in Agricultural Engineering	PE	3	3	0	0	3
4	21AGE39	Intellectual Property Rights	PE	3	3	0	0	3
5	21AGE40	Refrigeration and Air Conditioning for Agricultural Engineers	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE-5								
1	21AGE41	Wastewater Treatment	PE	3	3	0	0	3
2	21AGE42	Total Quality Management	PE	3	3	0	0	3
3	21AGE43	Agricultural Waste Management	PE	3	3	0	0	3
4	21AGE44	Process Engineering of Fruits and Vegetables	PE	3	3	0	0	3
5	21AGE45	CAD for Agricultural Engineering	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE-6								
1	21AGE46	Estimation and Valuation	PE	3	3	0	0	3
2	21AGE47	Instrumentation and Control Engineering in Agriculture	PE	3	3	0	0	3
3	21AGE48	Fundamentals of Nanoscience	PE	3	3	0	0	3
4	21AGE49	Systems Analysis and Soft Computing in Agricultural Engineering	PE	3	3	0	0	3
5	21AGE50	Sustainable Agriculture and Food Security	PE	3	3	0	0	3
OPEN ELECTIVE								
1	21OEE01	Waste to Energy	OE	3	3	0	0	3
2	21OEE02	Industrial Pollution Prevention	OE	3	3	0	0	3
3	21OEE03	Industrial Safety	OE	3	3	0	0	3
4	21OEE04	Energy Management	OE	3	3	0	0	3
VALUE ADDED COURSES								
1	21VAC01	Introduction to Sustainability		3	3	0	0	0
2	21VAC02	Sustainable Agricultural Land Management		3	3	0	0	0

SEMESTER I (CSE, IT, ECE, BME, BT and AGRI)								
S. No.	**Course Code**	**Course Name**	**Course Category**	**Contact Hours**	**L**	**T**	**P**	**C**
Theory								
1	21ENG01	Basics In Communication	HS	4	3	0	1	3
2	21MAT01	Algebra and Calculus	BS	4	3	1	0	4
3	21CHY01	Engineering Chemistry	BS	3	3	0	0	3
4	21GEN01	Engineering Graphics & Design	ES	5	1	0	4	3
5	21GEN02	Programming for Problem Solving	ES	3	3	0	0	3
6	21NCP01	Yoga		2	0	0	0	0
Practical								
7	21PHYP1	Engineering Physics Laboratory	BS	2	0	0	2	1
8	21GENP2	Programming for Problem Solving Laboratory	ES	2	0	0	2	1
Total				25	13	1	9	18

21ENG01	BASICS IN COMMUNICATION	L	T	P	C
		3	0	1	3

Course Objectives:

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning and materials used in the classroom to develop the listening skill.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT-I **LISTENING SKILLS** **12 Hours**

Listening to the sounds, silent letters & stress in English - words & sentences - Listening to conversation & telephonic - greetings, comments on the topic-excuses- general wishes, positive comments, thanks- telephonic conversation- viewing model interviews (face to face, video conferencing)- viewing a model group discussion and reviewing the performance of each participant- Sentence definition - Spelling & punctuation.

UNIT-II **SPEAKING SKILLS** **12 Hours**

Self-introduction -Expressing personal opinion -Dialogue & Conversation -Simple oral interaction - Speaking on a topic - Expressing views for & against. Adverbs -Adjectives – Comparative and Numerical adjectives -Nouns & compound nouns -Prefixes and suffixes. , Imperative forms- sequencing of sentences- Wh- questions

UNIT-III **READING SKILLS** **12 Hours**

Reading anecdotes, short stories, poems- an article from newspaper, critical reading - Reading pie chart & bar chart- Skimming and scanning -Reading-comprehension exercises - Words and their function -Different grammatical forms of the same word- Speed reading- reading passages with time limit- reading the job advertisement and the profile of the company concerned – note making skills- making notes from books or any form of written material.

UNIT-IV **WRITING SKILLS** **12 Hours**

Writing emails, notes, messages, memos, notices, agendas, advertisements, leaflets, brochures - Instructions, recommendations & checklists -Writing paragraphs -Comparisons & contrasts -Process description of Flow charts - Interpretation of Bar charts & Pie charts. - Correction of errors - Subject-verb Concord -Articles -Prepositions - Tenses- Active and passive voice- Impersonal passive

UNIT-V **INTRODUCTION TO COMMUNICATION** **12Hours**

Need for effective communication - Functions of Communication & Induction to the students - barriers to effective communication - non-verbal communication - body language. - Introduce oneself -Reading Newspaper - Magazine - Journal etc.

Course Outcomes:

- Learners should be able to speak clearly, confidently, comprehensibly, and communication with one or many listeners using appropriate communication strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range organizing their ideas logically on a topic.
- Read different genres of texts adopting various reading strategies.
- Listen/ view and comprehend different spoken discourses/ excerpts in different accents.

Text Books:

1. Muralikrishna C., Sunita Mishra "Communication Skills for Engineers" 2nd edition, Pearson, New Delhi 2010
2. Mahalakshmi.N. English workbookm – 1for Engineers. Chennai,VK Publications,2013.

Reference:

1. Vyas Manish A., Yogesh L. Patel, "Tasks for the English Classroom", MacMillan, New Delhi, 2012.
2. Achar Deeptha, Charul Jian and et al, English for Academic Purposes,Book-1&2 University Granthnirman Board, Gujarat, 2011
3. Michael vince, 'Advanced Language Practice', Macmillan Education, oxford,2003
4. Eisenbach Iris, "English for Materials Science and Engineering", Springer Fachmedien Wiesbaden GmbH 2011
5. Lougheed Lin, "Business Correspondence: A Guide to Everyday Writing', Longman, Pearson Education, Inc, 2003.

21MAT01	ALGEBRA AND CALCULUS (COMMON TO ALL BRANCHES)	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide the skills to the students for solving different real time problems by applying Algebra, matrices and differential calculus.
- Understand the concepts of improper and proper integrals and their applications
- Extend their knowledge of derivatives to find curvature, evolutes, etc., and measure extreme values of a given function of several variables.
- Compute external values which arise in functions of several variables.

UNIT I **ALGEBRA AND MATRICES** **12Hours**

Inverse and rank of matrices - System of linear equations-Symmetric, Skew symmetric and orthogonal matrices - Unitary matrices-Eigen values and Eigen vectors - Diagonalization of matrices - Cayley-Hamilton Theorem-Reduction from quadratic form to canonical form.

UNIT II **DIFFERENTIAL CALCULUS** **12Hours**

Curvature of curve - Center and Radius of Curvature (Cartesian polar, parametric and implicit form) Evolutes - Involutes - Envelopes (one parameter and two parameter) - Evolutes as the envelope of normal.

UNIT III **INTEGRAL CALCULUS** **12Hours**

Methods of integration-Definite integrals and its properties-Reduction formula for $e^{ax}x^n$, $\sin^m x$, $\cos^n x$, $\sin^m x \cos^n x$ (without proof) - Problems of Beta and Gamma functions - Inter-relation.

UNIT IV **APPLICATIONS OF DIFFERENTIAL CALCULUS & INTEGRAL CALCULUS** **12Hours**

Applications of differential calculus -Tangent & Normal –Angle of intersection of two curves – Angle between tangents - Velocity and acceleration - Applications of Integral calculus - Area and Volume in Cartesian and polar coordinates

UNIT V **FUNCTIONS OF SEVERAL VARIABLES** **12Hours**

Limits and continuity - partial derivatives -Total derivatives-differentiation of implicit functions - Jacobian - properties of Jacobians - Taylor's series for functions two variables - Maxima and Minima of functions of two variables (proofs of theorems are not included) - Constrained Maxima and Minima-Lagrange's method of multipliers.

Course Outcomes:

- After the completion of the course the student will be able to
- Solve engineering problems which needs matrix computations.
- Concept of Eigen values and eigenvectors and to reduce the quadratic form to canonical form.
- Identify Radius, Centre, Envelope and circle of curvature and apply them in the problem solving.
- Evaluation of improper integrals using beta and gamma functions
- Apply the concepts in solving physical problems arising in engineering

- Students should be able to apply the basic concepts of differential calculus to solve problems released function to maxima and minima of a single and two variables.

Text Books:

- B.S.Grewal . “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd edition, 2014.
- James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015
- Thomas’ Calculus, George B.Thomas, D.Weir and J. Hass, 13th edition, Pearson, 2014.
- N.P. Bali, “A Text Book of Engineering Mathematics”, 13th edition.

References:

1. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
2. Narayanan, S. and Manicavachagom Pillai, T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.

Reference Links:

https://nptel.ac.in › courses
https://en.wikipedia.org

21CHY01	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

Course Objectives:

The objective of the Engineering Chemistry is

- To acquaint the students with the basic phenomenon of chemistry.
- To acquire knowledge about desalination of water and treatment of municipal water.
- To learn about conducting polymers and fiber-reinforced plastics.
- To enhance the thinking abilities in line with the modern trends in engineering and technology.

UNIT I **WATER TREATMENT TECHNOLOGY** **9 Hours**

Definition of hard and soft water, Sources of water and classification of impurities, Hardness and its types, Units of hardness - Determination of hardness of water by EDTA method - Boiler fed water–Scale and Sludge formation in boiler, Priming & Foaming, Caustic Embrittlement - Internal treatment methods. Water softening processes–Zeolite process, Ion-exchange process - Brackish water treatment - Electro dialysis, Reverse osmosis - BOD, COD-definition and significance. Sterilization- ozonolysis, UV, chlorination, Specifications (Indian standards) for drinking water.

UNIT II **CHEMICAL THERMODYNAMICS** **9 Hours**

Introduction – Importance of thermodynamics – Definitions – System – Surrounding - State function – Path function– Extensive and intensive properties - Laws of thermodynamics First law – Significance – Mathematical formulation and its applications. Second law – Need for the second law – Enthalpy – Entropy - Third law statement and its significance - Gibbs free energy – Helmholtz free energy - Spontaneity and its criteria - Maxwell relations - Gibbs -Helmholtz equation (relating E & A) and (relating H & G) - van't Hoff equations

UNIT III **ELECTROCHEMISTRY** **9 Hours**

Electrochemical cells – reversible & irreversible cell - EMF- measurement of EMF - Significance of electrochemical series - Single electrode potential-Nernst equation-numerical - Reference electrode-SHE-Calomel electrode - Conductometric titration- Concentration cells with and without transfer. ISE-Glass electrode-measurement of PH - Potentiometric titration - Precipitation titration.

UNIT IV **POLYMERS AND REINFORCED PLASTICS** **9Hours**

Classification of polymers-types of polymerization reactions - Mechanism of addition polymerization: free radical, ionic - Ziegler-Natta-effect of structure - Properties of polymers-strength, plastic deformation, elasticity and crystallinity - Preparation and properties of important resins: Polyethylene, PVC, PMMA - Polyester, Teflon, Bakelite and Epoxyresins - Compounding of plastics- moulding methods -injection, extrusion - Compression and calendaring- reinforced plastics-FRP - Conducting polymers and its applications.

UNIT V	SPECTROSCOPY	9Hours

Introduction – Electromagnetic radiation-absorption of electromagnetic radiation - Beer-Lambert's law - Principle & instrumentation of UV-Visible spectroscopy - Principle & instrumentation and application of microwave and IR spectroscopy - Estimation of iron by colorimetry.

Course Outcomes:

- Students will be able to develop innovative methods to produce soft water for industrial use and portable water at cheaper cost.
- Analyze the need, design and perform a set of experiments.
- Identify the structure of unknown compounds with the help of spectroscopy.

Text Books

1. Gopalan, R, D.Venkappayya and Sulochana Nagarajan, A Textbook of Engineering Chemistry. Vikas Publishing House, New Delhi, 4thedition, 2013.
2. Uma Maheswari, K. and Philip Anthony, S. *Chemistry for Engineers*, McGraw Hill Publishing Company, Chennai, 2019.

Reference

- Kuriacose J. C and J. Rajaraman. Chemistry in Engineering and Technology. Vol I & II. Tata McGraw Hill Publishing Company.
- Engineering Chemistry- R. Sivakumar and N. Sivakumar. Tata McGraw Hill publishers (2009).
- P.C.Jain and Monica Jain - "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
- Gopalan, R, D.Venkappayya and Sulochana Nagarajan, A Textbook of Engineering Chemistry.Vikas Publishing House, New Delhi, 4thedition,2013.

21CHYP1	ENGINEERING CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To introduce different experiments to test basic understanding of Engineering chemistry concepts

Lab Practice — 10 Hours

1. Estimation of total, permanent and temporary hardness by EDTA method.
2. Conductometric titration-determination of strength of (a) strong acid vs strong base, (b) Acid in a mixture of acids.
3. Estimation of Fe^{2+} by potentiometry.
4. Determination of molecular weight of a polymer by viscosity average method.
5. Estimation of Nickel/Zinc- complexometric titration.
6. Determination of total alkalinity and acidity of a water sample.
7. Determination of rate of corrosion by weight loss method.

Course Outcome:

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

- Apply different types of estimation and titration method to study the properties of different type of chemicals and polymers.

21GEN01	ENGINEERING GRAPHICS & DESIGN	L	T	P	C
		1	0	4	3

Course Objectives:

- Understand and appreciate the importance of basic concepts and principles of Engineering Drawing (components, sections, views, and graphical representation).
- Enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
- Students will be able to draw orthographic projections and sections.
- To know projection of points, straight lines, solids etc.
- To know development of different types of surfaces and isometric projection.
- Develop the ability to communicate with others through the language of technical drawing and sketching. And the ability to read and interpret engineering drawings created by others.

UNIT I	CONIC SECTIONS, SPECIAL CURVES & ORTHOGRAPHIC PROJECTION	10 Hours

Basics of Drawing & Dimensioning - Conic Sections - Eccentricity Method - Cycloids & Involutes Representation of Three-Dimensional objects & Layout of views - Orthographic Projections & Free hand sketching

UNIT II	PROJECTION OF POINTS, LINES & PLANES	10 Hours

Four Angles of Projection - Projection of Points in different quadrants - Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations - Projection of planes (polygonal and circular surfaces) inclined to both the principal planes

UNIT III	PROJECTION OF SOLIDS	10 Hours

Classifications of Solids - Projection of prisms & pyramids - Projection of Cylinders & Cones - Projection of Truncated Solids

UNIT IV	SECTION OF SOLIDS & DEVELOPMENT OF SURFACES	10 Hours

Reason for sectioning - Sectioning of solids in simple vertical position - Obtaining true shape of the section - Development of lateral surfaces of simple and sectioned solids

UNIT V	ISOMETRIC PROJECTION	10 Hours

Isometric scales - Isometric projections of simple and truncated solids

Demonstration Only	INTRODUCTION TO COMPUTER AIDED DRAFTING	10 Hours

2D Drafting activities such as Drawing, Editing, Dimensioning, Layering & Hatching - Detailed Drawing practice of Prisms, Pyramids, Cylinders & Cones - Modelling the regular solids and section it to obtain the sectional views

Course outcomes:

On completion of the course the students will be able to

- gain knowledge on international standards of drawings and to draw the different types of projections for points, lines and planes.
- draw the different projections of primitive 3D objects like cylinder, cube, cone etc.
- draw sections of solids including prisms, cylinders, pyramids, and cones.
- understand the concepts of development of surfaces of simple and truncated solids
- draw the isometric projections for the given object

Text Books:

1. Venugopal K and Prabhu Raja V, "Engineering Graphics", New AGE International Publishers, 2015.
2. Natarajan K. V., "A text book of Engineering Graphics", 28th Ed., Dhanalakshmi Publishers, Chennai, 2015.
3. Jeyapoovan, T., "Engineering Drawing and Graphics using AutoCAD", Vikas Publishing House Pvt. Ltd., New Delhi, 2010.
4. Bethune, J.D., "Engineering Graphics with AutoCAD 2013", PHI Learning Private Limited, Delhi, 2013.

Reference Books:

1. Bhatt, N. D. and V. M. Panchal. "Engineering Drawing" Charotar Publishing house, 2012.
2. Gopalakrishna, K. R. "Engineering Drawing" Subas Publications, 2010.

21GEN02	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
		3	0	0	0

Course Objectives:

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

UNIT I INTRODUCTION TO COMPUTING AND PYTHON 9 Hours

Fundamentals of Computing - Computing Devices - Identification of Computational Problems Pseudocodes and Flowcharts - Instructions – Algorithms – Building Blocks of Algorithms - Introduction to Python: Features of Python, History and Future of Python - Working with Python Interactive and script mode - Identifiers and Keywords, Comments, Indentation and Multi-lining

UNIT II DATA TYPES AND EXPRESSION 9 Hours

Data types - Built-in data types – Operators - Boolean Values - Operator Precedence – Expression - Function Call and Returning Values - Parameter Passing - Local and Global Scope – Recursive Functions

UNIT III DECISION & CONTROL FLOW 9 Hours

Selection/Conditional Branching Statements: if, if-else, nested if, if-elif-else statement(s), Basic Loop Structures - Iterative Statements – while and for loop, Nested loops, break and continue statement, pass Statement, else Statement used with loops - Strings: Introduction, Indexing & Traversing - Concatenating, Appending - Multiplying, Formatting - Slicing, Comparing, Iterating - Basic Built-In String Functions

UNIT IV FUNCTIONS & LISTS 9 Hours

Functions: Communicating with functions - Variable Scope and lifetime - Return statement - Types of arguments - Lambda functions - Recursive functions - Lists: list operations & list slices - list methods, list loop and mutability - Aliasing, cloning lists and list parameters

UNIT V DICTIONARIES AND MODULES 9 Hours

Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting - Sorting, Looping & Nested Dictionaries Built-in Dictionary Function - Finding Key and Value in a Dictionary - Modules – Module Loading and Execution – Packages - Python Standard Libraries

Course Outcomes:

Upon completion of the course, students will be able to

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

Text Books

1. Think Python: How to think like a Computer Scientist Allen B. Downey Shroff O'Reilly Publishers 2nd edition 2016.
2. An Introduction to Python – Revised and updated for Python 3.2 Guido van Rossum and Fred L. Drake Jr Network Theory Ltd., 2018.

