SETHU INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to Anna University, Chennai)

DEPARTMENT OF AGRICULTURE ENGINEERING

CURRICULUM & SYLLABUS

(I to VIII Semester)

(CHOICE BASED CREDIT SYSTEM)

REGULATIONS 2019

CHAIRPERSON
BOARD OF STUDIES
AGRICULTURE ENGINEERING
SETHU INSTITUTE OF TECHNOLOGY
KARIAPATTI - 626 115

CHAIRMAN
ACADEMIC COUNCIL
Sethu Institute of Technology
Pulloor, Kariapatti - 625 115

SETHU INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

DEPARTMENT OF AGRICULTURE ENGINEERING

REGULATIONS 2019

OVERALL COURSE STRUCTURE

Code	Category	Total No of Courses	Credits	Percentage
BS	Basic Sciences	10	28.5	15
ES	Engineering sciences	9	22	14
HSS	Humanities and Social Sciences	5	9.5	8
PC	Professional Core	27	67	41
PE	Professional Electives	6	18	9
OE	Open Electives	4	12	6
PW	Project work, Seminar & Internship	5	15	8
	TOTAL	**66**	**172**	**100**

COURSE CERDIT – SEMESTER WISE

Branch	I	II	III	IV	V	VI	VII	VIII	TOTAL
AGRI	23	20.5	23	23.5	23.5	25.5	19	14	172

SEMESTER I

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UEN101	English for Technical Communication	2	0	0	2
2.	19UMA102	Engineering Mathematics – I	3	1	0	4
3.	19UPH103	Engineering Physics	3	0	0	3
4.	19UCY107	Chemistry for Agriculturist	3	0	0	3
5.	19UCS108	Problem Solving and Python Programming	3	0	0	3
6.	19UME109	Engineering Graphics	3	1	0	4
PRACTICAL						
7.	19UGS113	Basic Sciences Laboratory	0	0	2	1
8.	19UME111	Engineering Practices Laboratory	0	0	3	1.5
9.	19UCS110	Problem Solving and Python Programming Laboratory	0	0	3	1.5
10.	19UGM131	Induction Programme	Mandatory			
		TOTAL	**17**	**2**	**8**	**23**
TOTAL NO. OF CREDITS – 23						

SEMESTER II

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UEN201	Communication Skills for Professionals	1	0	1	1.5
2.	19UMA207	Calculus, Complex Analysis and Transform Techniques	3	1	0	4
3.	19UPH207	Green Physics	3	0	0	3
4.	19UEE226	Basic Electrical and Electronics Engineering	3	0	0	3
5.	19UAG201	Introduction to Agricultural Engineering	3	0	0	3
6.	19UCY204	Environmental Science	3	0	0	3
PRACTICAL						
7.	19UGS210	Energy and Environmental Science Laboratory	0	0	2	1.5
8.	19UEE221	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
		TOTAL	**16**	**1**	**6**	**20.5**
TOTAL NO. OF CREDITS –20.5						

SEMESTER III

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UMA326	Transform Techniques and Partial Differential Equations	3	1	0	4
2.	19UAG302	Unit Operations in Agricultural Processing	3	0	0	3
3.	19UAG303	Fundamentals of Engineering Mechanics	3	0	0	3
4.	19UAG304	Fundamentals of Theory of Machines	3	0	0	3
5.	19UAG305	Fluid Mechanics and Open Channel Hydraulics	3	0	0	3
6.	19UAG306	Principles and Practices of crop Production	3	0	0	3
7.	19UGM332	Biology for Engineering Applications	1	0	0	P/F
PRACTICAL						
8.	19UAG307	Seminar	0	0	2	1
9.	19UAG308	Agricultural Meteorology and Crop Husbandry Laboratory	0	0	3	1.5
10	19UAG309	Fluid Mechanics Laboratory	0	0	3	1.5
		TOTAL	**18**	**1**	**8**	**23**
TOTAL NO. OF CREDITS - 23						

SEMESTER IV

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UMA425	Probability, Statistics and Numerical Methods	3	1	0	4
2.	19UAG402	Tractor and Other Power Units	3	0	0	3
3.	19UAG403	Soil and Water Conservation Engineering	3	0	0	2
4.	19UAG404	Refrigeration and Air Conditioning for Agriculture Engineering	3	0	0	3
5.	19UAG405	Surveying and Leveling	3	0	0	3
6.	19UIT427	Object Oriented Programming in Python	3	0	0	3
7.	19UGS431	Reasoning & Quantitative Aptitude	2	0	0	1
8.	19UGM431	Gender Equality	1	0	0	P/F
PRACTICAL						
9.	19UAG407	Surveying and Levelling Laboratory	0	0	3	1.5
10.	19UAG408	Tractor and Farm Engine Laboratory	0	0	3	1.5
11.	19UIT428	Object oriented Programming Laboratory	0	0	3	1.5
		TOTAL	**17**	**1**	**9**	**23.5**
TOTAL NO. OF CREDITS – 23.5						

SEMESTER V

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UAG501	Irrigation and Drainage Engineering	3	0	0	3
2.	19UAG502	Agricultural Farm Machinery	3	0	0	3
3.	19UAG503	Micro Irrigation system	3	0	0	3
4.		Professional Elective – I	3	0	0	3
5.		Professional Elective – II	3	0	0	3
6.		Open Elective – I	3	0	0	3
PRACTICAL						
7.	19UAG507	Creative Thinking and Innovation	0	0	2	1
8.	19UAG508	Irrigation and Drainage Laboratory	0	0	3	1.5
9.	19UAG509	Agricultural Farm Machinery Laboratory	0	0	3	1.5
10.	19UGS532	Soft skills Laboratory	0	0	3	1.5
		TOTAL	**18**	**0**	**11**	**23.5**
TOTAL NO. OF CREDITS – 23.5						

SEMESTER VI

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UAG601	Hydrology and Water Resource Engineering	3	0	0	3
2.	19UAG602	Design of Agricultural Machinery	3	0	0	3
3.	19UAG603	Ground water and well engineering	3	0	0	3
4.		Professional Elective – III	3	0	0	3
5.		Professional Elective – IV	3	0	0	3
6.		Open Elective – II	3	0	0	3
7.	19UGM636	Indian Constitution and Essence of Indian Traditional Knowledge in Agriculture	1	0	0	P/F
PRACTICAL						
8.	19UAG607	Product Development Project	0	0	8	4
9.	19UAG608	CAD for Agricultural Engineering	0	0	4	2
10.	19UGS633	Interpersonal Skills Development Laboratory	0	0	3	1.5
		TOTAL	**18**	**0**	**15**	**25.5**
TOTAL NO. OF CREDITS – 25.5						

SEMESTER VII

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UME701	Project Management and Finance	3	0	0	3
2.	19UAG702	Crop Process Engineering	3	0	0	3
3.	19UAG703	Introduction to Green Energy	3	0	0	3
4.		Professional Elective – V	3	0	0	3
5.		Open Elective – III	3	0	0	3
6.	19UGM731	Professional Ethics and Human Values	2	0	0	P/F
PRACTICAL						
7.	19UAG707	Summer Internship	0	0	2	1
8.	19UAG708	Agricultural Processing Laboratory	0	0	3	1.5
9.	19UAG709	Green Energy Laboratory	0	0	3	1.5
TOTAL			**15**	**0**	**8**	**19**
TOTAL NO. OF CREDITS - 19						