Reference Books

1. Introduction to Computer Science using Python: A Computational Problem-Solving Focus Charles Dierbach Wiley India Edition 2013
2. Introduction to Programming in Python: An Inter-disciplinary Approach Robert Sedgewick, Kevin Wayne, Robert Dondero Pearson India Education Services Pvt. Ltd 2016
3. Fundamentals of Python: First Programs Kenneth A. Lambert CENGAGE Learning 2012

21GENP2	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

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

Lab Practice — 15 Hours

1. Demonstrate to numeric value.
2. Find the number is even or odd using a for loop.
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Implement Merge Sort, Selection sort & Insertion sort
7. First n prime numbers
8. Multiply matrices
9. Demonstrate list and tuples in python.
10. Programs that take 2 numbers as command line arguments and print its sum.
11. Find the most frequent words in a text read from a file

Course Outcomes:

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

- Develop algorithmic solutions to simple computational problems
- Develop and execute simple Python programs.
- Implement programs in Python using conditionals and loops for solving problems.
- Deploy functions to decompose a Python program.
- Process compound data using Python data structures.
- Utilize Python packages in developing software applications.

21ACY01	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

- Learners will be familiar with this course provides the Python Training module will make the reader accustomed to python language.
- This will help the reader in understanding the basics of the python language, Python libraries and the use of python for the analytics.
- Understanding what Python, its advantages and disadvantages, is how to run python scripts, how to use variables, string operator and functions.
- Understanding the different topics which are important from the point of view of data analytics and analysing some advance data analytics techniques.

UNIT I		6 Hours

What python is actually - advantages and disadvantages of python - how to get started with python and its different versions - variables, strings and functions - use the mathematical operators and functions - different statement like if, for etc.

UNIT II		6 Hours

Python libraries - details of the pandas library - series and data frames and grouping and aggregating and merging and joining - error handling in python and re objects - pattern matching and parsing of data and regression with use case study - exploratory data analysis and correlation matrix

UNIT III		6 Hours

Visualization using matplotlib - advance machine learning algorithms - support vector machine random forest - install and get start with python - churn analysis with use case

UNIT IV		18 Hours

How to use basic variables and strings in python - Work with mathematical operators in python - input data in python - boolean with python - if and elif statement in python - while loop in python - lists – functions - string operator – variables - python scripts - disadvantages of python - advantages of python

UNIT V		9 Hours

Python in different ways - Boolean and other statements - in depth working of Python like inputting the data - use of pandas' library for data analysis - different type of errors that one can encounter while working with Python - miscellaneous things in python - regression analysis with the help of a use case - different topics which are important from the point of view of data analytics - some advance data analytics techniques

Course Outcomes:

- Understanding what Python, its advantages and disadvantages, is how to run python scripts, how to use variables, string operator and functions.
- Understanding to consist more in depth working of Python like inputting the data, working with Boolean and other statements.
- Analyzing to provide the use of pandas' library for data analysis.
- Analyzing how to deal with different type of errors that one can encounter while working with
- Python.
- Creating and finding how to deal with miscellaneous things in python and regression analysis with the help of a use case.
- Understanding the different topics which are important from the point of view of data analytics and analyzing some advance data analytics techniques.

Text Books:

1. Software Foundation Course with Python Programming © Copyright International Business Machines Corporation 1993, 2009. US Government Users Restricted Rights - Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

Reference Books:

1. E Balagurusamy., "Python programming concepts", Tata McGraw-Hill 2015, India.
2. Robert Lafore, "Programming in Python", Waite Group, December 2013.
3. Herbert Schildt, "Python - The Complete Reference", Tata McGraw-Hill 2014, New Delhi.
4. Bjarne Stroustrup: "The Python Programming Language" (4th Edition). Addison-Wesley. May 2012.
5. Elements of Programming Interviews in Python: The Insiders' Guide, 2nd edition by 15 September 2016.

Other Resources (Online Resources or others)

1. Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction To Programming by Eric Matthes Programming Languages.
2. Learning Python, Programming Python, and Python Pocket Reference, all currently in fourth or fifth editions. He has been using and promoting Python since 1992, started writing Python books in 1995, and began teaching Python classes in 1997.

21ACYP1	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

- To understand how to use variables, string operator and functions.
- To understand how to create more in depth working of python like inputting the data.
- To understand how to provide the use of pandas' library for data analysis.
- To understand how to deal with different type of errors that one can encounter while working with python.
- To understand the try, throw, catch, throwing an exception, catching an exception.
- To understanding the different topics which are important from the point of view of data analytics and analyzing some advance data analytics techniques.

Lab Practice

15 Hours

1. Analyzing how to run python scripts.
2. Analyzing how to use variables, string operator and functions.
3. Creating more in depth working of python like inputting the data.
4. Understanding and working with Boolean and other statements.
5. Understanding to provide the use of pandas' library for data analysis.
6. Understanding how to deal with different type of errors that one can encounter while working with python.
7. Understanding and finding how to deal with miscellaneous things in python and regression analysis with the help of a use case.
8. Understanding the try, throw, catch, throwing an exception, catching an exception.
9. Understanding the exploratory data analysis and correlation matrix and the visualization using matplotlib.
10. Understanding different topics which are important from the point of view of data analytics and analyzing some advance data analytics techniques.

Course Outcomes:

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

- Understand what Python is and how to run pythonscripts, how to use variables, string operator and functions.
- Understand how Python like inputting the data, workingwith Boolean and other statements with exceptions.
- Analyze the use of pandas' library for data analyzing technologies.
- Analyze how to deal with errors that one can encounter while working Python.
- Create and find how to deal with miscellaneous things in python and regressionanalysis with the help of a use cases.
- Understand the important from the point of view of data analytics and analyzing some advance data analytics techniques.

SEMESTER II								
S. No.	**Course Code**	**Course Name**	**Course Category**	**Contact Hours**	**L**	**T**	**P**	**C**
Theory								
1	21ENG02	Technical Communication	HS	2	2	0	0	2
2	21MAT02	Advanced Calculus and ODE	BS	4	3	1	0	4
3	21PHY01	Engineering Physics	BS	3	3	0	0	3
4	21GEN03	Basic Electrical & Electronics Engineering	ES	3	3	0	0	3
5	21MEC01	Engineering Mechanics	ES	4	3	1	0	4
6	21NCP02	NSS	-	3	0	0	0	0
Practical								
7	21PHYP1	Engineering Physics Laboratory	BS	2	0	0	2	1
8	21GENP5	Workshop Practices Laboratory	ES	4	0	0	4	2
9	21ENGP2	Communication Skills Laboratory	HS	2	0	0	2	1
Total				27	14	2	8	20

21ENG02	TECHNICAL COMMUNICATION	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

1. To make learners acquire listening and speaking skills in both formal and informal contexts.
2. To help them develop their reading skills by familiarizing them with different types of reading strategies.
3. To equip them with writing skills needed for academic as well as workplace contexts.
4. To make them acquire language skills at their own pace by using e - materials and language lab components.

UNIT I	LISTENING FOR CLEAR PRONUNCIATION	10 Hours

Conversation --Listening for general meaning & specific information- Listening for positive & negative comments- Listening to technical topics- Listening to prose & poetry reading- Listening exercises.- fixed & Semi- Fixed expression.

UNIT II	MECHANICS OF WRITING	10 Hours

Phrase- Clause-Modal Verb- Sentence construction and synthesis-Sentence Improvement- Correction of Sentence- Abbrevations - Homonyms, homographs and homophones., Effective use of SMS for sending short notes and messages –free writing on any given topic(my favourite place/ Hobbies/ school life, etc…) – sentence completion – Autobiographical writing(Writing about one's leisure time activities, hometown, etc…).

UNIT III	STUDY SKILLS	10 Hours

Speaking on personal topics like present & past experiences, future plans- Participating in debates, presentations,- Reading comprehension- Note making- Precise Writing- Summarizing- Sentence completion (Technical and General interest).

UNIT IV	VOCABULARY	6 Hours

Vocabulary development- Idioms and Phrasal Verbs-One Word substitutes- 'Wh'- questions adverb and adjectives.

UNIT V	EFFECTIVE WRITING	12 Hours

Essay Writing- Paragraph Writing-Descriptive Writing- Formal Letter-Informal Letter inviting your friend to function, congratulating someone for his/her success, thanking one's friend and relative - resume preparation-vision –mission and goals of the candidates –Report Writing-Formal & Informal Report-Accidental Report-Survey Report- Industrial Report.

Course Outcomes:

1. Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, and argue using appropriate communicative strategies.
2. Write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
3. Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well for method of presentation.

4. Listen/ view and comprehend different spoken excerpts critically and infer unspoken and implied meaning.

TEXT BOOKS:

1. Norman Whitby. Business Benchmark: Pre-Intermediate to Intermediate – BEC Preliminary. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).
2. Mahalakshmi.N. English workbookm – 1for Engineers. Chennai,VK Publications,2013.

REFERENCE BOOKS:

1. Norman Whitby. Business Benchmark: Pre-Intermediate to Intermediate – Preliminary—Personal Study Book. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).
2. Cambridge BEC Preliminary: Self-study Edition – Practice Tests. New Delhi: Cambridge University Press, 2008 or latest South Asian edition.
3. Devaki Reddy & Shreesh Chaudhary. Technical English**.** New Delhi: Macmillan, 2009.
4. Rutherford, Andrea J. Basic Communication Skills for Technology. 2nd edition. New Delhi: Pearson Education, 2006.
5. Muralikrishna C., Sunita Mishra "Communication Skills for Engineers" 2nd edition, Pearson, New Delhi 2010
6. Vyas Manish A., Yogesh L. Patel, "Tasks for the English Classroom", MacMillan, New Delhi, 2012.
7. Achar Deeptha, Charul Jian and et al, English for Academic Purposes, Book-1&2, University Granthnirman Board, Gujarat, 2011.

21MAT02	ADVANCED CALCULUS AND ODE (COMMON TO ALL BRANCHES)	L	T	P	C
		3	1	0	4

Course Objective:

1. The course is designed to cover topics such as identify how engineering problems can be transformed into simple mathematical constructs and solve the same.
2. To make the student acquire sound knowledge of techniques in solving Ordinary differential equations that model
3. The various methods analysis and Laplace transform can be need for efficiently solving the problems that occur in various branches of engineering discipline.

UNIT I	MULTIPLE INTEGRALS	12 Hours

Evaluation of double integrals - Change of order of integration - Change of variables from Cartesian and polar co-ordinates - Evaluation of triple integrals- Area using double integral, volume using Triple integral-Change of variables from Cartesian , cylindrical and spherical co-ordinates.

UNIT II	ORDINARY DIFFERENTIAL EQUATIONS	12 Hours

Linear equations of second order with constant and variable coefficients-Homogeneous equation of Euler type-Equations reducible to homogeneous form-Variation of parameter-Simultaneous first order with constant co-efficient.

UNIT III	LAPLACE TRANSFORMS	12 Hours

Laplace transforms of simple functions-Basic operational properties-Laplace Transforms of derivatives and integrals-Initial and final value theorems-Inverse transforms-Convolution theorem-periodic functions-Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only.

UNIT IV	ANALYTIC FUNCTIONS	12 Hours

Definition of Analytic Function-Cauchy Riemann equations-Properties of analytic functions-Determination of harmonic conjugate - Milne-Thomson's method Conformal mappings: 1/z, az, az+b , z^2 and bilinear transformation.

UNIT V	COMPLEX INTEGRATION	12 Hours

Line integral-Cauchy's integral theorem (without proof)-Cauchy's integral formulae and-its applications-Taylor's and Laurent's expansions (statements only)-Singularities-Poles and Residue-Cauchy's residue theorem-Contour integration under unit circle and semicircular contour.

Course Outcomes:

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

1. Evaluate multiple integrals using change of variables.
2. Apply Integration to compute multiple integrals area, volume, Integrals in Polar Coordinates in addition change of order and change of variables.
3. Apply techniques of Laplace Transform and inverse Laplace transform for problems in science and engineering.

4. Demonstrate the understanding of solving ordinary differential equations using operator methods
5. Apply complex analytic functions and its properties in solving problems.
6. Apply complex integration using Cauchy Integral Theorem and their applications in evaluating integrals.

Text Books:

1. B.S. Grewal . "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd edition, 2014.
2. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley & Sons. Singapore, 10th edition, 2012.
3. Veerajan. T, "Engineering Mathematics I", Tata McGraw Hill Publishing Co, New Delhi, 5th edition, 2006.

Reference Books:

1. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., "Advanced Mathematics for Engineering students", Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
2. Kandasamy P etal. "Engineering Mathematics", Vol. I (4th revised edition), S.Chand &Co., New Delhi, 2000.
3. Wylie, R.C and Barrett, L.C., - "Advanced Engineering Mathematics" –Tata McGraw Hill education Pvt. Ltd 6th edition, New Delhi-2012.

Reference Links:

https://nptel.ac.in › courses
https://en.wikipedia.org

21PHY01	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

Course Objective:

- To enhance the fundamental knowledge in physics and its applications relevant to various streams of engineering and technology.

UNIT-I	SOLID MECHANICS AND MECHANICAL PROPERTIES	9 Hours

Elasticity Stress-strain diagram and its uses – factors affecting elastic modulus - Torsional Pendulum -Young's modulus by cantilever, Uniform and non-uniform bending - stress due to bending in beams - Tensile test, plastic deformation - strengthening methods - Creep resistance, fracture fatigue-methods of increasing fatigue life.

UNIT II	LASER PRINCIPLES AND OPTICAL FIBERS	9 Hours

Laser Characteristics - Einstein coefficient &its significance-population inversion - working principle , pumping scheme ,components of Nd:YAG, He:Ne, Co_2 laser- Semiconductor Laser - advanced applications of laser - light propagation through fibers - acceptance angle-numerical aperture types of optical fibers - fiber optic communication, fiber optic sensors.

UNIT III	CRYSTAL PHYSICS AND OPTOELECTRONICS	9 Hours

Crystal directions, planes and miller indices - symmetry elements-coordination number and packing factor for HCP,FCC,BCC and diamond structure - crystal imperfections - crystal growth techniques – Bridgmann Technique - classifications of optical materials - absorption, emission and scattering of lights - LED-OLED-laser diode- solar cell- quantum dot laser.

UNIT IV	QUANTUM MECHANICS	9 Hours

Black body radiation - planks concept - Duality nature, De Broglie hypothesis for matter waves - Compton effect - Heisenberg's uncertainty principle - Schrödinger time dependent wave equation - Schrödinger time Independent wave equation - particle in 1D box - scanning tunneling microscope.

UNIT V	NANO SCIENCE &ADVANCED ENGINEERING MATERIALS	9 Hours

Introduction to nano materials - properties of nano materials - quantum confinements(quantum well, wire &dot) - single electron transistor-magnetic semiconductor - preparation of nano materials – Ball milling Technique - carbon nano tubes(CNT),properties &applications of nano particles - Types and applications of Ceramics-composites-polymers- metallic materials - preparation and applications of metallic glasses – Melt Spinning System - shape memory alloy(SMA)

Course Outcomes:

Upon completion of this course, The students will gain knowledge on

1. basics of solid mechanics and mechanical properties.
2. the concepts of LASER principles and their applications in fiber optics.
3. basics of crystals, their structures , different
4. crystal growth techniques and optoelectronic devices
5. advanced physics concepts of quantum theory and its applications in tunneling microscopes.
6. the concepts of Nano science and advanced engineering materials and its applications

Text Books:

1. Dattu R.Joshi, "*Engineering Physics*",Tata McGraw- Hill,New Delih,2010.
2. Arthur Beiser et al., Concepts of Modern Physics, 2013, Sixth Edition, Tata McGraw Hill.

Reference Books:

1. Thiruvadigal, J. D., Ponnusamy,S. Sudha.D. and Krishnamohan M., "*Physics for Technologists"*, SSS Publications, 2015.
2. Leonard. I. Schiff, "*Quantum Mechanics"*, Third Edition, Tata McGraw Hill, 2010.
3. Alberto Sona, "*Lasers and their applications*", Gordon and Breach Science Publishers Ltd., 1976.
4. Wole Soboyejo, "*Mechanical Properties of Engineered Materials*", Marcel Dekker Inc., 2003. William Silfvast, Laser Fundamentals, 2008, Cambridge University Press.

21GEN03	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the various laws and theorems applied to solve electric circuits and networks
2. To import knowledge of different components and function of electrical machines
3. To explain the fundamentals and applications of semiconductor devices
4. To explain the principles of digital electronics
5. To provide the students with an overview of the most important concepts in Electrical and Electronics Engineering which is the basic need for every engineer

UNIT-I	DC CIRCUITS	9 Hours

Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem.

UNIT-II	AC CIRCUITS	9 Hours

Alternating voltages and currents, AC values, Single Phase RL, RC, RLC Series circuits, Power in AC circuits-Power Factor- Three Phase Systems–Star and Delta Connection.

UNIT-III	ELECTRICAL MACHINES	9 Hours

Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors and Stepper motor

UNIT-IV	SEMICONDUCTOR DEVICES AND SENSORS	9 Hours

Conduction in Semiconductor materials, Construction and Working of PN junction diodes, Zener diodes, BJTs, MOSFETs, Rectifiers - Half wave, Full wave, Sensors - LVDT, Thermocouple.

UNIT-V	DIGITAL SYSTEMS	9 Hours

Binary Number System - Boolean Algebra – DeMorgan's theorem – Digital circuits – Half adder, Full adder - Introduction to Sequential Circuits – Flip-Flops - Registers - SISO, SIPO, PISO, PIPO and Counters – Johnson and Ring.

Total: 45

Course Outcome

1. Solve basic electrical circuit problems using various laws and theorems
2. Analyze AC power circuits and networks, its measurement and safety concerns
3. Classify and compare various types of electrical machines
4. Design and implement various digital circuits
5. Analyze the characteristics of semiconductor devices

Text Books:

1. D.P. Kothari & I. J . Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
2. S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson India, 2011.

Reference Books:

1. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education (India) PrivateLimited,2009.
2. DelToro,"ElectricalEngineeringFundamentals",PearsonEducation,NewDelhi, 2007
3. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press,2013
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002
5. Mehta VK, "Principles of Electronics", S.Chand & CompanyLtd,1994
6. Nagsarkar T K and Sukhija MS, "Basics of Electrical Engineering", Oxford press2005

21MEC01	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	3

Course Objectives:

1. To understand distributed force systems, centroid/ center of gravity and method of finding centroids of composite figures and bodies.
2. To understand types of frames and analyze for the forces in the members of the truss by method of joints and method of sections.
3. To understand dynamics of a particle and to interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc.
4. To understand the kinetics of the rigid bodies and solve simple problems using work-energy method.
5. To understand the behaviour and properties of fluids.

UNIT I	STATICS OF PARTICLES & RIGID BODIES	9 Hours

Fundamental Concepts & Principles - Laws of Mechanics - Coplanar Forces & Resolution of Forces - Equivalent system of forces - Principle of transmissibility – Single equivalent force - Free body diagram - Equilibrium of rigid bodies in two dimensions and three dimensions - Varignon's Theorem - Couple - Moment of a Couple, Equivalent Couples - Reactions at Supports and Connections

UNIT II	ANALYSIS OF STRUCTURES	9 Hours

Types of loads, Types of supports and their reactions - Simple Trusses: Analysis of Trusses in Method of joints - Centre of Gravity: Centroids of lines, areas and volumes - determination of centroid - Theorems of Pappus – Guldinus - Moments of Inertia of Areas and Mass - Parallel-Axis Theorem

UNIT III	FRICTION	9 Hours

The Laws of Dry Friction - Coefficients of Friction - Angles of Friction - Wedges & Ladder friction - Wheel Friction - Rolling Resistance - Belt Friction

UNIT IV	DYNAMICS OF PARTICLES	9 Hours

Kinematics & Kinetics - Newton's Laws of Motion - Rectilinear & Curvilinear Motion - D'Alembert's principle - Work Energy Method - Impulse Momentum Method - Translation & Rotation - Instantaneous Centre Method - Impact of Elastic Bodies

UNIT 5	BASIC MECHANICS OF FLUIDS	9 Hours

Fluids – Density, Pressure – Blood pressure and gravity, Buoyancy - Newton's laws of viscosity - Definitions and simple problems on Newtonian fluid - Non-Newtonian fluid - Euler equations and Navier Stoke's equations - Visco-elasticity - Laminar flow & Turbulent flow - Hagen Poiseuille equation.

Total: 45

Course outcome:

On completion of the course the students will be able to

1. Calculate the moment produced by various force systems and develop static equilibrium equations for rigid body system.

2. Evaluate the centroid, centre of gravity and moment of inertia of geometrical shapes and solids respectively.
3. Comprehend the effect of dry friction and its applications.
4. Apply the different principles to study the motion of a body and analyse their constitutive equations
5. Basics of fluid mechanics and its behaviour

Text Books:

1. Basudeb Bhattacharyya, Engineering Mechanics, Second Edition, Oxford University Press, 2014.
2. R.K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 10th edition, Laxmi Publications, 2018.

Reference Books:

1. Beer, Johnston, Cornwell and Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, 10th Edition, McGraw-Companies, Inc., New York, 2013.
2. Russell C Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Pearson Education Inc., Prentice Hall, 2010.
3. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.
4. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

21PHYP1	ENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To introduce different experiments to test basic understanding of Engineering Physics concepts applied in optics, thermal physics, properties of matter and liquids

Lab Practice **10 Hours**

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method.
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of velocity of sound and compressibility of liquid –Ultrasonic interferometer
7. Determination of dispersive power of prism

Course Outcome:

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

- Apply principles of elasticity, optics and thermal properties for engineering applications.

21GEN05	WORKSHOP PRACTICES	L	T	P	C
		0	0	4	2

Group A	CIVIL & MECHANICAL ENGINEERING	30 Hours

Part A: Civil Engineering:

1. Plumbing Work:
   a. Layout of Pipe connection using PVC Pipes
   b. Layout of Pipe Connection using GI pipe fittings
2. Carpentry:
   a. Sawing, Planning, and Making of T-Joint
   b. Making of Dove Tail Joint

Part B: Mechanical Engineering:

1. Welding:
   a. Butt joint, Lap joint and T Joint using Arc Welding
2. Machining:
   a. Facing
   b. Step Turning
   c. Taper Turning
   d. Drilling
3. Sheet Metal:
   a. Making of Funnel
   b. Making of Tray

Group B	ELECTRICAL & ELECTRONICS ENGINEERING	30 Hours

Part A: Electrical Engineering:

1. Residential House wiring using switches, Fuse, Indicator, Lamp etc
2. Fluorescent Lamp Wiring
3. Stair Case Wiring
4. Measurement of Energy using Single Phase Energy Meter
5. Load Test on Single Phase Induction Motor

Part B: Electronics Engineering

1. Introduction to Electronic Engineering
   a. Study of Electronic Components & Equipments
   b. Resistor Colour Coding
   c. Measurement of AC signal parameters using CRO
2. Study of Logic Gates (AND, OR, EX-OR, NOT)
3. Soldering Practice – Components, Devices and Circuits using general purpose PCB
4. Measurement of Ripple Factor using Half Wave Rectifier
5. Audio Amplifier using Single Transistor

21ENGP2	COMMUNICATION SKILLS LABORATORARY	L	T	P	C
		0	0	2	1
LIST OF EXPERIMENTS		**10 Hours**			

Introduction to Vowels- Consonants- Diphthongs – Self introduction – introducing to one another - Speaking on personal topics like hobbies, topics of interest - Participating in group discussions, role plays, - power-point presentations- job-interviews.- Lexical term of Indian & British English – Letter Writing- Job Application Letter- cover letter –Report Writing.

SEMESTER -III

S.No	Course Code	Course Title	Subject Category	Contact Hours	L	T	P	C
THEORY								
1	21MAT05	Numerical Solutions	BS	4	3	1	0	4
2	21AGR01	Fundamentals of Soil Science	PC	4	3	0	0	3
3	21AGR02	Surveying & Levelling	PC	4	3	0	0	3
4	21AGR03	Irrigation Systems	PC	3	3	0	0	3
5	21AGR04	Fluid and Applied Hydraulics Engineering	PC	4	3	0	0	3
6	21AGR05	Agricultural Process Engineering	PC	3	3	0	0	3
PRACTICAL								
7	21AGRP1	Surveying lab	PC	4	0	0	4	2
8	21AGRP2	Applied Hydraulic Engineering Lab	PC	4	0	0	4	2
		TOTAL		**30**	**18**	**1**	**8**	**23**

21MAT05	NUMERICAL SOLUTIONS	L	T	P	C
		4	1	0	4

Course Objectives

- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I	SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	12 Hours

Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Pivoting . Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II	INTERPOLATION AND APPROXIMATION	12 Hours

Interpolation with unequal intervals - Lagrange's interpolation - Newton's divided difference interpolation - Cubic Splines - Difference operators and relations Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III	NUMERICAL DIFFERENTIATION AND INTEGRATION	12 Hours

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	12 Hours

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	12 Hours

Finite difference methods for solving second order two point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain - One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

Course Outcomes:

- Understand the basic concepts and techniques of solving algebraic equation.
- Apply the numerical techniques of differentiation and integration for engineering problems.

- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

Text books:

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", Khanna Publishers, 10th Edition, New Delhi, 2015.
3. Dr.P.Kandasamy, Dr.K.Thilagavathy & Dr.K.Gunavathi "Numerical Methods " S.Chand. Publications.

Reference Books:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 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 India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

21AGR01	FUNDAMENTALS OF SOIL SCIENCE	L	T	P	C
		3	0	0	3

Course Objectives :

- To impart Knowledge on Soil genesis, properties etc, so as to enable students to design implements in related to soil, soil conservation, irrigation and drainage applications.
- To enable students to understand farming principles, to grow agricultural field and orchard crop and farming practices.

UNIT I	INTRODUCTION OF SOIL	9 Hours

Introduction of Soil & Soil genesis and classification - Rocks & Minerals - Weathering of Rocks - Soil forming processes & factors - Preliminary Definitions & Relationship - Properties of Soil -Soil structure & clay mineralogy - Soil waters - Moisture constants.

UNIT II	SOIL COLLOIDS	9 Hours

Soil water movement:-saturated, unsaturated and vapour flows, laws governing water flow-Darcy's and poiseuille's law- Infiltration; Factors-importance - Evaporation; Factors influencing evaporation- Ways to minimize it-soil mulch-organic mulch etc, - Soil air; Composition of soil air-processes of gaseous exchange –soil aeration indices –and their importance (oxygen content-ODR-aeration porosity-redox potential) management of soil air - Soil temperature; influence of soil temperature on plant growth-factors influencing soil temperature-management of soil temperature. Soil color determination importance, - Soil colloids:- Definition-general properties-inorganic and organic colloids origin of charge on colloids (positive & negative)- Secondary silicate clay minerals (inorganic soil colloids) Kaolinite montmoriloniteillite their structures and properties, Introduction of Ion exchange - Factors influencing ion exchange capacity of soils & importance of ion exchange - Calculation of base saturation and exchangeable acidity.

Unit III	SOIL BIOLOGY	9 Hours

Soil organic matter: importance of organic matter CN ration of organic matter and its properties. Soil biology;- Soil flora and fauna their characteristics role of beneficial organisms mineralization–immobilization, nitrogen fixation, nitrification, de nitrification, solubilisation of phosphorus and sulphur - Soil fertility:- Concepts of soil fertility and soil productivity:-definitions and difference - Arnon's criteria of essentiality-essential and beneficial elements-factors influencing availability of nutrients - Problem in Soils:- Definition –Physical problems soil depth slope soil crust soil compaction drainage submergence (formation-adverse effects-effect on soil properties and plant growth management), Chemical problems –classification acid, saline, saline saline-sodic and calcareous soils-characteristics-nutrient availability in problem soils and their reclamation - Irrigation water:- Quality of irrigation water-classification based on EC, SAR,RSC and Boron content-use of saline waters in agriculture - Soil taxonomy:- New comprehensive system of soil classification (7th approximation) soil orders and their characteristics - Important soil groups of India:- Alluvial soils-black soils –red soils laterite soils and coastal soils.

UNIT IV	AGRONOMY	9 Hours

Meaning and scope of agronomy - History of agricultural development in ancient India, Agriculture in civilization era, National and International Agricultural Research Institutes in India. Classification of crops - Classification of field crops, According to Origin, Botanical Commercial, Economical, seasonal, Ontogeny, Agronomic, Lead Morphology and Special Purpose crops, Definition of climate and weather - Meteorology, Climatology and Agri-meteorology :-Introduction, scope and practical utility of Agricultural meteorology, composition and structure of atmosphere, Influence of weather on crop grain development, essential Resources for crop production - Factors influencing plant growth, Biotic and Abiotic factors, Crop seasons, Kharif, Rabi and summer seasons - Tillage and Tilth: - Objective of tillage, characteristic of

good seed bed, effect of tillage on soil properties (Pore space, texture, structure, bulk density, colour of the soil). Types of Tillage, preparatory cultivation, inter cultivation, after cultivation and preparatory cultivation for lowland rice pudding, implement used for seed bed preparation, sowing, inter-cultivation and special operation - Sowing:-Methods of sowing, time and depth of sowing of major agricultural crops, Methods and time of application of manure and fertilizers.

UNIT V	STUDY OF WEEDS & FERTILIZER	9 Hours

Introduction to weeds - characteristics of weeds their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds - Influence of weeds on crop production - principles and practices of weed management, Basics on soil plant-water relationship - Fertilizer & Types of fertilizer -Application of Fertilizer -Manures.

Course Outcomes:

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

- Fundamental knowledge of soil physical parameters.
- The procedures involved in soil survey and soil classification.
- Fundamental concept of Agronomy & Weeds.

Text books:

1. Brady, N.C. "Nature and Properties of Soils", New YORK, Macmillan, 1990.
2. Biswas TD. and Mukherjee, S.K. "text Book of Soil Science" 'New Delhi, Tata Mgraw,1987.
3. Ghildyal B.P. and Tripathi, R.P. "Soil Physics", Wiley eastern Ltd, 1987.
4. Hillel, D. "Introduction to Soil Physics" , San Diego, Academic press, 1982.
5. Singer Michael J. and Munns, D.N. "Soils - An Introduction" , 1983. / Foth, Henry D "Fundamentals of Soil Science", New Delhi

Reference books:

1. Wiley Eastern, 1972. Tandon, H.L.S "Methods of Analysis of Soils, Plants, Waters and Fertilisers" , 1985. Meteorology, William L Donn, 1965, McGraw-Hill Book. Co. New York.
2. Amon L 1972Crop Production in Dry Regions, Arnon L Leonard Hill Publishing Co., London.
3. Manures and Fertilizers, Yawalkar K S and Agrawal J P, 1977, Agricultural Horticultural Publishing House, Nagpur.
4. Principle of Weed Science, Rao V S, 1992, Oxford and IBH Publishing.
5. G.N.Shankara reddy, T.Yallamanda "Principle of Agronomy" Kalyani Publishers.

21AGR02	SURVEYING & LEVELLING	L	T	P	C
		3	0	0	3

Course Objectives :

- To introduce concept for usage of theodolite and tachometric surveying
- To learn the various methods of plane and geodetic surveying

UNIT I	FUNDAMENTALS OF SURVEYING	9 Hours

Introduction of Surveying - Types of surveying & Classification of surveying - Basic Principles of surveying - Methods of Locating a Point & Measurements - Instrument for Measuring Distance ,Marking stations &Setting out Right Angles - Chaining a Line - Chaining on slope Ground - Errors and mistakes in chaining - Compass Surveying - Bearing of Lines.

UNIT II	COMPUTATION OF AREA AND VOLUME & CONTROL SURVEYING	9 Hours

Area from field notes - Computation of areas along irregular boundaries and area consisting of regular boundaries- Embankments and cutting for a level section and two level sections with and without transverse slopes - Determination of the capacity of reservoir- Volume of barrow pits-Horizontal Control - Vertical control –Triangulation – Trigonometric levelling - Traversing

UNIT III	THEODOLITE AND TACHEOMETRIC SURVEYING	9 Hours

Introduction of Theodolite surveying - Uses and adjustments of Theodolite - Measurement of horizontal and vertical angles - Principles of Electronic Theodolite - Tachometric Surveying & determination of tachometric constants - Angular Tachometry - Analytic lens - Tangential & Subtense method of Tacheometry - Sources of Errors in Tacheometric Observation.

UNIT IV	EDM, TOTAL STATION, GPS SURVEYING	9 Hours

Electro-optical system - Measuring Principle of Electro optical system - Working Principle of Electro optical system - Sources of error in Electro optical System - Total station, Microwave system Measuring and working principle - Sources of error and good Practices in using Total station - GPS - Fundamentals - Different segments of GPS - Signal Structures for GPS - GPS Survey types-Kinematic and static survey Techniques.

UNIT V	LEVELLING	9 Hours

Definition & Definition of Terms used in levelling - Instruments for Levelling - Setting up the level &Benchmark - Steps used in Levelling - Principles of Levelling - Reduction of Levels- Rise and Fall Method, Height of collimation - Classification of Levelling - Curvature and Refraction - Distance of the visible horizon - Errors in levelling.

Course Outcomes:

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

- The use of various surveying instruments and mapping.
- Measuring Horizontal angle and vertical angle using different instruments.
- Methods of Leveling and setting Levels with different instruments.

Text Books:

1. Duggal S K, “Surveying (Vol – 1 & 2), Tata Mc.Graw Hill Publishing Co. Ltd. New Delhi, 2004.

2. Kanetkar .T.P, “Surveying and Levelling” Vols. I and II, United Book Corporation, Pune, 1994.
3. T P Kanetkar and Prof. S V Kulkarni, Poona Vidya griha Prakashan, “Surveying and leveling Part I”I, Punmia .B.C, “Surveying, Vols”. I and II, Laxmi Publications, 1999.

Reference Books

1. R. Subramanian, “Surveying and Levelling” Second Edition Oxford University Press - 2012.
2. James M. and Anderson Edward M. Mikhail “Surveying Theory and practice Seventh Edition” TATA McGraw Hill.
3. Satheesh Gopi, R. Sathi Kumar and N. Madhu. “Advanced Surveying Total Station GIS and Remote Sensing, Pearson Publisher.
4. Chandra A M, “Plane Surveying” and “Higher Surveying” New age International Pvt. Ltd., Publishers, New Delhi, 2002.
5. N.N.Basak “Surveying and Levelling” Mc Graw Hill.

21AGR03	IRRIGATION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives :

- The student is exposed to different phases in irrigation practices and Planning and management of irrigation. Further they will be imparted required knowledge on Irrigation storage and distribution canal system and Irrigation management.

UNIT I	IRRIGATION TECHNIQUES AND QUALITY OF IRRIGATION WATER	9 Hours

Definition & Need , Merits and Demerits of Irrigation - Importance of Irrigation in India - Water Requirement of crops - Crop period or Base period ,Duty and Delta of a crop - Methods of Improving Duty and Relation between Duty and Delta - Crop seasons in India and Numerical problems on delta & duty - Irrigation Efficiencies and Numerical problems on Irrigation efficiencies
Consumptive use of Water and Factors affecting consumptive use of water - Estimation of Consumptive use - Effective Rainfall and Net irrigation Requirement.

UNIT II	CANAL IRRIGATION	9 Hours

Introduction of Canal - Classification of Canal - Types of Impounding Structures - Gravity Dam - Diversion Head works - Canal drop fall - Cross Drainage Work - Canal Regulations - Canal lining - Canal section.