SEMESTER VIII

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.		Professional Elective – VI	3	0	0	3
2.		Open Elective – IV	3	0	0	3
PRACTICAL						
3.	19UAG801	Project Work - II	0	0	16	8
TOTAL			**6**	**0**	**16**	**14**
TOTAL NO. OF CREDITS - 14						

PROFESSIONAL ELECTIVES

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	19UAG901	Manufacturing Technology	3	0	0	3
2.	19UAG902	Soil and Water Conservation Structures	3	0	0	3
3.	19UAG903	Watershed Planning and Management	3	0	0	3
4.	19UAG904	Landscape Irrigation Design and Management	3	0	0	3
5.	19UAG905	Energy Auditing and Management	3	0	0	3
6.	19UAG906	Fundamentals of Heat and Mass Transfer	3	0	0	3
7.	19UAG907	Design and Construction of Greenhouse	3	0	0	3
8.	19UAG908	IoT Application in Agriculture Engineering	3	0	0	3
9.	19UAG909	Design of Food Processing Equipment	3	0	0	3
10.	19UAG910	Agricultural Extension	3	0	0	3
11.	19UAG911	Drying and Storage Engineering	3	0	0	3

ONE CREDIT COURCES

SL.No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	19UAG861	Mushroom Cultivation Technology	1	0	0	1
2.	19UAG862	Vermi Compost Technology	1	0	0	1
3.	19UAG863	Entrepreneurship in Agriculture	1	0	0	1
4.	19UAG864	AI in Agriculture	1	0	0	1
5.	19UAG865	Seed Production Technology	1	0	0	1
6.	19UAG866	Solar PV system	1	0	0	1

OPEN ELECTIVES

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	19UAG971	Organic Farming Technology	3	0	0	3
2.	19UAG972	Basics of Landscape Gardening	3	0	0	3
3.	19UAG973	Agricultural Farm structures	3	0	0	3
4.	19UAG974	Agribusiness Management	3	0	0	3

19UEN101	English for Technical Communication	L	T	P	C
		2	0	0	2

OBJECTIVES

- To enhance the vocabulary of students
- To strengthen the application of functional grammar and basic skills
- To improve the language proficiency of students

UNIT I **8**

Listening –Formal and informal conversations and comprehension **Speaking-** introducing oneself – exchanging personal and social information- **Reading** – Skimming and Scanning. **Writing –** Sentence Formation, Formal Letters (Permission/Requisition) - **Grammar** - Parts of Speech - Tense - **Vocabulary Development** – Technical Word Formation- Prefix- suffix - Synonyms and Antonyms-Phrases and Clauses.

UNIT II **8**

Listening– Telephonic Conversations**. Speaking** – Pronunciation rules with Stress pattern. **Reading** – comprehension-pre-reading, post-reading- comprehension questions **Writing** – Punctuation rules, paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions, Precise writing, Developing Hints - Report Writing (Industrial, Accident) - **Grammar** – Voice **Vocabulary Development**- Words from other languages in English.

UNIT III **7**

Listening – Motivational speech by Great Speakers **Speaking** –Narrating daily events - retelling short stories. **Reading** – Newspaper reading. **Writing** – Job application letter - Transformation of Information (Transcoding) –**Grammar** Subject-Verb Agreement (Concord),— **Vocabulary Development –**Same word in different parts of speech.

UNIT IV **7**

Listening – Understating the instruction. **Speaking** -Intonation and preparing dialogue on various formal and informal situation**Reading** –Note Making from given text - **Writing** – Creating coherence, Essay writing with proper introduction and conclusion, Giving Instruction (Guidance/Procedure) -**Grammar** – Spot the Errors in English, **VocabularyDevelopment** – One word substitution.

TOTAL = 30 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to

- Apply grammar effectively in writing meaningful sentences and paragraphs
- Exhibit reading skills and comprehension to express the ideas in the given text
- Develop writing skills to present the ideas in various formal situations
- Develop oral fluency to express the ideas in various formal situations
- Exhibit writing skills to prepare reports for various purposes.

TEXT BOOK

1. KN Shoba, Lourdes JoavaniRayen, **Communicative English,** New Delhi, Cambridge University Press, 2017

REFERENCE BOOKS

1. Raman, Meenakshi, Sangeetha Sharma, **Business Communication**, New Delhi, Oxford University Press, 2014.

2. Lakshminarayanan. K.R, **English for Technical Communication**, Chennai, Scitech Publications (India) Pvt. Ltd, 2004.

3. Rizvi. Asraf M, **Effective Technical Communication**, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2007

		L	T	P	C
19UMA102	**ENGINEERING MATHEMATICS – I (Common to ALL Branches – Except CSBS)**	**3**	**1**	**0**	**4**

OBJECTIVES

- To make the students capable of identifying linear equations based problems (Eigen Value) from practical areas and obtain the Eigen value oriented solutions in certain cases.
- To widen the students' knowledge base on linear algebra, growth rate computation and application of integrals.
- Able to integrating various types of functions using various integration methods.
- To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions
- To apply these mathematical concepts (matrix theory, differentiation and integration) in engineering field

UNIT I MATRICES 8+3

Eigen value and eigenvector of a real matrix – Characteristic equation – Properties – Cayley-Hamilton theorem (excluding Proof) – Orthogonal reduction –(transformation of a symmetric matrix to diagonal form) – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS 9 + 3

Introduction – Definition of derivatives – Limits and Continuity – Differentiation techniques (Product rule, Quotient rule, Chain rule) – Successive differentiation (n^{th} derivatives) – Leibnitz theorem (without proof) – Maclaurin's series – Physical Applications (Newton's law of cooling – eat flow problems, Rate of decay of radioactive materials - Chemical reactions and solutions, Ohm's law, Kirchoff's law – Simple electric circuit problems)

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobian – Taylor's expansion – Maxima and Minima – Method of Lagrangian Multipliers

UNIT IV INTEGRAL CALCULUS 8 + 3

Definitions and concepts of integrals – Methods of integration (Decomposition method, Substitution method, Integration by parts) – Definite integrals – Properties and problems – Reduction formulae – Beta and Gamma functions.

UNIT V MULTIPLE INTEGRALS 8 + 3

Double integration – Cartesian and Polar coordinates – Change of order of integration – Area as a double integral - Change of variables between Cartesian and Polar coordinates – Triple integration in Cartesian coordinates – Volume as triple integral.

TOTAL : 45 (L) + 15 (T) = 60 Periods

COURSE OUTCOMES

After the successful completion of this course, the student will be able toCompute Characteristic Equation, Characteristic roots and use the applicability of Cayley – Hamilton theorem to find the Inverse of matrix which is very important in Engineering and applications.(CO1) AP – K3.

1. Determine the limit of indiscriminate functions applicable to word problems and Engineering problems.(CO2)AP – K3
2. Analyze functions using limits, continuity and derivatives to solve problems involving these functions.(CO2) AP – K3
3. Apply Differentiation techniques to solve Maxima and Minima for given functions with several variables.(CO3)AP – K3
4. Use the Lagrange multiplier method to predict extreme values of functions with constraints and to find the absolute maximum and minimum of a function on different domains.(CO3) AP – K3
5. Learn the evaluation policy of some special function like Gamma, Beta function and their relation which is helpful to evaluate some definite integral arising in various branch of Engineering.(CO4) AP – K3
6. Apply integration to compute Multiple integrals, Area and Volume in addition to change of order and change of variables.(CO5) AP – K3
7. Demonstrate basic concepts and to solve the complex Engineering problems using
8. Matrix, Differentiation and Integration.(CO1, 2, 4)AP – K3

TEXT BOOKS

1. BALI N. P and MANISH GOYAL, “A Text book of Engineering Mathematics”, Laxmi Publications (P) Ltd, New Delhi, 8th Edition, (2011).
2. VEERARAJAN.T “Engineering Mathematics” Tata McGraw Hill Publishing Company, New Delhi, 2008.
3. GREWAL. B.S, “Higher Engineering Mathematics”, Khanna Publications, New Delhi, 42nd Edition, (2012).

REFERENCE BOOKS

1. RAMANA B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, (2010).
2. GLYN JAMES, “Advanced Engineering Mathematics”, Pearson Education, New Delhi, 7th Edition, (2007).
3. JAIN R.K and IYENGAR S.R.K,” Advanced Engineering Mathematics”, Narosa Publishing House, New Delhi, 3rd Edition, (2007).
4. BHARATI KRISHNA TIRTHAJI, “Vedic Mathematics - Mental Calculation”, MotilalBanarsi
   Dass Publications, New Delhi, 1st Edition, (1965).
5. KREYSZIG. E, “Advanced Engineering Mathematics”, John Wiley & Sons, New York, 10th Edition, (2011).
6. P.SIVARAMAKRISHNA DAS, E.RUKMANGADACHARI“Engineering mathematics”, volume1, Pearson Edison New Delhi, 2nd Edition, (2013).

		L	T	P	C
19UPH103	**ENGINEERING PHYSICS (Common To All Branches)**	**3**	**0**	**0**	**3**

OBJECTIVES

- To develop the research interest in crystal physics
- To use the principles of Lasers and its types
- To apply principles of Quantum physics in engineering field
- To develop knowledge about the properties of materials

UNIT I CRYSTAL STRUCTURE 12

Introduction – Classification of solids –Space lattice –Basis-Lattice parameter – Unit cell – Crystal system –Miller indices –d-spacing in cubic lattice - Calculation of number of atoms per unit cell – Atomic radius-Coordination number – Packing factor for SC, BCC, FCC and HCP structures – crystal imperfection – Burger vector.

UNIT II PHOTONICS **10**

Introduction- Principles of Laser- Characteristics of laser -Spontaneous and stimulated emission –Population inversion – Einstein's A and B coefficients - Pumping methods – Basic components of Laser - Types of lasers – Nd -YAG laser - CO2 laser –Holography – Construction and Reconstruction of hologram – Industrial and Medical Applications.

UNIT III QUANTUM MECHANICS **13**

Introduction - Black body radiation – Planck's law of radiation- Wien's displacement law- Rayleigh Jeans law- – Compton Effect – Theory and experimental verification – Matter waves-Schrodinger's wave equation – Time dependent – Time independent equation - Particle in 1-D dimensional box

UNIT IV PROPERTIES OF SOLIDS **10**

Introduction - Elasticity- Stress and Strain - Hooke's law – Three moduli of elasticity –stress-strain curve – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending –I- shaped girders.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

1. Identify the seven types of crystal structures and illustrate unit cell Characteristic sand crystal defect **[Understand]**
2. Compare the different types of lasers and Analyze the role of lasers in Medicaland Industrial Applications **[Understand]**
3. Analyze the Wave and Particle nature of matter using Quantum mechanics **[Apply]**
4. Describe the elastic behaviour of various materials**. [Understand]**
5. Apply the fundamental knowledge to solve Engineering problems **[Apply]**
6. Apply the theory for the analysis of electrical and optical properties of Solids **[Apply]**

TEXT BOOKS

1. Dr.Mani.P, "Engineering Physics", Dhanam Publications, Edition ,2018, Chennai.
2. Rajendran.V, "Engineering,Physics", Tata Mc-Graw Hill Publishing Company limited, New Delhi, Revised Edition 2018.
3. Palanisami P.K., "Physics For Engineers", Scitech Publications (India), Pvt Ltd., Chennai, 2018

19UCY107	CHEMISRTY FOR AGRICULTURIST	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To gain the knowledge on basics of chemical bonding.
- To know the soil based chemical process.
- To acquire knowledge about the applications of enzymes in food processing.

UNIT I CHEMICALBONDING 11

Chemical Bonding: Electronic Configuration– Ionic Bond - Covalent Bond – Metallic bond –Aufbau principle, Pauli Exclusion principle, Valence bond theory application and its limitations, Various types of hybridization (sp, sp^2, sp^3) (C_2H_2, C_2H_4, CH_4) -bond strength and bond energy - Hydrogen bonding, Vander Waals forces.

UNIT II WATER AND ITSTREATMENT TECHNOLOGIES 11

Hardnessofwater–types–expressionofhardness(Problems)–units–estimation of hardness of water by EDTA – boiler troubles (scale and sludge) – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment - Ion exchange process - zeolite process – desalination of brackish water – Reverse Osmosis.

UNIT III CHEMISTRY OFSOILMATERIALS 11

Soil Materials – Mineral materials, organic matter; Surface properties of Inorganic SoilMaterials– Surfacearea,Chargeofparticles,Classification;Sorptionprocessesinthe soil, ion exchange, Buffering Capacity, Cation exchange, pH measurement, Soil acidity, Lime content, Sodicsoils

UNIT IV FUNDAMENTALS OF FOOD CHEMISTRY 12

Principle of Food Chemistry- introduction to lipids, proteins, carbohydrates, vitamins, food preservators, colouring and flavouring reagents of food-Enzymes and their use in the manufacturing of ethanol and acetic acid by fermentation methods-Food Resources-Changes caused by overgrazing and agriculture**.**

TOTAL: 45 PERIODS

OUTCOMES

After completion of the course, the students are able to:

- Describe the fundamental concepts of chemical bonds. **Understand L2**
- Apply the knowledge of water treatment techniques to remove the hardness of water. **Apply L3**
- Explain the properties of soil. **Understand L2**
- Explain the principles of food chemistry and food resources. **Understand L2**

TEXT BOOKS

1. JainP.C.andMonicaJain,“EngineeringChemistry”,DhanpatRaiPublishingCompany (P)Ltd., New Delhi, 2010
2. Michael S. Mamlouk, John P. Zaniewski, “Materials For Civil andConstruction Engineers” Third Edition, Prentice Hall, Newyork, USA.
3. Pradeep. T “A textbook of Nanoscience and Nanotechnology”, Tata McGraw - Hilleducation private ltd,201

REFERENCE BOOKS

1. Physical chemistry – Samuel Glasstone, Macmillan II edition,1969.
2. A. K. Kaw, *Mechanics of Composite Materials*, CRC Press, New Delhi2005.
3. De. A.K. Kaw,” Environmental Chemistry”, Wiley Eastern Ltd, New Delhi2001.

		L	T	P	C
19UCS108	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to ALL Branches)	3	0	0	3

OBJECTIVES

- To impart the concepts in problem solving for computing
- To familiarize the logical constructs of programming
- To illustrate programming in Python

UNIT I INTRODUCTION **9**

Definition and basic organization of computers – classification of computers – Software – Types of software – types of programming paradigms - Translators: compiler and interpreter – Problem solving tools: Algorithms – Flowchart – Pseudo code.

UNIT II INTRODUCTION TO PYTHON **9**

Introduction to python – features of python – modes of working with python. Values and data types: numbers, Boolean, strings; variables, expressions, statements, tuple assignment, precedence of operators, comments – print function- conversion of algorithm in to program – Solving simple problems involving arithmetic computations and sequential logic to solve.