UNIT III	IRRIGATION METHODS AND MANAGEMENT	9 Hours

Types of Irrigation systems - Methods of Distribution of water - Irrigation Scheduling - Water distribution in irrigation System - Introduction ,objective and Necessity of PIM - Provisions in PIM Acts and water users Association - Women's role in PIM & Constraints in Implementation of PIM - PIM in other states - Participatory Irrigation Management with a case study.

UNIT IV	RECLAIMATION OF WATER LOGGED & SALINE SOILS FOR AGRICULTURAL PURPOSES	9 Hours

Definition of Salinity and Water logging - Causes of Water logging - Water logging control - Reclamation of saline and Alkaline Lands - Soil water Plant Relationship - Types of water potential - Measurement of Soil Moisture.

UNIT V	WATER RESOURCES &WATER RESOURCE MANAGEMENT	9 Hours

Water Resource survey - Water Resources of India and Tamil Nadu - Water Resources Planning - Water Requirements for Different Purpose - Levees and Flood level - Fixation of Storage capacity- National Water policy - Water quality - Water Budget.

Course Outcomes:

At the end of the course able to understand

- Have knowledge and skills on crop water requirements.
- Understand the methods and management of irrigation.
- Gain knowledge on types of impounding structures.

Text Books:

1. Dilip Kumar Majumdar, “Irrigation Water Management”, Prentice-Hall of India, New Delhi, 2008.
2. Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi, 2009 .
3. Garg S. K., “Irrigation Engineering and Hydraulic structures”, Khanna Publishers, 23rd Revised Edition, New Delhi, 2009.
4. A.M.Michael “Irrigation theory and practices” Vikas publisher

References:

1. Duggal, K.N. and Soni, J.P., “Elements of Water Resources Engineering”, New Age International Publishers, 2005.
2. Linsley R.K. and Franzini J.B, “Water Resources Engineering”, McGraw-Hill Inc, 2000
3. Chaturvedi M.C., “Water Resources Systems Planning and Management”, Tata McGraw-Hill Inc., New Delhi, 1997.

21AGR04	FLUID & APPLIED HYDRAULICS ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives :

- To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. And also
- To understand the basic properties of the fluid.
- At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

UNIT I	FLUID PROPERTIES AND FLUID STATICS	9 Hours

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics - Concept of fluid static pressure, absolute and gauge pressures - Pressure measurements by manometers - Forces on planes - Centre of pressure - Buoyancy and floatation.

UNIT II	FLUID KINEMATICS AND DYNAMICS	9 Hours

Fluid Kinematics - Classification and types of flow & velocity field and acceleration - Continuity equation (one and three dimensional differential forms) - Stream line-streak line-path line - Stream function - Velocity potential function & flow net - Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli's equation – applications - venturi meter, orifice meter and Pitot tube - Linear momentum equation - Application to pipe bend.

UNIT III	FLOWS	9 Hours

Definition and differences between pipe flow and open channel flow - Types of Flow & Properties of open channel - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Dynamic equations of gradually varied flows - Types of flow profiles -&Classifications - Computation by Direct step method and Standard step method - Hydraulic jumps – Types Rapidly varied unsteady flows

UNIT IV	PIPES	9 Hours

Loss of Energy due to friction - Laminar Flow through circular Pipe.(Hagen equation) - Laminar Flow Between the parallel Plates - Darcy’s weisbach equation for loss of head due to friction in pipe - Minor losses - Pipes in series and Parallel - Compound pipe, Equivalent pipe &flow through parallel pipes.

UNIT V	PUMPS	9 Hours

Classification of Pumps - Centrifugal pumps - Work done - Minimum speed to start the pump - NPSH - Multistage pumps - Characteristics curve - Reciprocating pumps – Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work done

Course Outcomes:

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

- Get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- To solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
- Understand the principles, working and application of turbines.
- Understand the principles, working and application of pumps.

Text Books:

1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2009.
2. Rajput.R.K. “Fluid Mechanics", S.Chand and Co, New Delhi, 2008.
3. Bansal.R.K., “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications Pvt. Ltd., New Delhi, 2013.

Reference Books:

1. Jain.A.K.., "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, Twelfth Edition, 2016.
2. Subramanya.K “Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2010.

21AGR05	AGRICULTURAL PROCESS ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To train students on unit operations of agricultural process engineering to acquaint with preliminary operations such as clearing, size reduction, mixing, separation, filtration and materials handling equipment.

UNIT I	CRUSHING	9 Hours

Scope and importance crop processing - Principles and methods of food processing Size reduction - Introduction, benefits, classification, determination and designation of the fineness of ground - material and screen Analysis - Principle of comminution, mechanisms of comminution of food, particle shape, mixed particle sizes, average particle size, Size reduction – Characteristics of comminuted products, crushing efficiency - Empirical relationships (Rittingen's Kick's and Bond's equations), Work index, energy utilization, Methods of operating crushers & classification based on particle size Size reduction equipment - Cutting machines (slicing, dicing, shredding, pulping)

UNIT II	MIXERS AND SEPARATORS	9 Hours

Mixing –Introduction, theory of solids mixing, criteria of mixer effectiveness - Mixing index for pastes and plastic masses, mixing index at zero time - Theory of liquid mixing - Power requirement for liquids mixing - Mixing equipment – Mixers for low or medium viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers) - Aerodynamics of agricultural products - Drag coefficient - Frictional drag and profile drag or pressure drag and terminal velocity - Theory of separation - Types of separators, cyclone separators - Size of screens applications - Separator based on length, width, and shape of the grains, specific gravity density.

UNIT III	FILTRATION	9Hours

Air-screen grain cleaner - Principle and types of screen grain cleaners - Sieve analysis-particle size determination, Ideal screen and actual screen - Effectiveness of separation and related problems Pneumatic separator - Theory of filtration, rate of filtration, pressure drop during filtration, applications- Constant-rate filtration - Constant–pressure filtration - Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters.

UNIT IV	MILLING	9 Hours

Threshing, Winnowing, cleaning and separation equipment, air screen cleaner - Rice millings, principles and equipments - Paddy parboiling methods and equipment - Wheat milling, milling of pulses and oilseeds - Scope and importance of material handling devices - Study of different material handling systems - Classification, & principle of Material Handling system.

UNIT V	CONVEYOR EQUIPMENT	9 Hours

Belt Conveyor–Inclined belt conveyors, idler spacing, belt tension, drive tension, Inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper - Chain conveyor–Principle of operation, advantages, disadvantages, capacity and speed - Screw conveyor – Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors - Bucket elevator–Principle, classification, operation, advantages, disadvantages, capacity& speed, buckets pickup, Bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types, Pneumatic conveying system-capacity and power requirement - Gravity conveyor design considerations – capacity and power requirement - Conveyor system selection and design

Course Outcomes:

At the end of the course students will be able understand

- The working principle of mixer, separators, and conveyor.
- Get the basic knowledge of combination of food.

Text Books:

1. GeankoplisC J Transport Process and separation Process Principle, 2003 Prentics-Hall Inc., New Jersey.
2. Earle R L "Unit operation in Food Processing"1983. Pergamon Press,New York
3. Chakravarthy A and De Ds "Post-Harvest Technology of cereals,Pulses and oil seeds" 1988. Oxford and IBH Publishing Co.Ltd. Calcutta.

Reference books:

1. McCabe WL, Smith JC and Harriott P "Unit operation of chemical Engineering"1993 Mc Graw-Hill Book Co., Boston.
2. Sahay KM and Singh KK"Unit operation of Agricultural "1994, Vikas Publishing House Pvt. Ltd., New Delhi.

21AGRP1	SURVEYING LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- At the end of the course the student will possess knowledge about Survey field techniques.

LIST OF EXPERIMENTS	60 Periods

1. **Chain Survey**
   a) Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset
   - Setting out works – Foundation marking using tapes single Room and Double Room
2. **Compass Survey**
   a) Compass Traversing – Measuring Bearings & included angles
3. **Levelling - Study of levels and levelling staff**
   a) Fly levelling using Dumpy level &Tilting level
   b) Check levelling
4. **Theodolite - Study of Theodolite**
   a) Measurements of horizontal angles by reiteration and repetition and vertical angles
   b) Determination of elevation of an object using single plane method when base is accessible/inaccessible.
5. **Tacheometry – Tangential system – Stadia system**
   a) Determination of Tacheometric Constants
   b) Heights and distances by stadia Tacheometry
   c) Heights and distances by Tangential Tacheometry
6. **Total Station - Study of Total Station, Measuring Horizontal and vertical angles**
   a) Traverse using Total station and Area of Traverse
   b) Determination of distance and difference in elevation between two inaccessible points using Total station

Course Outcomes:

a) The students will be able to understand working principle of dumpy level & theodolite.
b) The students will be able to develop the knowledge of levelling concept.

21AGRP2	APPLIED HYDRAULICS ENGINEERING LAB	L	T	P	C
		0	0	4	2

Course Objectives:

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

LIST OF EXPERIMENTS	60 Periods

1. **Flow Measurement**
   a) Calibration of Rotameter.
   b) Calibration of Venturimeter / Orifice meter.
   c) Bernoulli's Experiment.
2. **Losses in Pipes**
   a) Determination of friction factor in pipes.
   b) Determination of minor losses.
3. **Pumps**
   a) Characteristics of Centrifugal pumps.
   b) Characteristics of Gear pump.
   c) Characteristics of Submersible pump.
   d) Characteristics of Reciprocating pump.
4. **Turbines**
   a) Characteristics of Pelton wheel turbine.
   b) Characteristics of Francis turbine/Kaplan turbine.
5. **Determination of Metacentric height**
   a) Determination of Meta centric height of floating bodies.

Course Outcomes:

- The students will be able to measure flow in pipes and determine frictional losses.
- The students will be able to develop characteristics of pumps and turbines.

SEMESTER -IV

S.NO	COURSE CODE	COURSE TITLE	SUBJECT CATEGORY	CONTACT HOURS	L	T	P	C
THEORY								
1	21AGR06	Strength of Materials	PC	4	3	1	0	4
2	21AGR07	Drainage Engineering	PC	3	3	0	0	3
3	21AGR08	Mechanics of Soil	PC	4	3	0	0	3
4	21AGR09	Crop protection Techniques	PC	3	3	0	0	3
5	21AGR10	Ground water and Well Engineering	PC	3	3	0	0	3
6	21NCP04	Indian Constitution	MC	2	0	0	0	0
PRACTICAL								
7	21AGRP3	Strength of Materials Lab	PC	4	0	0	4	2
8	21AGRP4	Agricultural Engineering Practice Lab	PC	4	0	0	4	2
		TOTAL		25	15	1	8	20

21AGR06	STRENGTH OF MATERIALS	L	T	P	C
		3	1	0	4

OBJECTIVE:

- To learn the fundamental concepts of Stress, Strain and deformation of solids.
- To learn the concept of Analysis of perfect frames.

Unit I	STRESS AND STRAIN	12 Hours

Elasticity- Stresses and strains- Elastic limit- Elastic constants-Lateral strain-Composite sections-Temperature stresses-Volumetric strain in a body-Resilience and strain energy.

Unit II	ANALYSIS OF BEAM	12 Hours

Analysis of statically determinate beams-Shear force and bending moment diagrams-Slope and deflection of beams using double integration method-Macaulay's method-Clapeyron's equation for continuous beam-Clapeyron's equation for Fixed beam.

Unit III	SLENDER MEMBER	12 Hours

Introduction- Failure of a column-Assumption made in the Euler's column Theory-End conditions for Long Column- Expression for crippling load when both the ends of the column are hinged-Expression for crippling load when both the ends are fixed-Limitations of Euler's formula-Limitations of Rankine's formula.

Unit IV	ANALYSIS OF PERFECT FRAMES	12 Hours

Introduction of frames-Types of Frames- Assumptions made in finding out the forces in a frame- Reaction of support of a frame-Analysis of a frame.

Unit V	UNSYMMENTRICAL BENDING AND SHEAR CENTER	12 Hours

Introduction-Properties of beam cross section- Stress in unsymmetrical bending-Deflection of beam in unsymmetrical bending- Shear centre-Determination of shear centre for channel Section-Determination of shear centre for I Section.

OUTCOMES:

At the end of the course the students will be

- Determine Shear force and bending moment in beams and understand the concept of theory of simple bending.
- Calculate the deflection of beams by different methods.

Text Books:

1. Bansal, R.K. (1992). Engineering Mechanics and Strength of materials. Laxmi Publications, New Delhi.
2. Khurmi, R.S. (1996) Strength of Materials. S. Chand and Company Limited, New Delhi.
3. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2015.
4. Punmia.B.C. Ashok Kumar Jain and Arun Kumar Jain, SMTS –I Strength of materials, Laxmi publications. New Delhi, 2015
5. Rattan. S. S, "Strength of Materials", Tata McGraw Hill Education Private Limited, New delhi 2010

Reference Books:

1. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, New Delhi, 1995.
2. Junnarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol I, Charotar Publishing House, New Delhi 2016.

21AGR07	DRAINAGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To design appropriate techniques for effective drainage systems.

Unit I	HISTORY OF DRAINAGE AND WATER LOGGING	9Hours

Drainage definition-Need for land drainage-History of land drainage-Design considerations for land drainage-Definitions of parameters in drainage equations.-Hydraulic conductivity-Transmissivity-Drainable porosity, drainage coefficient-Different agencies for water logging -Sources of water logging and causes nature and its extent.

Unit II	SURFACE DRAINAGE	9 Hours

Surface drainage systems-Bedding, Field drains, Field laterals; Layout of field drains &lateral-Diversion or interceptor drains-Definition and advantages of surface drainage-Drainage coefficient- Hydrological design for different crops and catchment areas-Design of open drains.

Unit III	SUB SURFACE DRAINAGE	9 Hours

Subsurface drainage systems-Drain materials-Envelopes, filters and surrounds; Functions of envelope, envelope materials, envelope requirements in relation to soil characteristics, gravel envelopes, organic envelopes, synthetic envelopes-Subsurface flow to drains ,Steady state equations. the Hooghoudt's equation, derivation, importance of equivalent depth-The Ernst equation -derivation, horizontal, vertical and radial flow-Unsteady state equations- The Glover Dumm equation-Comparison between Steady State and Unsteady State-Tube well drainage-introduction, physical and economic feasibility; Mole drainage.

Unit IV	DRAINAGE DESIGN	9 Hours

Hydraulics of Drainage pipes-Manning's equation for pipe flow- Hydraulic gradient and slope-Investigations of drain design parameters through drain testing-Observation wells and their installation-Recording water table data and drain discharges-Flow equations used in drainage testing-Steady state and non-steady state condition-Drainage design criteria and system economics.

Unit V	SALT PROBLEM IN AGRICULTURAL LAND	9 Hours

Origin of salts in irrigated soils-Salinity and alkalinity in soils-Sodium adsorption ratio, cation exchange capacity-Classification and reclamation of saline and alkaline soil-Determination of requirement of soil amendments for reclamation of salt affected soils-Leaching requirement and water balance-Economic aspects of drainage with a typical example for total cost estimation-SSD system and benefit – cost ratio.

OUTCOMES:

At the end of the course students will be understand

- Drainage problems in agricultural lands.
- Usefulness and design considerations for under steady and non-steady state drainage.

Text Books:

1. Garg,S. K. (1987). Irrigation Engineering and Hydraulic Structures. Khanna Publishers, New Delhi.
2. Israelson and Hassan. (1981). Irrigation Principles and Practices. John Wiley and sons, New York.
3. Luthin J 1970"Drainage Engineering" Wiley Eastern Ltd., New Delhi.

Reference books:

1. Schwab G O, Frevert R K, Edminister T w and Barner K K, Soil and water Conservation Engineering" 1981, John-Wiley and Sons, NewDelhi.
2. Schwab, G.O., Frevert, R.K., Edminister, T.W. and Barnes, K.K. "Soil and Water Conservation Engineering". John Wiley and Sons Inc. New York

21AGR08	MECHANICS OF SOIL	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification.

Unit I	SOIL CLASSIFICATION AND COMPACTION	9Hours

History – formation and types of soil-Composition and Index properties of soil-Clay mineralogy structural arrangement of grains-Textural Classification of soil-Phase relationship of soil- Theory of Compaction-Laboratory and field technology of compaction-Field compaction Methods-Factors influencing compaction.

Unit II	EFFECTIVE STRESS AND PERMEABILITY	9 Hours

Modes of occurrence of water in soil-Static pressure in water-Effective stress concepts in soils-Capillary phenomena-Shrinkage and swelling of soils-Permeability & Darcy's law- Determination of Permeability-Field measurement pumping out in unconfined and confined aquifer-Factors influencing permeability of soils

Unit III	CONSOLIDATION	9 Hours

One -dimensional consolidation-Solution of consolidation equation-Laboratory consolidation test-Spring Analogy-Consolidation of Laterally confined soil- Consolidation of undisturbed specimen-Secondary consolidation- 3-dimensional consolidation test- Vertical sand drains.

Unit IV	BEARING CAPACITY OF SOIL AND FOUNDATIONS	9 Hours

Definitions & Types of bearing capacity Failures-Rankine analysis-Terzaghi analysis-General and local shear failure-Mayerhoeff's analysis-Effect of water table on bearing capacity-Plate load test; Penetration test; Dutch cone test-Types of foundations-Group Action in pile-Under Reamed pile foundations.

Unit V	STRENGTH AND STABILITY OF SOIL	9 Hours

Shear strength and theoretical consideration for Mohr circle of stresses-Measurement of shear strength-Skempton's Pore pressure parameters- Shear strength of cohesive soils-Stress path method-Active and passive earth pressures-Stability of slopes-Planar Failure surface: Culmann's method-Swedish slip circle method-Taylors stability number and stability curves.

OUTCOMES:

At the end of the course students will be understand

- Classify the soil and assess the engineering properties, based on index properties.
- The stress concepts in soils.

Text Books:

1. Murthy, V.N.S. "Soil Mechanics and Foundation Engineering". Delhi, Dhanpat Rai, 1987.
2. Punmia, B.C. "Soil Mechanics and Foundation". New Delhi STD Book House, 1987 .

Reference books:

1. Gopalrajan and Rao, A.S.R. "Basic and Applied Soil Mechanics", 1993.
2. Bowell, S'J. "Soil Mechanics". New Delhi Wiley Eastern, 1991.

21AGR09	AGRONOMY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the favourable conditions for good crop growth, seed germination, emergence of young plants, and also to study about weed control &tillage practices.

Unit I	CROPS AND CROPPING SYSTEMS	9Hours

Concepts in crop production- Geographical distribution of crops and cropping systems; economic importance-Crop Classification-Detailed descriptions of rice based cropping systems-Sugarcane based cropping systems-Cotton based cropping systems-Pulses and oilseeds based cropping systems-Suitability in different agro-ecological regions.

Unit II	MODERN TECHNIQUES AND TILLAGE PRACTICES	9 Hours

Introduction of **Crop Eco Systems**-Irrigated and rain fed eco systems-Strategies of crop production in tropical and sub-tropical regions in the two major eco systems-Techniques of nursery raising-Methods of planting & fertilization-Irrigation scheduling, weed control, and other practices to optimize yield, economic evaluations-Conventional tillage practices and their effects and shortcomings- Modem tillage practices and their advantages-Optimum tillage with different tillage implements and their effect of soil properties-Soil changes due to long term effect of certain tillage system.

Unit III	SEEDING PRACICES AND SCHEDULING OF IRRIGATION	9 Hours

Quality of seed-Seed rate-Seed treatment-Seeding methods- Modern seeding techniques-Irrigation schedules for different crops in different soils-Agro-climatic regions-Ferti- irrigations-Irrigation methods.

Unit IV	PLANT PROTECTION MEASURES & HARVESTING	9 Hours

Pesticides types of weedicides-Insecticides available to control different weed flora- Pests and diseases and their mode of action-Time of application and symptoms-Method of harvesting-Modern implements their efficiency and economics-Losses during harvesting-Threshing and storage-Threshing methods and modern threshing techniques, and economics.

Unit V	CROP GROWTH ASSESSMENT	9 Hours

Water stress in relation to crop productivity-Concept of crop productivity-Plant type for dry farming areas; dry farming practices- Crop improvement for efficient water use-Efficient water utilization practices-Crop growth parameters and their measurements-Models for estimating crop growth and yield and their usefulness.

OUTCOMES:

- At the end of the course Students understand the concept for methods of harvesting and threshing.

Text Books:

1. Singh, Chidda "Modem technique of raising of field crops". Oxford and IBH Publishing Company Pvt. Ltd., 1994.
2. Agarwa1.R.L. "Seed Technology". Oxford and IBH Publishing Company Pvt. Ltd., 1990.
3. Chalam, G.B., Singh Amir and Douglas. J.E. "Seed Testing Mannual". ICAR and NSC, 1967.

Reference books:

1. Rao, V.S. "Principles of Weed Science". Oxford and IBH Publishing Company Pvt. Ltd., 1983.
2. Singh, R.P., Reddy, P.S. and Kiresur, V.(eds.). "Efficient Management of Dryland Crops in India". Indian Society of Oilseed Research, DOR Rajendra Nagar, Hyderabad, 1997.

21AGR10	GROUND WATER & WELL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the techniques of development and management of groundwater.
- To introduce the concept about Characteristics of different aquifers.

Unit I	GROUNDWATER INVESTIGATION	9Hours

Ground water chemistry .Origin, movement and quality-Water quality standards .Drinking water – Industrial water – Irrigation water-Ground water Pollution and legislation-Environmental Regulatory requirements-Ground water development and potential in India-Groundwater prospective-Geophysical Techniques-Electrical resistivity survey.

Unit II	GROUNDWATER HYDRAULICS	9 Hours

Darcy's law & Groundwater Flow Equation-Steady state flow – Dupuit Forcheimer Assumption-Theim's Equation -& unsteady flow-Theis method and Jacob method- Image well theory & Partial penetration of wells-Chow's method & .Bailer method -Slug method & Tests-Well losses-Specific Capacity and Safe yield-Collector well and Infiltration gallery

Unit III	GROUNDWATER RECHARGE	9 Hours

Artificial Recharge Techniques-Reclaimed wastewater recharge-Soil aquifer treatment (SAT)-Aquifer Storage and Recovery (ASR) Seawater Intrusion and Remediation-Ground water Basin management and Conjunctive use -Protection zone delineation-Contamination source inventory and remediation schemes-Water Balance – Distribution of subsurface water-Types of Aquifers – Aquifer properties Estimation – Pumping test.

Unit IV	WELL CONSTRUCTION AND MAINTENANCE	9 Hours

Types of wells-Well drilling - Boring, Jetting-Rotary drilling, Hammer drilling- Construction of well-Installation of pipes and screens-Well development, Completion and disinfection- Well maintenance-Well performance test-Well effectiveness Pumping equipment.

Unit V	GROUND WATER MODELLING	9 Hours

Need for Management Model-Database for Groundwater Management-Groundwater balance study-Introduction to Mathematical model-Model Conceptualization -Initial and Boundary Condition-Calibration – Validation – Future Prediction- Sensitivity Analysis- Uncertainty – Development of a model.

OUTCOMES:

At the end of the course students

- Understand aquifer properties and its dynamics.
- Get an exposure towards well design and practical problems.
- Develop a model for groundwater management.
- The importance of artificial recharge and groundwater quality concepts.
- Gain knowledge on conservation of groundwater

Text Books:

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.

Reference books:

1. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.
2. Karanth, K.R. Groundwater Assessment, Development and Management. Tata Mc-GrawHill, 2008.

21AGRP3	STRENGTH OF MATERIALS LAB	L	T	P	C
		0	0	4	2

OBJECTIVE:

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

	LIST OF EXPERIMENTS	60 PERIODS

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

OUTCOMES:

- The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.

S.NO	DESCRIPTION OF EQUIPMENT
1.	UTM of minimum 400 Kn capacity
2.	Torsion testing machine
3.	Izod impact testing machine
4.	Hardness testing machine Rockwell Vicker's Brinnel (any 2)
5.	Beam deflection test apparatus
6.	Extensometer
7.	Compressometer
8.	Dial gauges
9.	Le Chatelier's apparatus
10.	Vicat's apparatus

21AGER4	AGRICULTURAL ENGINEERING PRACTICE LAB	L	T	P	C
		0	0	4	2
	LIST OF EXPERIMENTS	60 PERIODS			

AGROMETEOROLOGY

- Meteorology – Precipitation – Rain gauges – recording and non-recording rain gauges – Automatic Weather Station (AWS)
- Measurement of evaporation using evaporimeter
- Measurement of humidity, sunshine, solar radiation, wind direction and speed.

SEEDS AND CROPS

- Identification of food grains and crops.
- Estimation of germination rate for cereals, pulses and oilseeds by conventional method and using Seed Growth germinator
- Estimation of biometric parameters of different food crops.

SOIL AND WATER PARAMETERS

- Soil Moisture estimation by different methods.
- Ph and EC measurement using electrode device.

AGRICULTURAL MACHINERY

- Demonstration of Agricultural machineries and equipment.
- Demonstration of Agricultural processing equipment.
- Demonstration of Agro-energy equipment direction and speed.

OUTCOMES:

At the end of the course the student will be able to Use various aspects of agricultural and irrigation engineering practices like measurement• of evaporation, humidity, soil moisture estimation and familiarize with agricultural processing equipments.

S.NO	DESCRIPTION OF EQUIPMENT
1	Rain gauge – Recording type, Non-recording type, Automatic Weather Station – 1 each
2	Open Pan Evaporimeter – 1
3	Sunshine recorder, Hygrometer, Wind vane, Anemometer, Stevenson's screen – 1 each
4	Seed growth germinator
5	Hot air oven
6	Hot air over, Soil moisture meter, tensiometer (for 3 varying depths), soil auger, weighing balance – 1 each
7	Drip irrigation and Sprinkler irrigation setup with all features.
8	Mouldboard plough, disc plough, disc harrow, rotovator, single tyne and multi tyne cultivator, bund former, sub soiler, conoweeder, seed drill, sprayers – 1 each
9	.Bucket elevator, screw conveyor, belt separator, belt conveyor, fluidized bed dryer, extruder, groundnut decorticator, Paddy thresher – 1 each
10	Bio gas plant, wind mill, solar pump, solar dryer

SEMESTER -V

S.NO	COURSE CODE	COURSE TITLE	Subject category	Contact Hours	L	T	P	C
THEORY								
1	21AGE11	Soil &Water conservation Engineering	PC	3	3	0	0	3
2	21AGE12	Post Harvest Engineering	PC	3	3	0	0	3
3	21AGE13	Dairy & Food Process Engineering	PC	4	3	1	0	4
4	21NCP05	Essence of Indian Traditional Knowledge	MC	3	3	0	0	0
5		Professional Elective-1	PE	3	3	0	0	3
6		Professional Elective-2	PE	3	3	0	0	3
PRACTICAL								
	21AGEP5	Diary and Food Engineering Lab	PC	4	0	0	4	2
8	21AGEP6	Soil Mechanics Laboratory	PC	4	0	0	4	2
9	21ENGP3	Professional Communication Lab	HS	2	0	0	2	1
		TOTAL		**29**	**18**	**1**	**10**	**21**

21AGE11	SOIL &WATER CONSERVATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- 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.

Unit I	SOIL EROSION PRINCIPLES	9 Hours

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

Unit II	ESTIMATION OF SOIL EROSION	9 Hours

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

Unit III	EROSION CONTROL MEASURES	10 Hours

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

Unit IV	WATER CONSERVATION MEASURES	9 Hours

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

Unit V	SEDIMENTATION	8 Hours

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

OUTCOMES:

At the end of the course students will be understand

- to gain fundamental knowledge on the concepts of erosion and sedimentation.
- sufficient knowledge on soil and water conservation measures.

Textbooks:

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

Reference books:

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

21AGE12	POST-HARVEST ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

Unit I	FUNDAMENTALS OF POST HARVESTING	9 Hours

Types and methods of harvest.- 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 Hours

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

Unit III	CLEANING AND GRADING	9 Hours

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

Unit IV	SHELLING AND HANDLING	9 Hours

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

Unit V	CROP PROCESSING	9 Hours

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

OUTCOMES:

At the end of the course students will be understand

- Material handling equipment.
- Different Post Harvest operations and processing methods of harvested crops.
- Fundamentals of various unit operations of Agricultural Processing

Textbooks:

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

Reference books:

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

21AGE13	DAIRY & FOOD PROCESS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products , sanitation, and effluent treatment in dairy industry
- To expose the students to the fundamental knowledge of food, its properties, and different methods of food processing

Unit I	PROPERTIES AND PROCESSING OF MILK	9 Hours

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 Hours

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 Hours

Constituents of food - thermal processing of foods - cooking, blanching, sterilization, pasteurization, canning - Interaction of heat energy on food components, reaction kinetics, Arrhenius equation, TDT curves - water activity, sorption behaviour of foods – isotherm models - monolayer value, BET isotherms, Raoult‟s law, Norrish, Ross, Salwin- Slawson equations.

Unit IV	PROCESSING AND PRESERVATION OF FOODS	9 Hours

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

Unit V	PACKAGING AND QUALITY CONTROL	9 Hours

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 affecting quality.

OUTCOMES:

1. The students will gain knowledge about Dairy and Food process engineering.
2. Understand the process of manufacturing of dairy products and thermal processing of food.
3. Students will understand the importance of quality control and food preservation and packaging.

Textbooks:

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”, CRC press, 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 Age International Publications, New Delhi, 2007.
2. Toledo, R.T., “Fundamentals of Food Process Engineering”, CBS Publishers and Distribution, New Delhi, 1997.
3. 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

21AGEP5	DIARY AND FOOD ENGINEERING LAB	L	T	P	C
		0	0	4	2

OBJECTIVE:

To get hands on experience on various aspects of food science and food process engineering.

	LIST OF EXPERIMENTS	60 PERIODS

1. Determination of cooking properties of parboiled and raw rice.
2. Estimation of microbial load in food materials.
3. Determination of rehydration ratio of dehydrated foods.
4. Experiment on osmotic dehydration of foods
5. Experiment of food extruder
6. Experiment on properties of food through microwave oven heating.
7. Determination of properties of milk
8. Experiments on cream separator to determine the separation efficiency.
9. Experiments on construction and operation of butter churn and butter working accessories.
10. Experiments on detection of Food Adulteration.
11. Experiments on estimation of protein in food.
12. Experiment on expansion and Oil absorption characteristic of snacks on frying

The lab includes visit to food processing and dairy industry

OUTCOMES:

On completion of the lab course, the students will be able to get experience on various aspects of food processing, preservation.

S.NO	DESCRIPTION OF EQUIPMENT
1.	Extruder
2.	Pasteurizer
3.	Hot air oven
4.	Hand refractometer
5.	Desiccator
6.	Dean and Stark’s apparatus
7.	Cabinet dryer
8.	Soxhlet flask
9.	Distillation column
10.	Kjeldahl flask
11.	Distillation apparatus
12.	Microwave oven
13.	Cream separator
14.	Butter churner

21AGEP6	SOIL MECHANICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVE:

- To verify various quality aspects of soil and water studied in theory by performing experiments in lab.

	LIST OF EXPERIMENTS	60 PERIODS

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

OUTCOMES:

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

S.NO	DESCRIPTION OF EQUIPMENT
1	Conductometer
2	pH meter
3	Specific Gravity bottle
4	Mechanical Sieve Shaker

21ENGP3	PROFESSIONAL COMMUNICATION LAB	L	T	P	C
		0	0	2	1

OBJECTIVE:

The Course will enable learners to:

- Equip students with the English language skills required for the successful academic speaking and listening skills.
- Make effective presentations.
- Strengthen the reading skills of students of Engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students 'critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

	LIST OF EXPERIMENTS	30 PERIODS

1. Listening – Intro & video / audio
   Listening as a key skill- its importance- being an active listener - listen to follow and respond to explanations, directions and instructions in academic and business contexts speaking - give personal information - ask for personal information - Improving pronunciation - pronunciation basics.
2. Self- Introduction - Deliver a five-minute talk about oneself.
3. Presentation- Group/Pair, Individual presentation
   giving verbal and non-verbal feedback - participating in a group discussion - participating in conversations. strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.
4. Phonetics-Pronunciation
   clarification Improving pronunciation - pronunciation basics - lexical chunking for accuracy and fluency-factors influence fluency.
5. Group Discussion, participating in group discussions, Agree & Disagree
   giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.
6. Interview
   Attending job interviews- telephone/ Skype interview-one to one interview & panel interview, FAQs related to job interviews.
7. Review writing
   Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence – Write a descriptive paragraph.
8. Email writing
   Email writing- project writing-writing convincing proposals.
9. Resume
   Resumes – Job application - Statement of Purpose
10. Critical Reading & Thinking
    Strategies for Critical Reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title . State reasons and examples to support ideas - speed reading techniques. Genre and Organization of Ideas

OUTCOMES:

On completion of the lab course, the students will be able to Listen and respond appropriately.

- Participate in group discussions.
- Make effective presentations.
- Participate confidently and appropriately in conversations both formal and informal Enhance their writing skills with specific reference to technical writing.
- Develop students 'critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills

SEMESTER -VI

S.NO	COURSE CODE	COURSE TITLE	Subject category	Contact Hours	L	T	P	C
THEORY								
1	21AGE16	Micro Irrigation system	PC	4	3	1	0	4
2	21AGE17	Farm machinery and Equipment	PC	4	3	1	0	4
3	21AGE18	Building Materials	PC	3	3	0	0	3
4		Professional Elective-3	PE	3	3	0	0	3
5		Professional Elective-4	PE	3	3	0	0	3
PRACTICAL								
6	21AGEP7	Farm machinery and equipment Lab	PC	4	0	0	4	2
7	21AGEP8	Industrial Mini project	EEC	0	0	0	1	1
		TOTAL		**21**	**15**	**2**	**5**	**20**

21AGE16	MICRO IRRIGATION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

Unit I	WATER LIFTS AND PUMPS	8 Hours

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 Hours

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 Hours

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 Hours

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 Hours

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

OUTCOMES:

At the end of the course the students will have

- thorough knowledge on micro irrigation, its concepts and design of a sprinkler and drip system

Textbooks:

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”, 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 Irrigation Manufacturing Corporation, Glendora, California, USA.

21AGE17	FARM MACHINERY AND EQUIPEMENT	L	T	P	C
		3	1	0	4

OBJECTIVE:

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

Unit I	FARM MECHANIZATION	12 Hours

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

Unit II	PRIMARY AND SECONDARY TILLAGE IMPLEMENTS	12 Hours

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

Unit III	SOWING AND FERTILIZING EQUIPMENT	12 Hours

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

Unit IV	WEEDING AND PLANT PROTECTION EQUIPMENT	12 Hours

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

Unit V	HARVESTING MACHINERY	12 Hours

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

OUTCOMES:

At the end of the course students will be understand

- understand the mechanization and various equipment used in the farm for different field operations.

Textbooks:

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

Reference books:

1. Kepner, R.A., et al. Principles of farm machinery. CBS Publishers and Distributers, Delhi. 99, 1997.
2. Harris Pearson Smith et al. Farm machinery and equipment. Tata McGraw-Hill pub., New Delhi.,1996.
3. Srivastava, A.C. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi, 1990

21AGE18	BUILDING MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce students to various materials commonly used in civil engineering construction and their properties.

Unit I	STONES – BRICKS – CONCRETE BLOCKS	9 Hours

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stonework – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Concrete blocks – Lightweight concrete blocks.