UNIT III CONTROL CONSTRUCTS **9**

Flow of execution – control structures: conditional (if), alternative (if-else), chained conditional (if-Relif-else); Iteration: state, while, for, break, continue, pass – Solving problems involving decision making and iterations

UNIT IV FUNCTIONS AND PACKAGES **9**

Functions - function definition and use, flow of execution, parameters and arguments; parameters, local and global scope, function composition-Anonymous or Lambda Function, recursion -packages

UNIT V LISTS, TUPLES, DICTIONARIES AND STRINGS **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension - Strings: string slices; immutability, string functions and methods, string module.

TOTAL: 45Periods

COURSE OUTCOMES

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

- Utilize problem solving tools in solving computing problems**.(Apply)**
- Solve mathematical expressions involving sequential logic in python.**(Apply)**
- Solve problems using python using decision structure and looping constructs**.(Apply)**
- Write modular programs using functions and packages **.(Apply)**
- Manipulate data using List, Tuples, Dictionaries and strings**.(Apply)**

TEXT BOOKS

1. Ashok NamdevKamthane&Amit Ashok Kamthane, “Problem solving and python programming”, McGraw Hill Education, 2018 (copyright)
2. Anurag Gupta & G P Biswas, “Python Programming – Problem solving, packages and libraries”, McGraw Hill Education, 2020 (copyright).

REFERENCE BOOKS

1. John V Guttag, “ Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd.,
3. Timothy A. Budd, “Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, “Fundamentals of Python: First Programs‖, CENGAGE Learning,
5. Charles Dierbach, “ Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

		L	T	P	C
19UME109	**ENGINEERING GRAPHICS (Common to ALL Branches)**	**3**	**1**	**0**	**4**

OBJECTIVES

- To develop student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.
- To impart knowledge in development of surfaces, isometric and perspective projections.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 14

Listening –Formal and informal conversations and comprehension Speaking**-** introducing oneself – exchanging personal and social information- **Reading** – Skimming and Scanning. **Writing –** Sentence Formation, Formal Letters (Permission/Requisition) - **Grammar** - Parts of Speech - Tense - **Vocabulary Development** – Technical Word Formation- Prefix- suffix - Synonyms and Antonyms-Phrases and Clauses

UNIT I PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel, perpendicular and inclined to one of the plane.

UNIT II SECTION OF SOLIDS 10

Section of solids - simple position with cutting plane parallel, perpendicular and inclined to one of the plane

UNIT III DEVELOPMENT OF SURFACES 10

Development of lateral surfaces of simple and truncated solids - Prisms, pyramids and cylinders and cones - Development of lateral surfaces of sectioned solids

UNIT IV ISOMETRIC PROJECTIONS 12

Principles of isometric projection – isometric scale – isometric view - isometric projections of simple solids and cut solids

UNIT IV ORTHOGRAPHIC PROJECTION 12

Representation of Three Dimensional objects – General principles of orthographic projection- Need for importance of multiple views and their placement – First angle projection – layout views – layout views – Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects

TOTAL 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Apply the knowledge of First angle of projection and to draw the Projection of different simple solids. **(Apply)**
2. Draw the section of solids with true shape of the section. **(Apply)**
3. Draw the development of lateral surface of regular and sectioned solids. **(Apply)**
4. Draw the isometric view of simple solids and sectioned solids. **(Apply)**
5. Sketch the orthographic views from the given pictorial (isometric) view. **(Apply)**

TEXT BOOKS

1. Natarajan K.V., "A Text book of Engineering Graphics", Dhanalakshmi Publishers, (2006).
2. Bhatt N.D., "Engineering Drawing", 46th Edition, Charotar Publishing House, (2003).

REFERENCE BOOKS

1. Venugopal K., and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, (2008).
2. Gopalakrishnan K.R., "Engineering Drawing" (Vol.I&II), Subhas Publications.
3. DhananjayA.Jolhe, "Engineering Drawing with an introduction to Auto CAD", Tata McGraw Hill Publishing Company Limited, (2008).

		L	T	P	C
19UGS113	BASIC SCIENCES LABORATORY CHEMISTRY LABORATORY	0	0	2	1

OBJECTIVES

- To impart knowledge on basic concepts in applications of chemicalanalysis
- Train the students to handle variousinstruments.
- To acquire knowledge on the chemical analysis of various metalions

list of Experiments(Common to ALL)

S.NO	EXPERIMENTS
1.	Preparation of molar and normal solutions of the following substances – Oxalic acid , Sodium Carbonate , Sodium Hydroxide and Hydrochloric acid.
2.	Conductometric Titration of strong acid with strongbase
3.	Conductometric Titration of Mixture ofAcids
4.	Estimation of Iron by potentiometry
5.	Determination of Strength of given acid using pHmetry
6.	Determination of molecular weight of polymer byviscometry
7.	Comparison of the electrical conductivity of twosamples-
8.	Estimation of copper in brass by EDTAmethod

Course Outcomes

At the end of the course, the student will able to

- Prepare solutions on various concentrations.**(Apply)**
- Analyse the given solution quantitatively using chemical and electro analytical methods. **(Analyze)**
- Determine the amount and molecular weight of the given substances. **(Apply)**

TOTAL: 30 PERIODS

		L	T	P	C
19UGS113	BASIC SCIENCES LABORATORY PHYSICS LABORATORY	0	0	2	1

OBJECTIVES

- To create scientific Temper among the students.
- To know how to execute experiments properly, presentation of observations and arrival of conclusions.
- To view and realize the theoretical knowledge acquired by the students through experiments

LIST OF EXPERIMENTS(Common to ALL)

1. Laser – Determination of particle size and wavelength of Laser source. using Diode Laser
2. Ultrasonic Interferometer - Determination of velocity of sound in liquid and compressibility of liquid.
3. Poiseuille's method - Determination of Coefficient of viscosity of liquid
4. Spectrometer – Determination of dispersive power of a prism
5. Air Wedge method - Determination of thickness of a thin wire.
6. Uniform bending method – Determination of Young's modulus of the given rectangular beam.

COURSE OUTCOMES

After the successful completion of this course, the student shall be able to

- Apply the principles of Optics, Laser physics and Mechanics to determine the Engineering properties of materials
- Analyze the given liquid sample to determine the viscosity and compressibility of the liquid.
- Apply the principles of spectroscopy to determine the properties using prism

Laboratory classes on alternate weeks for Physics and Chemistry

TOTAL: 30 Periods

19UME111	ENGINEERING PRACTICES LABORATORY (Common to Mech, EEE, Civil, Chemical and Agri)	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To demonstrate the plumbing and carpentry works.
- To train the students to perform welding, fitting and drilling operations.
- To demonstrate residential house wiring, fluorescent lamp wiring, measurement of earth resistance, colour coding of resistors, logic gates and soldering

LIST OF EXPERIMENTS(Common to ALL)

GROUP A (CIVIL & MECHANICAL)
CIVIL ENGINEERING PRACTICE

LIST OF EXPERIMENTS

1) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2) Preparation of plumbing line sketches for water supply and sewage works.
3) Hands-on-exercise: Basic pipe connections–Mixed pipe material connection Pipe connections with different joining components.
4) Demonstration of plumbing requirements of high-rise buildings.
5) Study of the joints in roofs, doors, windows and furniture.
6) Hands-on-exercise: Wood work, cutting, planning and joints by sawing –Half lap joint

MECHANICAL ENGINEERING PRACTICE

LIST OF EXPERIMENTS

1) Preparation of arc welding of butt joints, lap joints and tee joints.
2) Drilling Practice.
3) Sheet metal model making – Trays, funnels, etc.
4) Different type of fittings-'V' type, 'L' Type
5) Study of Lathe Machine tool.
6) Study of Plastic Injection Moulding.
7) Study of Moulding.