Unit II	LIME – CEMENT – AGGREGATES – MORTAR	9 Hours

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – fine aggregates – river sand – crushed stone sand – properties – coarse Aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading

Unit III	CONCRETE	9 Hours

Concrete – Ingredients – Manufacturing Process – Batching plants –mixing – transporting – placing – compaction of concrete –curing and finishing – Ready mix Concrete – Mix specification.

Unit IV	TIMBER AND OTHER MATERIALS	9 Hours

Timber – Market forms – Industrial timber– Plywood – Veneer – Thermocol – Panels of laminates – Steel – Aluminium and Other Metallic Materials – Composition – Aluminium composite panel – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumen.

Unit V	MODERN MATERIALS	9 Hours

Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles– Geomembranes and Geotextiles for earth reinforcement.

OUTCOMES:

On completion of this course the students will be able to

1. Compare the properties of most common and advanced building materials.
2. understand the typical and potential applications of lime, cement, and aggregates.
3. know the production of concrete and also the method of placing and making of concrete elements.
4. understand the applications of timbers and other materials.
5. Understand the importance of modern material for construction.

Textbooks:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3. Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.

Reference books:

4. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
5. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
6. IS456 - 2000: Indian Standard specification for plain and reinforced concrete, 2011
7. IS4926 - 2003: Indian Standard specification for ready–mixed concrete, 2012

21AGEP7	FARM MACHINERY AND EQUIPMENT LAB	L	T	P	C
		0	0	4	2

OBJECTIVE:

To the practice of different farm machinery in the field on tillage, sowing, plant protection, harvesting and threshing; care and maintenance; lubrication; fits and tolerances and replacements; adjustments of farm machines; dismantling and reassembling of a disc harrow, seed-cum fertilizer drill and sprayer, engine pumps.

	LIST OF EXPERIMENTS	60 PERIODS

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

OUTCOMES:

On completion of the lab course, the students will be able to get experience on various aspects of operation and maintenance of farm machinery and equipment.

S.NO	DESCRIPTION OF EQUIPMENT
1.	Tractor
2.	Disc Harrow
3.	Disc Plough
4.	Power tiller
5.	Multi Tyne cultivator
6.	Paddy transplanter
7.	Sprayer
8.	Mower
9.	Weeder
10.	Combine harvester (optional) – can be had as demonstration

21AGEP8	INDUSRIAL MINI PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVE:

- To undergo and observe the daily operations in an agricultural industry and submit an evaluative report.

	LIST OF EXPERIMENTS	30 PERIODS

The student has to visit an industry and develop a working model by observing the day-to-day operations of the industry.

OUTCOMES:

Students know the dos and don'ts in an industrial setup and the consequences of mistakes in real life situations.

SEMESTER -VII

S.NO	COURSE CODE	COURSE TITLE	Subject category	Contact Hours	L	T	P	C
THEORY								
1	21AGE19	Solid Waste Management	PC	3	3	0	0	3
2	21AGE20	Tractor and Power units	PC	3	3	0	0	3
3		Professional Elective-5	PE	3	3	0	0	3
4	21UHV02	Universal Human Values - II	HS	3	2	1	0	3
5		Open Elective-1	OE	3	3	0	0	3
6	21GEN06	Disaster Management	HS	3	3	0	0	3
PRACTICAL								
7	21AGEP9	Building Materials and Structural Drawing Lab	PC	4	0	0	4	2
8	21AGEP10	Industrial Training (4 weeks During VI Semester –Summer)	EEC	0	0	0	0	2
		TOTAL		**22**	**18**	**0**	**4**	**22**

21AGE19	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing, and disposal of municipal solid waste.

Unit I	SOURCES AND TYPES	8 Hours

Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management.

Unit II	ON-SITE STORAGE AND PROCESSING	8 Hours

On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage– source reduction of waste – Reduction, Reuse and Recycling.

Unit III	COLLECTION AND TRANSFER	8 Hours

Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance

Unit IV	OFF-SITE PROCESSING	12 Hours

Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and bio-methanation; Thermal processing options

Unit V	DISPOSAL	9 Hours

Land disposal of solid waste; Sanitary landfills – site selection, design, and operation of sanitary landfills – Landfill liners - Landfill bioreactor– Dumpsite Rehabilitation

OUTCOMES:

At the end of the course students will have

- an understanding of the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management
- ability to plan waste minimization and design storage, collection, transport, processing, and disposal of municipal solid waste

Textbooks:

1. Tchobanoglous, G., Theisen, H. M., and Eliassen, R. "Solid. Wastes: Engineering Principles and Management Issues". McGraw Hill, New York, 1993.
2. Vesilind, P.A. and Rimer, A.E., “Unit Operations in Resource Recovery Engineering”, Prentice Hall, Inc., 1981
3. Paul T Willams, "Waste Treatment and Disposal", John Wiley and Sons, 2000.

Reference books:

1. Government of India, "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, New Delhi, 2000.
2. Bhide A.D. and Sundaresan, B.B. "Solid Waste Management Collection", Processing and Disposal, 2001
3. George Tchobanoglous and Frank Kreith, "Handbook of Solid waste Management", McGraw Hill, New York, 2002

21AGE20	TRACTOR AND POWER UNITS	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

Unit I	TRACTORS	9 Hours

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

Unit II	ENGINE SYSTEMS	9 Hours

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

Unit III	TRANSMISSION SYSTEMS	9 Hours

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

Unit IV	HYDRAULIC SYSTEMS	9 Hours

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

Unit V	POWER TILLER, BULLDOZER AND TRACTOR TESTING	9 Hours

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

OUTCOMES:

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

- the various equipment and mechanizations used in the farm.
- the knowledge on earth moving machineries, tractor classification and tillage implements.

Textbooks:

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

Reference books:

4. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors, and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.
5. Domkundwar A.V. A course in internal combustion engines. Dhanpat Rai & Co. (P) Ltd., Educational and Technical Publishers, Delhi,1999.
6. Black, P.O. Diesel engine manual. Taraporevala Sons& Co., Mumbai, 1996.
7. Grouse, W.H. and Anglin, D.L. Automotive mechanics. Macmillan McGraw- Hill, Singapore, Indian Standard Codes for Agricultural Implements Published by ISI, New Delhi, 1993.
8. Jagadeeshwar Sahay, Elements of Agricultural Engineering, Standard Publishers Co., New Delhi, 2010.

21AGEP9	BUILDING MATERIALS AND STRUCTURAL DRAWING LAB	L	T	P	C
		0	0	4	2

OBJECTIVE:

- To facilitate the understanding of the behavior of construction materials.
- At the end of the semester, the student shall conceive, design, and draw the irrigation and environmental engineering structures in detail showing the plan, elevation, and Sections.

	LIST OF EXPERIMENTS	60 PERIODS

PART A: BUILDING MATERIAL

I. TEST ON FINE AGGREGATES 15

1. Grading of fine aggregates
2. Test for specific gravity

II. TEST ON COARSE AGGREGATE 15

1. Determination of impact value of coarse aggregate
2. Determination of elongation index
3. Determination of flakiness index
4. Determination of aggregate crushing value of coarse aggregate

III. TEST ON CONCRETE 10

1. Test for Slump
2. Test for Compaction factor

IV. TEST ON BRICKS AND BLOCKS 10

1. Test for compressive strength of bricks and blocks
2. Test for Water absorption of bricks and blocks

PART B: STRUCTURAL DRAWING

Tank surplus weir- Earth dam – Profile of Gravity Dam- Canal regulator- Syphon aqueduct – Canal drop

OUTCOMES:

- The students will have the required knowledge in the area of testing of construction materials and components of construction elements experimentally.
- The students after completing this course will be able to design and draw various units of Municipal water treatment plants and sewage treatment plants.

21AGEP10	INDUSTRIAL TRAINING (4 WEEKS DURING VI SEMESTER –SUMMER)	L	T	P	C
		0	0	0	2

OBJECTIVE:

- To train the students in field work by attaching to any industry / organization to have a first-hand knowledge of practical problems in Agricultural Engineering
- To gain working experience and skills in carrying out engineering tasks related to various fields of agriculture..

LIST OF EXPERIMENTS

The students individually undertake training in reputed engineering companies / Govt organisations / NGOs / Educational Institutions who work in the area of Agricultural Engineering for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOMES:

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

SEMESTER -VIII

S.NO	COURSE CODE	COURSE TITLE	Subject category	Contact Hours	L	T	P	C
THEORY								
1		Professional Elective-6	PE	3	3	0	0	3
2		Open Elective-2	OE	3	3	0	0	3
PRACTICAL								
3	21AGEP11	PROJECT WORK	PC	20	0	0	20	10
		TOTAL		**26**	**6**	**0**	**20**	**16**

21AGEP11	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVE:

- 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.

	LIST OF EXPERIMENTS	60 PERIODS

Students in a group of 3 or 4 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.

OUTCOMES:

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

ELECTIVES

S.NO	COURSE CODE	COURSE TITLE	Subject category	Contact Hours	L	T	P	C
PROFESSIONAL ELECTIVES								
1	21AGE21	Design of structures	PE	3	3	0	0	3
2	21AGE22	Food packaging Technology	PE	3	3	0	0	3
3	21AGE23	Seed Technology	PE	3	3	0	0	3
4	21AGE24	Agricultural Extension	PE	3	3	0	0	3
5	21AGE25	On Farm Water Management	PE	3	3	0	0	3
6	21AGE26	Green Energy	PE	3	3	0	0	3
7	21AGE287	Technology in Agricultural Systems	PE	3	3	0	0	3
8	21AGE28	Tillage and traction Engineering	PE	3	3	0	0	3
9	21AGE29	Storage and Packaging Technology	PE	3	3	0	0	3
10	21AGE30	Special Farm Equipment	PE	3	3	0	0	3
11	21AGE31	Heat and Mass Transfer	PE	3	3	0	0	3
12	21AGE32	Tractor systems and controls	PE	3	3	0	0	3
13	21AGE33	Hydrology and water shed Management	PE	3	3	0	0	3
14	21AGE34	Energy Auditing and Management	PE	3	3	0	0	3
15	21AGE35	Climate Change and Adaptation	PE	3	3	0	0	3
16	21AGE36	Air Pollution Control	PE	3	3	0	0	3
17	21AGE37	Remote sensing and GIS	PE	3	3	0	0	3
18	21AGE38	Ergonomics and Safety in Agricultural Engineering	PE	3	3	0	0	3

19	21AGE39	Intellectual Property Rights	PE	3	3	0	0	3
20	21AGE40	Refrigeration and Air Conditioning for Agricultural Engineers	PE	3	3	0	0	3
21	21AGE41	Wastewater Treatment	PE	3	3	0	0	3
22	21AGE42	Total Quality Management	PE	3	3	0	0	3
23	21AGE43	Agricultural Waste Management	PE	3	3	0	0	3
24	21AGE44	Process Engineering of Fruits and Vegetables	PE	3	3	0	0	3
25	21AGE45	CAD for Agricultural Engineering	PE	3	3	0	0	3
26	21AGE46	Estimation and Valuation	PE	3	3	0	0	3
27	21AGE47	Instrumentation and Control Engineering in Agriculture	PE	3	3	0	0	3
28	21AGE48	Fundamentals of Nanoscience	PE	3	3	0	0	3
29	21AGE49	Systems Analysis and Soft Computing in Agricultural Engineering	PE	3	3	0	0	3
30	21AGE50	Sustainable Agriculture and Food Security	PE	3	3	0	0	3
OPEN ELECTIVES								
1	21OEE01	Waste to Energy	OE	3	3	0	0	3
2	21OEE02	Industrial Pollution Prevention	OE	3	3	0	0	3
3	21OEE03	Industrial Safety	OE	3	3	0	0	3
4	21OEE04	Energy Management	OE	3	3	0	0	3
VALUE ADDED COURSES								
1	21VAC01	Sustainable Agricultural Land Management		3	3	0	0	0
2	21VAC02	Introduction to Sustainability		3	3	0	0	0

21AGE11	DESIGN OF STRUCTURES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To use the above two methods for the design of Concrete beams and slabs under various
- To inform about the methods of design through working stress and limit state methods.
- To use the limit state method for design of a concrete staircase

Unit I	DESIGN OF CONCRETE MEMBERS AND WORKING STRESS DESIGN OF BEAMS	12 Hours

Concept of Elastic method, Ultimate Load Method, and Limit State Method – Advantages of Limit State Method over other methods. Analysis and Design of singly and doubly reinforced rectangular and flanged beams for bending.

Unit II	LIMIT STATE DESIGN OF BEAMS	12 Hours

Analysis and design of singly and doubly reinforced rectangular and flanged beams for Bending – Design of Continuous beams using IS code co-efficient.

Unit III	LIMIT STATE DESIGN OF SLABS	7 Hours

Behaviour of one way and two-way slabs – Design of one way and two-way slabs for various edge conditions - Corner effects.

Unit IV	DESIGN OF CIRCULAR SLABS	7 Hours

Design of Simply supported and fixed Circular slabs subjected to uniformly distributed loads.

Unit V	DESIGN OF STAIRCASE BY LIMIT STATE METHOD	7 Hours

Types of Staircases – Design of Dog Legged Staircase.

OUTCOMES:

At the end of the course the students will be

- Dog legged staircase design using LSD.
- RC beams and slabs to be designed by applying the above concepts.
- Understand the different concepts of WSM and LSD methods using the codal provisions

Textbooks:

1. S.N. Sinha, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1998.
2. Shah, “Reinforced Concrete”, Vol. 1 and 2, Charotar Publishing House, Anand, 1998.

Reference Books:

1. P.Dayaratnam, “Design of Reinforced Concrete Structures”, Oxford and IBH Publishing Co., 1983.
2. C. Sinha and S.K. Roy, “Fundamentals of Reinforced Concrete”, S.Chand & Co., New Delhi, 1983.
3. Dr. B.C. Punmia, “Reinforced Concrete Structures”, Vol, 1 & 2 Laxmi publication, Delhi, 2004.
4. IS 456 “Indian Standard, Plain and Reinforced Concrete, Code of Practice, Bureau of Indian Standards, 2000.

21AGE22	FOOD PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the underlying principles of spoilage and storage
- To provide knowledge on different storage methods and packaging techniques

Unit I	SPOILAGE AND STORAGE	9 Hours

Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses.

Unit II	STORAGE METHODS	9 Hours

Improved storage methods for grain-modern storage structures-infestation-temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities

Unit III	FUNCTIONS OF PACKAGING MATERIALS	9 Hours

Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – biodegradable packaging materials – shrink and stretch packaging materials.

Unit IV	FOOD PACKAGING MATERIALS AND TESTING	9 Hours

Vacuum and gas packaging - aseptic packaging - retort pouching – edible film packaging – tetra packaging – antimicrobial packaging – shrink and stretch packaging

Unit V	SPECIAL PACKAGING TECHNIQUES	9 Hours

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

OUTCOMES:

The students will have a clear understanding of various methods of storage and different packaging techniques for food

Textbooks:

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, Handbook, 2004. NIIR Board, New Delhi.
3. Pandey, P.H.2002. Post-harvest engineering of horticultural crops through objectives. Saroj Prakasam. Allahabad.

Reference books:

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

21AGE23	SEED TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To expose the students to scope and importance of good quality seed production.
- To acquaint them with the principles and special techniques used in the process of production of good quality seed using specific examples.
- To familiarize them with planning, development, and organization of seed programmes

Unit I	SEED CHARACTERS	9 Hours

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 Hours

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 Hours

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 Hours

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 Hours

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

OUTCOMES:

- The students will be able to appreciate the different methods of seed production, processing, and testing.
- They will also have the knowledge on different seed programmes

Textbooks:

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

Reference books:

9. Subir Sen and Ghosh, N., Seed Science, Kalyani Publishers, Chennai, 1999.
10. Dahiya, B.S., and Rai, K.N., Seed Technology, Kalyani Publishers, Chennai, 1997.
11. George, Raymond, A.T., Vegetable Seed Production, Longman Orient Press, London, and New York, 1985.
12. Handbook of Seedling Evaluation, ISTA, 1979.

21AGE24	AGRICULTURAL EXTENSION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To expose the students to different extension methods for communication to take the work from lab to field

Unit I	COMMUNICATION AND PROGRAMME PLANNING	8 Hours

Communication – meaning – definition – models – elements and their characteristics – types and barriers in communication. Programme planning – meaning, definition, principles, steps in programme development process, monitoring and evaluation of extension programmes.

Unit II	EXTENSION TEACHING METHODS	8 Hours

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

Unit III	MODERN COMMUNICATION GADGETS	8 Hours

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	12 Hours

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 Hours

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

OUTCOMES:

At the end of the course students will be

- familiar with various extension methods, communication gadgets.
- trained in capacity building techniques

Textbooks:

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 & IBH Publishing Co. Pvt. Ltd, New Delhi.

21AGE25	ON FARM WATER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the fundamentals of minor irrigation, its types, operation and maintenance and people's participation
- Command Area Development, On farm structures, policy, operation and maintenance

Unit I	DESIGN OF IRRIGATION CHANNELS	9 Hours

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 Hours

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

Unit III	CONJUNCTIVE USE OF SURFACE AND GROUNDWATER	9 Hours

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 Hours

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 Hours

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

OUTCOMES:

The students will have a clear understanding of various practices of water management on farm

Textbooks:

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

21AGE26	GREEN ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on available energy sources, rising energy demand for the day-to day life requirements and the need of research on this area to meet the demand.

Unit I	INTRODUCTION	9 Hours

Current energy requirements, growth in future energy requirements, Review of conventional energy resources, Coal, gas and oil reserves and resources, Tar sands and Oil Shale, Nuclear energy Option.

Unit II	SOLAR ENERGY	9 Hours

Solar radiation: measurements and prediction. Solar thermal collectors- flat plate collectors, concentrating collectors. Basic theory of flat plate collectors, solar heating of buildings, solar still, solar water heaters, solar driers; conversion of heat energy into mechanical energy, solar thermal power generation systems. Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes.