GROUP B (ELECTRICAL & ELECTRONICS)
ELECTRICAL ENGINEERING PRACTICE

LIST OF EXPERIMENTS

(a) Residential house wiring using switches, fuse, indicator, lamp and energy meter and Stair case wiring.

(b) Fluorescent lamp wiring.

(c) Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

LIST OF EXPERIMENTS

1. Study of Electronic components and equipments – Resistor, colour coding
2. Measurement of AC Signal parameter (peak-peak, rms, period, frequency) usingCRO.
3. Study of logic gates AND, OR, EX-OR and NOT Gate.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

Total: 45 Periods

COURSE OUTCOMES

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

1. Apply the basic knowledge of plumbing to make simple house hold pipe line connections. **(Apply)**
2. Fabricate the given components using carpentry, sheet metal, fitting& welding equipment/tools. **(Understand)**
3. Perform the drilling operations. **(Apply)**
4. Apply basic electrical engineering knowledge for house wiring practice. **(Apply)**
5. Apply the knowledge of basic electrical engineering to practice soldering using general purpose PCB. **(Apply)**

TOTAL: 30 Periods

EQUIPMENT REQUIREMENT

CIVIL ENGINEERING

S.No.	Name of the equipment	Quantity Required
1.	Assorted components for plumbing consisting of metallic Pipes, plastic pipes, flexible pipes, couplings, unions, Elbows, plugs and other fittings	5 sets
2.	Carpentry vice (fitted to workbench)	15 Nos
3.	Standard working tools	15 sets
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	Power tool rotary hammer	2 Nos
6.	Demolition hammers	2 Nos
7.	Planer	2 Nos
8.	Hand drilling machine	2 Nos
9.	Jigsaw	2 Nos

MECHANICAL ENGINEERING

S.No.	Name of the equipment	Quantity Required
1.	Arc welding transformer with cables and holders	5 Nos
2.	Welding booth with exhaust facility	5 Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	2 Nos
5.	Vice	5 Nos
6.	Hacksaw frame and blade	5 Nos
7.	Files	5 Nos
8.	Study-purpose items: Centre Lathe, pattern, cope & drag box and moulding tools	Each 1 No.

ELECTRICAL ENGINEERING

Sl.No	Name of the equipment /software	Quantity Required
1.	Assorted electrical components for house wiring	15 sets
2	Electrical measuring instruments	10 sets
3	Megger (250V/500V)	1 No
4	Study purpose items: Iron box, fanand regulator, emergency lamp	One each
5	Power Tools: (a) Range Finder (b) Digital Live-wire detector	2 No 2 No

ELECTRONICS ENGINEERING

Sl.No	Name of the equipment/software	Quantity Required
1.	Logic trainer kit	2 No
2.	CRO,AFO	2 Each
3.	Small multipurpose PCBs	10 No
4.	Soldering guns	10 No
5.	Multimeters	5 No
6.	Assorted electronic components for making circuits	Required quantity

19UCS110	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To familiarize with programming environment
- To familiarize the implementation of programs in Python

LIST OF EXPERIMENTS

Problems involve Sequential logic and Decision making

1. Write a Python program to process the mark processing system (Record has the following fields: Name, Reg_no, Mark1, Mark2, Mark3, Mark4, Total, average). Print the student details and find the total and average mark.
2. Write a Python program to compute the +2 Cutoff mark, given the Mathematics, physics and Chemistry marks. A college has decided to admit the students with a cut off marks of180. Decide whether the student is eligible to get an admission in that college or not.
3. A pizza in a circular shape with 8 inches and which is placed in a square box whose side length is 10 inches. Find how much of the box is “empty”?
4. A person owns an air conditioned sleeper bus with 35 seating capacity that routes between Chennai to Bangalore. He wishes to calculate whether the bus is running in profit or loss state based on the following scenario:
   Amount he spent for a day for diesel filling is: Rs. 15,000
   Amount he spent for a day for Driver and cleaner beta is: Rs. 3,000
   Ticket amount for a Single person is Rs: 950
   If all the seats are filled, what would be the result?
   If only 15 seats are filled, what would be the result?
5. Consider the person ‘X’ has some amount in his hand and the person ‘Y’ has some amount in his hand. If they wish to exchange the amount among them, how they can exchange the amount by using the third party ‘Z’.

Problems involve iterations

6. A man is blessed with a duck that can lay golden eggs. First day it lays one egg, in second day it lays two eggs, in third day it lays three eggs, and it continues to lay eggs in an incremental manner day by day. Now calculate how many golden eggs that duck lays till ‘n’th day.
7. Four People A,B,C,D are sitting in a Circular arrangement. In how many ways their seating can be arranged.
8. The Greek theater shown at the right has 30 seats in the first row of the center section. Each row behind the first row gains two additional seats. How many seats are in the 5^{th} row in the center section?

Problem involve functions and recursive functions

9. Write a program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle. (Recall from the Pythagoras theorem that in a right triangle, the square of one side equals the sum of the squares of other two sides)
10. A game has to be made from marbles of five colors, yellow, blue, green, red and Violet where five marbles has to be kept one upon another. Write a python program using recursion, to find how many ways these marbles can be arranged.

11. Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules: Here is a high-level outline of how to move a tower from the starting pole, to the goal pole, using an intermediate pole:

    1. Move a tower of height-1 to an intermediate pole, using the final pole.
    2. Move the remaining disk to the final pole.
    3. Move the tower of height-1 from the intermediate pole to the final pole using original pole

Problems involve List and Nested List

12. In a class of 50 numbers of students, 6 students are selected for state cricket academy. Sports faculty of this school has to report to the state cricket academy about the selected students' physical fitness. Here is one of the physical measures of the selected students'; Height in cm is given for those 6 selected students [153,162,148,167,175,151]. By implementing functions, do the following operations.
    (i) State academy selector has to check whether the given height is present in the selected students list or not.
    (ii) State academy selector has to order the height of students in an incremental manner.
    (iii) State academy selector has to identify the maximum height from the list.

Problems involve Dictionary and Tuples

Dictionary

13. A university wishes to create and maintain the details of the students such as Rollno, Regno, Name, Dept, Batch, Contact_no, Nativity(Indian/NRI) as key value pairs. Do the following operations:
    (i) Display the complete student details on giving Rollno as input.
    (ii) Display the complete student details whose nativity belongs to NRI.
    (iii) Display the complete student details whose department is CSE.

Tuples

14. A librarian wishes to maintain books details such as ISBN, Book Name, Author Name, Year published, Publisher Name. He wishes to retrieve the book details in the following scenario:
    (i) Retrieve the complete details of the book on giving ISBN.
    (ii) Retrieve the details of the book which published after the year 2015.
    (iii) Retrieve the details of the book whose author name is 'Andrew'.
    (iv) Retrieve the details of the book that name of the book is 'Python'

Problems involve Strings

15. A musical album company has 'n' number of musical albums. The PRO of this company wishes to do following operations based on some scenarios:
    (i) Name of the album starts with 's' or 'S'.
    (ii) (ii) Name of the album which contains 'jay' as substring.
    (iii) Check whether the album name presents in the repository or not.
    (iv) Count number of vowels and consonants in the given album name.