Unit III	WIND ENERGY	9 Hours

Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, and applications

Unit IV	OCEAN ENERGY	9 Hours

Ocean energy resources-ocean energy routes - Principles of ocean thermal energy conversion systems- ocean thermal power plants- Principles of ocean wave energy conversion and tidal energy conversion.

Unit V	HYDRO AND OTHER SOURCES OF ENERGY	9 Hours

Hydropower, Nuclear fission and fusion-Geothermal energy: Origin, types of geothermal energy sites, site selection, geothermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

OUTCOMES:

At the end of the course students will be

- Aware about the current scenario of energy requirements.
- Apply the solar energy-based systems to meet the energy demand.
- Apply the wind energy-based set-ups for energy management.
- Apply the principles of ocean and tidal energy generation for the current and future energy needs.
- Aware of various source of energy like nuclear, geo-thermal and hydropower to withstand the present and future energy requirements.

Textbooks:

4. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, Second Edition, 2000.
5. J. Twidell, & T. Weir, Renewable energy resources. Taylor and Francis, Third edition, 2015.

Reference books:

4. D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press, Second Edition, 2009.
5. S.P. Sukhatme, Solar Energy: principles of Thermal Collection and Storage, Tata McGraw Hill, Third Edition, 2008.
6. L.L. Freris, Wind Energy Conversion Systems, Prentice Hall,1990.

21AGE27	TECHNOLOGY IN AGRICULTURAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

Unit I	PRECISION FARMING	9 Hours

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

Unit II	ENVIRONMENT CONTROL SYSTEMS	9 Hours

Artificial light systems, management of crop growth in greenhouses, simulation of CO2 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 Hours

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence, and decision support systems.

Unit IV	WEATHER PREDICTION MODELS	9 Hours

Importance of climate variability and seasonal forecasting, Understanding, and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

Unit V	E-GOVERNANCE IN AGRICULTURAL SYSTEMS	9 Hours

Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development, and information society.

OUTCOMES:

The students shall be able to understand the IT applications in environmental control systems, precision farming, agricultural systems management, and weather prediction models

Textbooks:

4. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
5. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989

Reference books:

8. Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, New York, 2004.
9. Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer, Germany, 2000.

21AGE28	TILLAGE AND TRACTION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart the fundamental knowledge of mechanics and dynamics in various tillage implements
- To study the tyres, traction, and its applications

Unit I	MECHANICS OF TILLAGE	9 Hours

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

Unit II	DYNAMICS OF TILLAGE	9 Hours

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 Hours

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

Unit IV	TYRES	9 Hours

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

Unit V	APPLICATIONS	9 Hours

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

OUTCOMES:

After completion of the course, the students will be able to understand the concepts of mechanics, dynamics, and traction of implements and their applications.

Textbooks:

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

21AGE29	STORAGE AND PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the underlying principles of spoilage and storage
- To provide knowledge on different storage methods and packaging techniques.

Unit I	SPOILAGE AND STORAGE	9 Hours

Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses.

Unit II	STORAGE METHODS	9 Hours

Improved storage methods for grain-modern storage structures-infestation-temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities

Unit III	FUNCTIONS OF PACKAGING MATERIALS	9 Hours

Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials

Unit IV	FOOD PACKAGING MATERIALS AND TESTING	9 Hours

Introduction – paper and paper boards - flexible - plastics - glass containers – cans – aluminium foils - package material testing-tensile, bursting and tear strength.

Unit V	SPECIAL PACKAGING TECHNIQUES	9 Hours

Vacuum and gas packaging - aseptic packaging - retort pouching – edible film packaging – tetra packaging – antimicrobial packaging – shrink and stretch packaging.

OUTCOMES:

- The students will have a clear understanding of various methods of storage and different packaging techniques for food.

Textbooks:

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. Himangshu Barman. 2008, Post Harvest Food grain storage. Agrobios (India), Jodhpur.
2. Chakaraverty, A. 2000. 3rd edition. Post harvest technology of cereals, pulses and oil seeds. Oxford & IBH publishing & Co.Pvt.Ltd. New Delhi.

21AGE30	SPECIAL FARM EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the special machineries used for agricultural applications

Unit I	MOWERS AND WEEDING EQUIPMENT	9 Hours

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 Hours

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

Unit III	THRESHERS AND HARVESTERS	9 Hours

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 Hours

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 Hours

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.

OUTCOMES:

- After completion of the course, the students will have a thorough knowledge on special farm equipment required for various agricultural operations.

Textbooks:

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

Reference books:

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

21AGE31	HEAT &MASS TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVE:

- The course is intended to build up necessary background for the understanding of the physical behaviour of the various modes of heat transfer, like, conduction, convection, and radiation.

Unit I	CONDUCTION	9 Hours

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 Heisler's chart.

Unit II	CONVECTION	9 Hours

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 Hours

Nusselt's 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 Hours

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

Unit V	MASS TRANSFER	9 Hours

Basic concepts, law of radiation – Stefan-Boltzmann law, Kirchhoff's law – Block body radiation – Grey body radiation shape factor algebra – Electrical analogy – Radiation shields – introduction to gas radiation.

OUTCOMES:

After completion of the course, the students will be able:

- To understand the application of various experimental heat transfer correlations in engineering calculations.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.

Textbooks:

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.

21AGE32	TRACTOR SYSTEMS AND CONTROLS	L	T	P	C
		3	0	0	3

OBJECTIVE:

Unit I	TRANSMISSION SYSTEM	9 Hours

Study of need for transmission system in a tractor. Transmission system – types, major functional systems. Study of clutch – need, types, functional requirements, construction, and principle of operation. Familiarization with single plate, multi-plate, centrifugal and dual clutch systems.

Unit II	GEAR BOX	9 Hours

Study of Gear Box – Gearing theory, principle of operation, gear box types, functional requirements, and calculation for speed ratio. Study of differential system – need, functional components, construction, calculation for speed reduction. Study of need for a final drive. Study of Brake system – types, principle of operation, construction, calculation for braking torque.

Unit III	STEERING SYSTEM	9 Hours

Study of steering system – requirements, steering geometry characteristics, functional components, calculation for turning radius. Familiarization with Ackerman steering. Steering systems in track type tractors. Study of Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements. Familiarization with the Hydraulic system adjustments and ADDC.

Unit IV	TYRES	9 Hours

Study of tractor power outlets – PTO. PTO standards, types and functional requirements. Introduction to traction. Traction terminology. Theoretical calculation of shear force and rolling resistance on traction device. Study of wheels and tyres – Solid tyres and pneumatic tyres, tyre construction and tyre specifications. Study of traction aids.

Unit V	TRACTOR MECHANICS	9 Hours

Study of tractor mechanics – forces acting on the tractor. Determination of CG of a tractor. Determination and importance of moment of inertia of a tractor. Study of tractor static equilibrium, tractor stability especially at turns. Determination of maximum drawbar pull. Familiarization with tractor as a spring-mass system. Ergonomic considerations and operational safety. Introduction to tractor testing. Deciphering the engine test codes.

OUTCOMES:

At the end of the course students will be understand

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Textbooks:

6. Jones, F.R. Farm Gas Engines and Tractors
7. Barger, E.L.; Lijedehl, J.B; Carleton, W.B. and Mc Kibben, E.G. Tractors and their Power Units.

Reference books:

13. Moses and Frost. Farm Power.
14. Radhey Lal and Dutta. Agricultural Engineering through solved examples.
15. Frazeee, Irving and Philip, V.E. Tractors and Crawlers.

21AGE33	HYDROLOGY AND WATER SHED MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

Unit I	INTRODUCTION TO HYDROLOGY AND WATERSHED	9 Hours

Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain Gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods.
Watershed – Definition - concept - Objectives – Land capability classification - priority watersheds - land resource regions in India

Unit II	WATERSHED PLANNING	9 Hours

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 Hours

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

Unit IV	WATER CONSERVATION PRACTICES	9 Hours

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

Unit V	WATERSHED DEVELOPMENT PROGRAMME	9 Hours

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

OUTCOMES:

- At the end of the course students will have a thorough knowledge on watershed planning, development and management strategies through different soil and water conservation approaches.

Textbooks:

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

Reference books:

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

21AGE34	ENERGY AUDITING AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To acquaint and equip the students in energy auditing in industries and household sectors for increasing energy efficiency.

Unit I	ENERGY CONSERVATION CONCEPTS	9 Hours

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 Hours

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 Hours

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 –

Unit IV	ELECTRICAL ENERGY AUDIT - I	9 Hours

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 Hours

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.

OUTCOMES:

- The students will acquire the knowledge on fundamentals of economic operation of an electrical system and understand the basic principles of energy auditing, types and objectives, instruments used.

Textbooks:

1. Guidebooks 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.

21AGE35	CLIMATE CHANGE AND ADAPTATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- 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	EARTH'S CLIMATE SYSTEM	9 Hours

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

Unit II	ATMOSPHERE AND ITS COMPONENTS	9 Hours

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

Unit III	IMPACTS OF CLIMATE CHANGE	9 Hours

Causes of Climate change : Change of Temperature in the environment - Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

Unit IV	CLIMATE CHANGE AND MITIGATION MEASURES	9 Hours

Climate change and Carbon credits- CDM- Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC– IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India.

Unit V	POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY	9 Hours

Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding 78 Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

OUTCOMES:

After successful completion of this course students are expected to be able to:

- Demonstrate an understanding of how the threats and opportunities of predicted climate change will influence specific sectors at global and regional scale.
- Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts.
- Understand and critically evaluate the scientific insights underlying the assessment reports of the IPCC, with a focus on impacts, adaptation and mitigation.

Textbooks:

1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

Reference books:

1. Adaptation and mitigation of climate change-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.

21AGE36	AIR POLLUTION CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVE:

- Enable the students to identify the air pollutants, their standards, and the control mechanisms.

Unit I	INTRODUCTION	9 Hours

Air Pollution Regulatory Framework History - Regulatory System – Laws and Regulations – Clean air Act – Air Quality Index - Provisions for Recent Developments.

Unit II	AIR POLLUTION GASES	9 Hours

Measurement fundamentals – chemicals and physical properties – Phase Equilibrium - Conservation laws, Control of gaseous pollutants from stationary sources, Incinerators – Design and Performance –Operation and Maintenance - Absorbers – Design operation and improving performance of Absorbers.

Unit III	PARTICULATE AIR POLLUTION	9 Hours

Particle Collection mechanisms– Fluid Particle Dynamics – Particle size Distribution – Efficiency – Gravity Settling Chambers Cyclones- Electrostatic precipitators- Baghouses.

Unit IV	HYBRID SYSTEM	9 Hours

Heat electrostatic precipitation – Genizing Heat Scrubbers – Dry Scrubbers –Electrostatically Augmented Fabric Filtration.

Unit V	AIR POLLUTION CONTROL EQUIPMENT	9 Hours

Introduction-Selection – Design considerations - Installation – Cost Model

OUTCOMES:

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

- Identify and analyze the global effects of air pollution.
- Aware of the chemical and physical properties of various gaseous pollutants.
- Adapt appropriate legal strategies and techniques to control air pollution.
- Select appropriate techniques to enhance the control of air pollution.
- Design economical air pollution control equipment.

Textbooks:

1. Louis Theodore, “Air Pollution Control Equipment Calculations”, Wiley Blackwell, 2008.
2. Noel De Nevers, “Air Pollution Control Engineering”, McGraw Hill, 2000.

Reference books:

1. Trivedy, R.K; Goel, P.K, “An Introduction to Air Pollution, ABD Publishers, 2003.
2. Bhatia S.C, “Textbook of Air Pollution and its Control”, Atlantic, 2008.
3. Mudakavi J.R, “Principles and Practices of Air Pollution Control and Analysis”, I K International Publishing House, New Delhi, 2010.

21AGE37	REMOTE SENSING AND GIS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the principles and basic concepts of Remote Sensing and GIS
- To introduce the remote sensing systems, data products and analysis
- To introduce the spatial data models, analysis, and presentation techniques
- To study the applications of Remote Sensing and GIS in agriculture, soil, and water resources

Unit I	CONCEPTS OF REMOTE SENSING AND SATELLITES	9 Hours

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

Unit II	DATA PRODUCTS AND IMAGE ANALYSIS	9 Hours

Data products –based on level of processing- o/p – scale – area/coverage – data availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices.

Unit III	CONCEPT OF GIS	9 Hours

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

Unit IV	DATA INPUT AND ANALYSIS	9 Hours

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

Unit V	APPLICATION OF RS AND GIS	9 Hours

Crop Acreage estimation - Estimation of Crop Water Requirement – Crop condition - Soil mapping – classification of soil with digital numbers – soil erosion mapping- reservoir sedimentation using image processing - Inventory of water resources – water quality assessment - Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health - Management Decision Support Systems.

OUTCOMES:

- The students will understand the remote sensing principles, remote sensing systems satellite data processing and available data products.
- The students will understand decision making process using DBMS and utilization of these advanced techniques in addressing the real-world problems.

Textbooks:

1. Anji Reddy. M, Remote Sensing and Geographical Information Systems, BS Publications, Hyderabad, 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.

21AGE38	ERGONOMICS AND SAFETY IN AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the physical workload, equipment/workplace design, safety, and occupational health hazards in farm operations.

Unit I	ERGONOMICS	9 Hours

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

Unit II	ENERGY EXPENDITURE	9 Hours

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

Unit III	ENERGY EXPENDITURE	9 Hours

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

Unit IV	ANTHROPOMETRY	9 Hours

Anthropometry – introduction- Types of data- Principles of applied anthropometry - concept of percentile – Normal distribution – Estimating the range – Minimum and Maximum dimensions- Cost benefit analysis - applications of anthropometric data. Anthropometric consideration in tool / equipment design.

Unit V	HUMAN ENGINEERING IN TRACTOR	9 Hours

The operator – Machine Interface – Operator exposure to environmental factors – Thermal comport for tractor operator – Spatial, Visual and Control requirement of the operator – Occupational health hazards - Noise – Dust- Vibration in Tractor

OUTCOMES:

- The student will gain knowledge to improve the performance of the farm systems by improving the human - machine interaction with safety measures.

Textbooks:

1. Bridger, R.S. Introduction to ergonomics, McGraw Hill, INC, New York. 1995.
2. Sharma, D.N and Mukesh, S. Design of Agricultural Tractor- Principles and Problems, Jain Brothers, New Delhi. 2012.
3. Handbook of Agricultural Engineering, Indian Council of Agricultural Research, New Delhi. 2013. (ISBN : 978-81-7164-134-5)

Reference books:

1. Wesley E.Woodson. Human Factors design Handbook. McGraw Hill Book Co., New York. 1981.

21AGE39	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an idea about IPR, registration and its enforcement.

Unit I	INTRODUCTION	9 Hours

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 WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

Unit II	REGISTRATION OF IPRs	10 Hours

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	10 Hours

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 Hours

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	EMFORCEMENT OF IPRs	7 Hours

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

OUTCOMES:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

Textbooks:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India Pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

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”, McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

21AGE40	REFRIGERATION AND AIR CONDITIONING FOR AGRICULTURAL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the underlying principles of operation in different refrigeration & Air conditioning systems and components.
- To provide knowledge on basic design aspects of Refrigeration & Air conditioning systems.

Unit I	REFRIGERATION CYCLE	8 Hours

Review of thermodynamic principles of refrigeration. Concept of Air refrigeration system. Vapour compression refrigeration cycle – use of P.H charts – multistage and multiple evaporator systems – cascade system – COP comparison

Unit II	REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING	9 Hours

Compressors – reciprocating & rotary (elementary treatment) – condensers – evaporators cooling towers. Refrigerants – Properties – selection of refrigerants, Alternative refrigerants, cycle controls.

Unit III	PSYCHROMETRY	10 Hours

Psychrometric processes use of psychrometric charts – grand and room sensible heat factors – bypass factors – air washers, requirements of comfort air conditioning, summer and winter air conditioning.

Unit IV	AIR CONDITIONING SYSTEMS	9 Hours

Cooling load calculation working principles of – centralized Air conditioning systems, split, ductable split, packaged air conditioning, VAV & VRV systems. Duct design by equal friction method, indoor air quality concepts.

Unit V	UNCONVENTIONAL REFRIGERATION CYCLES	9 Hours

Vapor absorption systems – Ejector jet, steam jet refrigeration, thermos-electric refrigeration. Applications: ice – plant – food storage plants – milk chilling plants.

OUTCOMES:

- The students will have a clear understanding of psychrometry, refrigeration and air conditioning and their applications to agriculture

Textbooks:

1. Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Ltd., New Delhi, 1983.
2. Arora, C.P., “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 1988.

Reference Books:

1. Dossat, R.J., “Principles of Refrigeration and Air Conditioning”, Pearson Education Pvt. Ltd., New Delhi, 1997.
2. Jordon and Priester, “Refrigeration and Air Conditioning”, Prentice Hall of India Pvt. Ltd., New Delhi, 1985.
3. Stoecker, N.F., and Jones, “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 1981.

21AGE41	WASTEWATER TREATMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable students to understand about the principles behind separation systems, Chemical unit processes, and biological treatment and advanced wastewater treatment methods

Unit I	PLANNING FOR WATERSUPPLY SYSTEM	9 Hours

Public water supply system – Planning, Objectives, Design period – Sources of water and their characteristics, Surface, and Groundwater - Source Water quality – Drinking Water quality standards.

Unit II	CONVEYANCE SYSTEM	9 Hours

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes

Unit III	WATER TREATMENT	9 Hours

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation, and flocculation

Unit IV	PRIMARY TREATMENT OF SEWAGE	9 Hours

Primary treatment – Principles, functions, and design of sewage treatment units. Design of septic tank.