TOTAL: 45 Periods

COURSE OUTCOMES

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

- Formulate algorithms for simple problems and translate the algorithms to a working program **(Apply)**
- Formulate algorithms and programs for arithmetic computations and sequential logic**.(Apply)**
- Write iterative programs using control constructs**.(Apply)**
- Develop programs using functions, packages and use recursion to reduce redundancy**.(Apply)**
- Represent data using lists, tuples, dictionaries and manipulate them through a program**.(Apply)**

		L	T	P	C
19UEN201	**COMMUNICATION SKILLS FOR PROFESSIONALS**	**1**	**1**	**0**	**1.5**

OBJECTIVES

- Improve their oral expression and thought
- Develop their confidence and ability to speak in public
- Develop their capacity for leadership

Project 1: SELF INTRODUCTION & DELIVER A SPEECH BEFORE AUDIENCE

- To Speak in front of an audience with courage.
- Make your message clear, with supporting material.
- Create a strong opening and conclusion.

Project 2: SPEAK ON THE CHOSEN CONTENT

- Select a general topic and bring out specific purposes.
- Avoid using notes.
- Use symbolic ideas to develop your ideas

Project 3: USE EFFECTIVE BODY LANGUAGE & INTONATION

- Use appropriate posture, gestures, facial expressions and eye contact to express your ideas.
- Use proper intonation and adequate speech module.

Project 4: PRESENT YOUR TOPIC WITH VISUAL AIDS

- Persuade your points with suitable illustration, specific facts, examples
- Use suitable visual aids to present your topic with confidence.

Project 5: GRASP THE ATTENTION OF THE AUDIENCE

- Influence your listeners by adopting holistic viewpoint.
- Use emotions, stories, and positive quotes in your speech.

Total Hours =30 Periods

COURSE OUTCOME

After successful completion of this course the students will be able to:

CO-1 Apply Language skills to write and speak effectively
CO-2 Select the right words and sentence to communicate ideas clearly and accurately

CO-3 Exhibit good postures and proper attire to present the ideas effectively
CO-4 Present the ideas effectively using visual aids.
CO-5 Communicate with clarity and present the ideas effectively to the audience

Reference Book

1. Competent Communication- A Practical Guide to becoming a better speaker, Toastmasters International, USA.

2. Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.

		L	T	P	C
19UMA207	**CALCULUS, COMPLEX ANALYSIS AND TRANFORM TECHNIQUES**	**3**	**1**	**0**	**4**

(COMMON TO CHEMI, AGRI, BIO MED AND BIO TECH)

OBJECTIVES :

- To develop an understanding of the basics of vector calculus comprising of gradient, divergence and curl, and line, surface and volume integrals and the classical theorems involving them.
- To acquaint the student with the concepts of analytic functions and their interesting properties which could be exploited in a few engineering areas, and be introduced to the host of conformal mappings with a few standard examples that have direct application.
- To make the student to acquire sound knowledge of Laplace transform techniques and its applications in getting the solution of certain linear differential equations

UNIT I SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Applications of ODE (Bacterial growth, Population growth, Decayed problems).

UNIT II VECTOR CALCULUS 8+3

Gradient Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields –Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopiped.

UNIT III COMPLEX VARIABLES 8+3

Functions of a complex variable – Analytic function – Necessary and Sufficient Conditions (excluding Proofs) – Harmonic function - Properties of an analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping- simple Transformations: w = z+c, cz, 1/z, and Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Statement and applications of Cauchy's integral theorem, Cauchy's integral formula and Cauchy Residue Theorem – Taylor's and Laurent's expansions – Applications of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding Poles on the real axis).

UNIT IV LAPLACE TRANSFORM **9 + 3**

Existence conditions – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function, impulse function and periodic function - Inverse Laplace transform – Convolution theorem (excluding Proof) –Solution of linear ODE of second order with constant coefficients.

TOTAL : 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES

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

- Solve first and higher order ordinary differential equations analytically and apply in real life engineering problems. (CO1)AP – K3
- Demonstrate the use of vector identities in problem solving and evaluate the line, surface and volume integrals.(CO2)AP – K3
- Construct analytic function and applying conformal mapping in various Engineering fields.(CO3)AP – K3
- Apply the knowledge of standard techniques of complex variables for evaluating different functions. (CO3) AP – K3
- Acquired the knowledge of singularities, residues and applying in complex integration.(CO4) AP – K3
- Understand the concept of Laplace transform and solve the problems with periodic function, convolution and Ordinary Differential Equation.(CO5)AP – K3
- Determine the solution of Ordinary Differential Equations by Normal and by applying Laplace transform methods. (CO1, 5)AP – K3

TEXT BOOKS

1. VEERARAJAN.T “Engineering Mathematics” Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. BALI N. P and MANISH GOYAL, “Text book of Engineering Mathematics”, Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, (2008).
3. GREWAL. B.S, “Higher Engineering Mathematics”, Khanna Publications, New Delhi, 43rd Edition, (2014).

REFERENCE BOOKS

1. RAMANA B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, (2010).
2. BROWN J.W. and CHURCHIL R.V.” Complex Variable and Applications” 7th Edition McGraw Hill Publishing Company 2004.
3. JAIN R.K and IYENGAR S.R.K, “Advanced Engineering Mathematics”, Narosa Publishing House Pvt. Ltd., New Delhi, 3rd Edition, (2007).
4. INCE E.L “Ordinary Differential Equations “, Dover Publications 1958.

19UPH207	GREEN PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the essential principles of physics related to agricultural engineering.
- To gain knowledge about the physical properties of the various materials.
- To cover the fundamental scientific principles for the different synthesis techniques and assembly of the advanced materials

UNIT I ENERGY PHYSICS **13**

Introduction - various forms of energy - Conventional energy sources -Fossil fuels- Biomass energy and its classification - Thermo-chemical Conversion-Pyrolysis-Gasification-Combustion- Bio-fuels: Importance, Production and applications- Non-Conventional Energy Sources –Solar energy- wind energy-Applications in agriculture field

UNIT II SOIL PHYSICS **10**

Introduction –Physical properties of soil-Soil parameters- Texture -Methods of textural analysis- Structure –Types of structure- Thermal properties of soil-Soil temperature-Factors affecting soil temperature- Measurement of soil temperature.

UNIT III ADVANCED ENGINEERING MATERIALS **12**

Introduction-Metallic glasses– preparation – properties & applications -Shape memory alloys– preparation – properties & applications - Nanomaterial: synthesis- plasma arcing –Solgel-Chemical vapour deposition – ball milling - properties - Application of Nano-materials in Agriculture

UNIT IV REMOTE SENSING IN AGRICULTURE **10**

Introduction-Remote sensing-Basic Principle-Essential component of remote sensing and its process- Types of remote sensing –Factors that influence soil reflectance in remote sensing – Data characteristics-Data processing-Remote sensing applications in agriculture

TOTAL:45PERIODS

COURSEOUTCOMES

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

1. Explain the conventional and non-conventional energy sources reliable to agricultural industry.**[Understand]**
2. Analyze the physical propertiesof soilsfor structural transformations influencing agriculture.**[Analyze]**
3. Apply the concepts of physics related to new engineering materials, properties and manufacturing methods encountered in agricultural engineering**[Apply]**
4. Gain knowledge regarding the role of nanomaterials in agriculture.**[Understand]**
5. Recognize and explain basic computational properties of remote sensing data acquisition, storage, and processing. **[Understand]**
6. Utilize thefundamentalsof physics in agricultural related problems.**[Understand]**

TEXT BOOK

1.Dr. Mani.P, “A Text book for Agricultural Engineering”, Dhanam Publications, Chennai Revised Edition, 2018

REFERENCESBOOKS

1. William D. Callister, Jr. “Material Science and Engineering”, Seventh Edition, John Wiley & Sons Inc. New Delhi, 2010
2. Electronic radiation of foods - An Introduction to Technology, R.B.Miller,
3. Fundamentals of Remote Sensing, George Joseph, University Press Pvt.Ltd., 2
4. Non –Conventional Energy Sources, G.D.Rai, Khanna Publishers,2015
5. Biomass Gasification Principles and Technology, Energy technology review No. 67, - T.B.Read(NoyesData Corp. , 1981)

19UEE226	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (COMMON TO MECH,CIVIL,CHEMICAL & AGRI)	L	T	P	C
		3	0	0	3

OBJECTIVES

- This course facilitates the students to get a comprehensive exposure to electrical and electronics engineering

UNIT I DC AND AC CIRCUITS **9**

Direct currents and voltages, power, KirchhoffsLaws,Alternating current and voltage,Peak, RMS and average values, circuit elements R,L &C, Phasor Diagram, impedance, real and reactive power in single phase circuits.

UNIT II DC MACHINES AND TRANSFORMERS **9**

DC machines Construction, principle of operation and applications, Single phase transformer – construction, principle of operation, Applications.

UNIT III AC MACHINES 9

Synchronous and Induction machines -Construction, Principle of operation, and applications.

UNIT IV SPECIAL MACHINES 9

AC Servo Motor, Stepper Motor, Linear induction motor and Universal Motor – Construction, Principle of operation and applications.

UNIT V INTRODUCTION TO ELECTRONICS 9

Diode- PN Diode, ZenerDiode,BJT Configurations, Rectifiers, Data acquisition system- ADC, DAC – principles of operation.

TOTAL:45PERIODS

COURSE OUTCOMES:

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

- Apply the basic laws of electrical circuits to linear circuit problems.**[Apply]**
- Summarize the working principle and construction of DC machines and transformers.**[Understand]**
- Explain the principle of operation and construction of AC machines. **[Understand]**
- Explain the working principle and construction of Special machines. **[Understand]**
- Illustrate the characteristics of basic semiconductor devices. **[Understand]**

REFERENCE BOOKS:

1. V K Mehta and Rohit Mehta, ***"***Principles of Electrical Engineering and Electronics", S. Chand Publishing, New Delhi, 2019
2. Arumugam M. and Premkumar N., "Electric circuits theory", KhannaPublihsers, 7th edition, NewDelhi,2007.
3. Kothari D.P. Nagrath I.J, "Electric Machines", Tata McGraw Hill, 2009.
4. K. Venkataratnam,Special Electrical Machines, Universities Press, 2014.
5. R.J.Smith, R.C.Dorf, Circuits devices and systems, 5th edition, John Wiley and sons,2001.

19UAG201	INTRODUCTION TO AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart the fundamental knowledge on the importance of soil and water conservation.
- To acquire knowledge about the fundamentals of farm machineries.
- To apply the above concepts in meeting the post harvest and food processing.
- To understand the concepts in renewable energy systems in agriculture.
- To impart various fundamental knowledge about farm structures

UNIT I SOIL AND WATER CONSERVATION 9

Introduction – Soil - Water Soil erosion –mechanics soil erosion - water erosion – wind erosion –erosion control – gully control structures –water harvesting technology –watershed management – farm pond

UNIT II FOOD AND AGRICULTURAL PROCESSING 9

Introduction - Food and its classification –Physical and chemical properties of food – maturity index of food- basic food preservation techniques- traditional and modern – Cleaners, washers and graders-principle and working of cold storage - Types of food packaging.

UNIT III FARM MACHINERY 9

Introduction - Internal Combustion Engines - Land Preparation – Tillage – Primary – Secondary – Implements – Weeding – Implements - Manual – Power Operated – Harvesting Equipments

UNIT IV BIO-ENERGY 9

Introduction -Indian Renewable Energy Scenario - Solar Energy – Solar PV System - Solar Pumping – Solar Driers - Wind Milll – Types – Water Pumping Wind Mills – Biogas – Types - Applications

UNIT V FARM STRUCTURES 9

Introduction -Site selection - Farm Shed –Poultry House and Types – Cattle Shed – Loose House System - Types – Storage Structures – Food Grains and Forage – Types of roofs – building plan - farm roads

TOTAL : 45 Periods

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Design water harvesting structures and use water conservation technologies in field
- Apply various unit operations required for food processing industries
- Analyze and implement the various tillage implements to be utilized in land preparation.
- Impart modern tools in renewable energy technologies for agro industries
- Design and construct various farm structures involving wider range of applications
- Render solutions for complex engineering problems in grain storage technologies and enhancing the shelf life of food grains

TEXT BOOKS

1. Earle, R.L., 1985.Unit operations in Food Processing", Pergamon Press, Oxford, U.K.
2. JagdishwarSahay. 2006. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.
3. Rai G.D, 1995. Non-conventional sources of Energy, Khanna publishers, New Delhi.
4. Donnell Hunt. 2013. Farm power and machinery management. Scientific International Pvt. Ltd. New Delhi.

REFERENCE BOOKS

1. Sanjay Kumar et al. 2013. Fundamentals of Agricultural Engineering. Kalyani publishers, Ludhiana-141 008.
2. SurendarSingh, 2011. Farm Machinery Principles and Applications. Indian Council of Agricultural Research, New Delhi-12.
3. Chawla O.P, 1986. Advances in Biogas Technology ICAR publication New Delhi.

19UCY204	ENVIRONMENTAL SCIENCE (COMMON TOALLBRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of Environment andecosystem.
- To acquire knowledge about the impact of environmentalpollution.
- To understand the importance of environmental issues in thesociety.
- To gain knowledge about the impact of environment related to humanhealth.
- To gain knowledge in alternativeenergies.

UNIT I ENVIRONMENTAND ECOSYSTEMS 9

Definition, scope and importance of environment – Need for public awareness – Conceptofecosystem–Structureandfunctionofecosystem–Producers,consumersand decomposers-Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Aquatic ecosystems (c) Grasslandecosystem.

UNIT II ENVIRONMENTALPOLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermalpollution - pollution case studies - Role of an individual in prevention of pollution –Disaster management: floods, earthquake, cyclone and landslides.

UNIT III SOCIAL ISSUES ANDTHEENVIRONMENT 9

Water conservation, rain water harvesting, watershed management – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Environmental laws/Acts, (EPA).

UNIT IV HUMAN POPULATION ANDTHEENVIRONMENT 9

Population growth, variation among nations – Population explosion – Human rights – Family welfare programme – Environment and Human Health – Human Rights Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health.

UNIT V FUTURE POLICYAND ALTERNATIVES 9

Introduction to future policy and alternatives-fossil fuels-nuclear energy-solar energy-wind energy - hydroelectric energy-geothermal energy - tidal energy – sustainability - green power-nanotechnology**.**

TOTAL:45PERIODS

OUTCOMES

After successful completion of this course the students will be able to:

- Express the concepts of an ecosystem.
- Describe the impact of environmental pollution.
- Explain the importance of environmental issues to the society.
- Analyze the impact of environmental issues related to humanhealth.
- Identify alternate energy sources for technological applications.