Unit V	ADVANCED WASTEWATER TREATMENT	9 Hours

Technologies used in advanced treatment – Classification of technologies Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration Absorption – Ion Exchange – Advanced oxidation process

OUTCOMES:

The students completing the course will have:

- an insight into the structure of drinking water supply systems, including water transport, treatment, and distribution.
- the knowledge in various unit operations and processes in water treatment and to design the various functional units in water treatment.
- The required understanding on the characteristics and composition of sewage, self-purification of streams.
- An ability to perform basic design of the unit operations and processes that are used in sewage treatment.

Textbooks:

1. Garg, S.K. (1992). Environmental Engineering (vol 1) Water supply Engineering. (Vol 1). Khanna Publishers, Delhi.
2. Metcalf and Eddy. (1997). Wastewater Engineering-Treatment, Disposal, reuse. Tata-Mc Graw Hill Publishing Co. Ltd. New Delhi.

Reference Books:

1. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G.C. (1986). Environmental Engineering. Mc Graw Hill Book Co., New York.
2. Rangwala, S.C. (1992). Water Supply and Sanitary Engineering. Charotar Publishing House, Anand.

21AGE42	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

Unit I	INTRODUCTION	9 Hours

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

Unit II	TQM PRINCIPLES	9 Hours

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

Unit III	TQM TOOLS AND TECHNIQUES I	9 Hours

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

Unit IV	TQM TOOLS AND TECHNIQUES II	9 Hours

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

Unit V	QUALTIY MANAGEMENT SYSTEM	9 Hours

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation— Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM**: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS

OUTCOMES:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

Textbooks:

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.

21AGE43	AGRICULTURAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

Unit I	INTRODUCTION	7 Hours

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 Hours

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 Hours

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

Unit IV	BIOCHAR PRODUCTION	9 Hours

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

Unit V	BIOGAS AND BIOETHANOL PRODUCTION	10 Hours

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

OUTCOMES:

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

- Various eco-friendly methods for agricultural waste management.
- Nutritive value and energy production potential of agro wastes.

Textbooks:

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-production characterization 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

21AGE44	PROCESS ENGINEERING OF FRUITS AND VEGETABLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Post Harvest Technology of fruits and vegetables through their structure and composition
- To study the different methods of processing and preservation of fruits and vegetables including drying and dehydration
- To learn the latest methods of storage of fruits and vegetables

Unit I	STRUCTURE, COMPOSITION, RIPENING AND SPOILAGE	9 Hours

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 Hours

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

Unit III	PRESERVATION OF FRUITS AND VEGETABLES	9 Hours

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 Hours

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 Hours

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.

OUTCOMES:

- At the end of this course, the student will be thorough in various methods of processing, preservation and storage of fruits and vegetables using latest technologies.

Textbooks:

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.

21AGE45	CAD FOR AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

Unit I	MATHEMATICS FOR COMPUTER GRAPHICS	9 Hours

Hardware, graphs and charts, two-dimensional transformations, lines, circles, ellipses and polygons. Storage of graphical data, animation, two-dimensional geometric construction techniques, user interface techniques.

Unit II	MESHING & MODELING	9 Hours

Introduction to three-dimensional graphics, three-dimensional transformations, surfaces, shading. Solid and wire frame modeling of machine components.

Unit III	FINITE ELEMENT ANALYSIS	9 Hours

Graphical techniques in finite element analysis. Interfacing data between CAD and CAM applications, Concurrent engineering

Unit IV	DESIGN & CONTROL	9 Hours

Introduction to manufacturing, part design specifications, computer-aided design. Automation, programmable logic controllers, fundamentals of numerical control, numerical control programming, group technology, process planning

Unit V		9 Hours

Integrated computer-aided manufacturing. Planning of manufacturing process.

OUTCOMES:

At the end of this course, students will be able to

- Develop the solid model and simulate the working of various machine elements.
- Apply the advanced techniques of stress analysis for the mechanical design of machine elements.
- Understand the design of machine elements from mechanical production considerations.

Textbooks:

1. Alavala, C.R. 2008. CAD/CAM: Concepts and Applications. PHI Learning, New Delhi.
2. Kundra, T.K. 1993. Computer Aided Manufacturing. Tata McGraw-Hill Education, New Delhi.

Reference Books:

1. Sarcar, M.M.M., Rao, K.M. and Narayan, K.L. 2008. Computer Aided Design and Manufacturing. PHI Learning Pvt. Ltd., New Delhi.
2. Xu, X. 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control : Principles and Implementation. Information Science Reference.

21AGE46	ESTIMATION AND VALUATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, valuation of properties and preparation of reports for estimation of various items.

Unit I	QUANTITY ESTIMATION	11 Hours

Methods of estimation – Types of estimates – Approximate estimates –Detailed estimate – Estimation of quantities for small buildings, retaining walls – culverts

Unit II	CONTRACTS	9 Hours

Contract – Types of contracts – Formation of contract – Contract conditions –Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements

Unit III	SPECIFICATION	9 Hours

Specifications – sources – Preparation of detailed and general specifications

Unit IV	VALUATION	8 Hours

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease

Unit V	REPORT PREPARATION	8 Hours

Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.

OUTCOMES:

The student shall be able to estimate the material quantities, prepare a bill of quantities, make specifications, and prepare tender documents. Student shall be able to prepare value estimates.

Textbooks:

- Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2003
- Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S.Chand & Company Ltd., 2004

Reference books:

- PWD Data Book.
- Tamil Nadu Transparencies in Tender Act, 1998
- Arbitration and Conciliation Act, 1996
- Standard Bid Evaluation Form, Procurement of Goods or Works, The World Bank, April 1996.

21AGE47	INSTRUMENTATION AND CONTROL ENGINEERING IN AGRICULTURE	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, valuation of properties and preparation of reports for estimation of various items.

Unit I	QUANTITY ESTIMATION	11 Hours

Methods of estimation – Types of estimates – Approximate estimates –Detailed estimate – Estimation of quantities for small buildings, retaining walls – culverts

Unit II	CONTRACTS	9 Hours

Contract – Types of contracts – Formation of contract – Contract conditions –Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements

Unit III	SPECIFICATION	9 Hours

Specifications – sources – Preparation of detailed and general specifications

Unit IV	VALUATION	8 Hours

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease

Unit V	REPORT PREPARATION	8 Hours

Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.

OUTCOMES:

The student shall be able to estimate the material quantities, prepare a bill of quantities, make specifications, and prepare tender documents. Student shall be able to prepare value estimates.

Textbooks:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2003
2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S.Chand & Company Ltd., 2004

Reference books:

1. PWD Data Book.
2. Tamil Nadu Transparencies in Tender Act, 1998
3. Arbitration and Conciliation Act, 1996
4. Standard Bid Evaluation Form, Procurement of Goods or Works, The World Bank, April 1996.

21AGE48	FUNDAMENTALS OF NANOSCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To learn about basis of nanomaterial science, preparation method, types and application

Unit I	INTRODUCTION	9 Hours

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires- ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

Unit II	GENERAL METHODS OF PREPARATION	9 Hours

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

Unit III	NANOMATERIALS	12 Hours

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc- growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays□functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

Unit IV	CHARACTERIZATION TECHNIQUES	9 Hours

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

Unit V	APPLICATIONS	7 Hours

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

OUTCOMES:

At the end of this course, the student will

- familiarize about the science of nanomaterials.
- demonstrate the preparation of nanomaterials.
- develop knowledge in characteristic nanomaterial.

Textbooks:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Characterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

Reference books:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007

21AGE49	SYSTEMS ANALYSIS AND SOFT COMPUTING IN AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the students to the application of systems concept to agricultural engineering problems, planning and management.
- Soft computing techniques for modeling different problems in the field agricultural engineering

Unit I	SYSTEM CONCEPTS	8 Hours

To introduce the students to the application of systems concept to agricultural engineering problems, planning and management. • Soft computing techniques for modeling different problems in the field agricultural engineering

Unit II	LINEAR PROGRAMMING A& DYNAMIC PROGRAMMING	9 Hours

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 Hours

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 IV	NEURAL NETWORKS	9 Hours

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 Hours

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

OUTCOMES:

- Upon completion of the course, the student will have the knowledge on system concepts and will be able to apply the optimization techniques like LP, DP, ANN, FL and GA for problems in agriculture.

Textbooks:

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 – Optimizing efficiency 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 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.
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.

21AGE50	SUSTAINABLE AGRICULTURE AND FOOD SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- 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	LAND RESOURCE AND ITS SUSTAINABILITY	9 Hours

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 Hours

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 Hours

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	SUSTAINABLE AGRICULTURE & ORGANIC FARMING	9 Hours

Performance of Major Food Crops over the past decades – trends in food production – Decline in total factor productivity growth – Demand and supply projections – Impact of market force – 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 Hours

Food and Crop Production polices – Agricultural credit Policy – Crop insurance –Policies of Natural Resources Use – Policies for sustainable Livelihoods – Virtual water and trade - Sustainable food Security Action Plan.

OUTCOMES:

- Upon completion of this course, the students will gain knowledge on the need for sustainable agriculture.
- They will be able to comprehend the need for food security on global level and the Nutritional Security.
- The students will be able to demonstrate how ecological balance is required for sustainability of agriculture.

Textbooks:

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

Reference books:

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

21OEE01	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart the knowledge on the waste management and energy recovery through various process.

Unit I	INTRODUCTION TO WASTE & WASTE PROCESSING	9 Hours

Definitions, sources, types, and composition of various types of wastes; Characterization of Municipal Solid Waste (MSW) , Industrial waste and Biomedical Waste (BMW), waste collection and transportation; waste processing-size reduction, separation; waste management hierarchy, waste minimization and recycling of MSW; Life Cycle Analysis (LCA), Material Recovery Facilities (MRF), recycling processes of solid waste.

Unit II	WASTE TREATMENT AND DISPOSAL	9 Hours

Aerobic composting, incineration, different type of incineration; medical and pharmaceutical waste incinerations- land fill classification, types, methods and sitting consideration, layout, and preliminary design of landfills: composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases

Unit III	ENERGY FROM WASTE-THERMO CHEMICAL CONVERSION	9 Hours

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

Unit IV	ENERGY FROM WASTE- BIO-CHEMICAL CONVERSION	9 Hours

Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestion biogas production, land fill gas generation and utilization, present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships, and villages

Unit V	ENVIRONMENTAL AND HEALTH IMPACTS-CASE STUDIES	9 Hours

Environmental and health impacts of waste to energy conversion, case studies of commercial waste to energy plants, waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions - Rules related to the handling, treatment, and disposal of MSW and BMW in India.

OUTCOMES:

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

- Acquire the knowledge on fundamentals of waste management and energy recovery.
- Understand the importance of waste treatment and disposal.
- Understand the process of incineration, pyrolysis, and gasification of waste.
- Apply the process of anaerobic digestion for sewage, solid and e-waste.
- Assess the environmental and health impacts and apply for waste to energy conversion

Textbooks:

1. Dieter D. And Angelika S, Biogas from waste and renewable resources, Wiley-Vch Publication, 2010.
2. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall, 2000

Reference books:

1. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, John Wiley & Sons, 2010.
2. Robert Green, From Waste to Energy, Cherry Lake, 2009.
3. G. Evans, Biowaste and Biological Waste Treatment, 2014.

21OEE02	INDUSTRIAL POLLUTION PREVENTION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the importance of industrial Pollution Prevention with case studies and understand the underlying principles of Industrial Pollution Prevention.

Unit I		9 Hours

Basics of Jurisprudence-Environmental law relation with other disciplines-Criminal law - Common Law-Relevant sections of the code of civil procedure, criminal procedure code, EPA.

Unit II		9 Hours

Fundamental Rights-Directive principles of state policy-Article 48(A) and 51-A (g) Judicial Enforceability-Constitution and resources management and pollution control-Indian forest policy (1990) –Indian Environmental policy (1992).

Unit III		9 Hours

Administration regulations-constitution of pollution control Boards Powers, functions, Accounts, Audit etc.-Formal Justice Delivery Mechanism Higher and Lower of judiciary- Constitutional remedies writ jurisdiction Article 32,226,136 special reference to mandamus and certiorari for pollution abatement-Equitable remedies for pollution control.

Unit IV		9 Hours

Administrative regulation under recent legislations in water pollution control, Water (prevention and control of pollution)Act 1974 as Amended by amendment act 1988 Water(prevention of control and pollution)Rules1975 Water (prevention and pollution) Cess Act.1977 as amended by amendment act1991.Air(prevention and control of pollution)Act 1981 as amended by Amendment act 1987 and relevant notifications

Unit V		9 Hours

Relevant notifications in connection with Hazardous Wastes (Management and handling), Biomedical Wastes (Management and Handling), Noise pollution, Eco labelling, and EIA.

OUTCOMES:

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

- Understand the Environmental law relation with other disciplines.
- Analyze state Policy and pollution control.
- Follow regulations for pollution abatement and waste minimization.
- Adapt recent legislation for water and air pollution.
- Know the Management and handling of Hazardous and Biomedical wastes.

Textbooks:

1. Tiwari, H.N., Environmental Law, Allahabad Law. Agency 1997.
2. Pandey, J.N., Constitutional Law of India, (31st Edition) Central Law of Agency, Allahabad, 1997.

Reference books:

1. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.
2. Constitution of India Eastern Book Company Lucknow Twelfth Edition.1997.
3. Kesari, U.P.D, Administrative Law, Universal Book Trade, Delhi, 1998.

21VAC01	INTRODUCTION TO SUSTAINABILITY	L	T	P	C
		3	0	0	0

OBJECTIVE:

- To introduce the concept of sustainability in processes.

Unit I	DEFINITION AND CHALLENGES	6 Hours

Definitions of sustainability, relation between development, ecosystem and human wellbeing, status of ecosystem and need for sustainability, nature and complexity of environmental problems, nature of sustainability challenge, requirements for sustainability, approaches towards sustainability engineering.

Unit II	SUSTAINABILITY ASSESSMENT	6 Hours

Inventory analysis, Footprint assessment, energy and material flow analysis, exergy analysis, cumulative exergy consumption and energy analysis, Environmental Data Collection Issues.

Unit III	LIFE CYCLE ASSESSMENT	6 Hours

Overview of LCA Methodology - Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools, life cycle impact assessment with case studies in energy and process industry.

Unit IV	DESIGN FOR SUSTAINABILITY	6 Hours

Environmental Design for Sustainability: Economic, Environmental Indicators, Social Performance Indicators, Sustainable Engineering Design Principles and Environmental Cost Analysis.

Unit V	SOLUTIONS FOR SUSTAINABILITY	6 Hours

Industrial symbiosis and circular economy, Ecosystems engineering, economic policies: Global and local, societal development.

OUTCOMES:

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

- To understand the theoretical and practical aspects of sustainability in engineering.
- To gain knowledge of some methods of accounting and of measuring sustainability.
- To demonstrate Life Cycle analysis with case studies.
- To gain insight into the methodology for sustainability and performance indicators.
- To gain awareness on policy for sustainable development and programmatic aspect of implementation.

References:

1. Bhavik R Bakshi, “Sustainable Engineering: Principles and Practice”, Cambridge University Press; First edition, 2019.
2. David T. Allen David R. Shonnard, Sustainable Engineering Concepts, Design and case Studies, Pearson. First edition, 2015.
3. Jeffery Perl, Sustainability Engineering: A Design Guide for the Chemical Process Industry First edition, Springer, 2016

21VAC02	SUSTAINABLE AGRICULTURAL LAND MANAGEMENT	L	T	P	C
		3	0	0	0

OBJECTIVE:

- To empower the students with an economically viable, socially supportive, and ecologically sound education on sustainable agriculture.

Unit I	INTRODUCTION TO SUSTAINABLE AGRICULTURE	6 Hours

The concept of sustainability and sustainable development-emerging issues- Sustainable agriculture- concept themes- differences between conventional, sustainable, and alternate agriculture- Various alternate agricultural systems- Conventional, sustainable, and alternate agriculture- forms and limitations- Modernization of agriculture and its relation to sustainability.

Unit II	GOOD AGRICULTURAL PRACTICES	6 Hours

Good Agricultural Practices(GAP)- GAP certification -Improved manure handling - crop residue management - strategic use of chemical fertilizers and pesticides, traps, repellents and biological control - water conservation measures for sustainability- water harvesting - Role of water in soil and plants- Irrigated agriculture vs. Rainfed agriculture, dry farming, and dryland farmingdefinition. Soil conservation vs. water conservation - agronomic measures- mechanical measuresRole of grasses and pastures in soil conservations

Unit III	CROPPING PATTERN	6 Hours

Introduction-importance of system approach in crop production, different cropping systems; Terms and definition- Cropping pattern - Multiple cropping and various forms- advantages and disadvantages- Intercropping- ecological basis of intercropping systems- types- sequential cropping and crop rotation-planned crop rotation- Mixed farming.

Unit IV	ORGANIC FARMING	6 Hours

Organic agriculture-history-concepts- philosophy- objectives, opportunities, and priorities Criticisms- Organic farming and food security-Principles of organic farming. Tools and practices of organic farming.

Unit V	INTRODUCTION TO HORTICULTURE	6 Hours

Introduction - scope and importance - problems and prospects of protected culture in India - growing structures - green house - polyhouse - net house - basic considerations in establishment and operation of greenhouses - maintenance.

OUTCOMES:

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

- To familiarize with the concept of sustainability and sustainable development.
- To have an overview of good agricultural practices.
- To compare and analyze various cropping patterns.
- To acquaint with the fundamentals of organic farming.
- To have an outline of Horticulture practices.

References:

1. Veeresh, G.K., Shivashankar, K. and Singlachar, M.A. 1997. Organic Farming and Sustainable Agriculture, Association for Promotion of Organic Farming, Bangalore.
2. Palaniappan, S.P and Anandurai, K. 1999. Organic Farming- Theory and Practice, Scientific Pub., Jodhpur.
3. Gurmel Singh, C. Venkataraman, G., Sastry,B. and Joshi, P. 1990. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co., New Delhi.
4. Roy. A. Larson., 1992. Introduction of Floriculture. International Book Distributing Co., Lucknow.