TEXT BOOKS

1. AnubhaKaushik, kaushik C.P., “Environmental Science and Engineering”,Third Edition, New Age International, New Delhi, 2009.
2. Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.

REFERENCE BOOKS:

1. Gilbert M.Masters, ‘Introduction to Environmental Engineering andScience’, Pearson Education,Upper saddle River, New Jersey, 2008.
2. Miller T.G. Jr., Environmental Science”, Wadsworth PublishingCompany, Belmont, California, 2005.
3. De A.K., “Environmental Chemistry”, Wiley Eastern Ltd., New Delhi,2001.
4. Trivedi R.K., Goel P.K., “Introduction to Air Pollution”, Techno-Science Publication, Jaipur,2005.

19UGS210	ENERGY AND ENVIRONMENTAL SCIENCE LABORATORY (AGRICULTURE ENGINEERING)	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- Apply the theoretical concepts to perform lab experiments**.**
- To assess the water quality parameters.
- To acquire knowledge on water quality parameters for the analysis of industrial effluents.

LIST OF EXPERIMENTS(Common to ALL)

S.NO	EXPERIMENTS
1.	Estimation of hardness of water by EDTAmethod.
2.	Estimation of alkalinity of watersample.
3.	Estimation of Chloride in water sample (Argent metricmethod)
4.	Determination of DO in water
5.	Estimation of chromium in tannerywastes
6.	Estimation of available chlorine in bleachingpowder
7.	Estimation of iron bySpectrophotometry.
8.	Determination of acidity of industrialeffluents

COURSE OUTCOMES:

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

- Test and analyze the water quality parameters for the given sample. **(Analyse)**

A minimum of FIVE experiments shall be offered

TOTAL: 30 PERIODS

		L	T	P	C
19UGS221	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY (COMMON TO CHEMICAL AND AGRI)	0	0	3	1.5

OBJECTIVES

This course facilitates the students to get a basic practical exposure to electrical andelectronics engineering.

LIST OF EXPERIMENTS(Common to ALL)

S.NO EXPERIMENTS

1. Verification of Ohm's Law
2. Verification of Kirchoff's Laws.
3. Measurement of Electrical Quantities voltage, current, power ad power factor in RLC Circuits.
4. Load test on electrical motor.
5. Study of Batteries.
6. Characteristics of PN Junction Diode.
7. Characteristics of Zener Diode.
8. Characteristics of BJT.
9. Study of UPS.
10. Study of Electrical and Electronic software packages.
11. Field visit to College EB Section

COURSE OUTCOMES

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

- Solve the electrical parameters in a circuit using Ohm's law and Kirchhoff's laws. **[Apply]**
- Demonstrate the behavior of RLC circuits with electrical quantitiesand Explain the loadhandling capacity of electrical motor.**[Understand]**
- Interpret the basic construction, working and types of Batteries and select suitable battery for particular applications. **[Apply]**
- Illustrate the characteristics of Semiconductor diodes and Transistor and develop power supply circuits. **[Apply]**
- Interpret the basic structure and working of UPS and outline the electrical &electronics software tools.**[Understand]**

TOTAL: 30PERIODS

19UMA326	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS (COMMON TO AGRI, CHEMICAL, BIO MED AND BIO TECH)	L	T	P	C
		3	1	0	4

OBJECTIVES

- To make the student knowledgeable in formulating certain practical problems in terms of partial differential equations, solve them and physically interpret the results.
- To familiarize the students to formulate and identify certain boundary value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve them numerically and interpret the results.
- To acquaint the student with the basics of Z - transform in its applicability to discretely varying functions, gained the skill to formulate certain problems in terms of difference equations and solve them using the Z - transform technique bringing out the elegance of the procedure involved.

UNIT I FOURIER SERIES 9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic analysis - Application of Fourier series - Gibb's Phenomenon.

UNIT II FOURIER TRANSFORM 9 + 3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application of Fourier Transform.

UNIT III Z-TRANSFORM AND DIFFERENCE EQUATIONS 9 + 3

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value Theorems - Formation of difference equations – Solution of difference equations.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

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

UNIT V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Introduction of Partial differential equations - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

TOTAL : 45 (L) + 15 (T) = 60 Periods

COURSE OUTCOMES:

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

- Apply the knowledge of Fourier series for the given function or Discrete data and compute the Periodic function arising in the study of Engineering problems.(**CO1) AP – K3**
- Apply the knowledge of Fourier transform and its properties which are used to transform signals between time and frequency domain**.(CO2) AP – K3**
- Apply the acquired knowledge of Z transform and its properties inverse Z transform and difference equations **.(CO3) AP – K3**
- Apply the knowledge of partial differential equation in solving linear and higher order partial differential equation.**(CO4) AP – K3**
- Apply the knowledge of PDE in solving linear, higher order and one dimensional Wave, Heat flow equation.**(CO5). AP – K3**
- Understand the basic concept of periodic, non-periodic function and nature of partial differential equation. **(CO6) U- K2**

TEXT BOOKS:

1. GREWAL B.S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 42nd Edition, (2012).
2. BALI N.P., MANISH GOYAL and WATAINS, "Advanced Engineering Mathematics", Firewall Media (An imprint of Laxmi Publication Private limited) New Delhi, 7th Edition, (2009).
3. VEERAJAN.T, "Higher Engineering Mathematics", Yes Dee Publishing Pvt. Limited, 2015.

REFERENCE BOOKS:

1. RAMANA.B.V, "Higher Engineering Mathematics" Tata McGraw Hill, New Delhi, 11th Reprint (2010).
2. GLYN JAMES, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 3rd Edition, (2007).
3. ERWIN KREYSZIG, "Advanced Engineering Mathematics", Wiley India, 10th Edition, (2011).
4. KANDASAMY.P, THILAGAVATHY.K, and GUNAVATHY.K, Engineering Mathematics III, S.Chand & Company Ltd., New Delhi, 3rd Edition, (1996).

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO.1	3			1								1		
CO.2	3			1								1		
CO.3	3			1								1		
CO.4	3			1								1		
CO.5	3			1								1		
CO.6	3			1								1		

19UAG302	UNIT OPERATIONS FOR FOOD PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

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

UNIT I EVAPORATION AND CONCENTRATION 9

Unit operations in food processing –conservation of mass and energy – overall view of an engineering process -evaporation – definition – liquid characteristics – single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator.

UNIT II FILTRATION AND SEDIMENTATION 9

Filtration – definition –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter cake resistance-filtration equipment – rotary vacuum filter – filter press-sedimentation – gravitational sedimentation of particles in a fluid – Stoke‟s law, sedimentation of particles in gas-cyclones – settling under sedimentation and gravitational sedimentation-centrifugal separations – rate of separations – liquid – liquid separation – centrifuge equipment-Types of membarane-Micro-Ultra-Nano filtration-Applications-Reverse osmosis

UNIT III SIZE REDUCTION 9

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

UNIT IV PROCESSING 9

Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – equilibrium concentration relationships – operating conditions-calculation of separation in contact – equilibrium processes-gas absorption – rate of gas absorption – stage – equilibrium gas – absorption equipment -extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator – continuous leaching – decantation systems – extraction towers-washing – equipments.

UNIT V CRYSTALLISATION AND DISTILLATION 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Understand about various types of evaporators and their economy in concentration process
- Classify filtration and sedimentation process
- Understand the size reduction methods and working principle of various mills
- Relate gas-liquid and solid-liquid equilibrium
- Acquire knowledge on crystallization and distillation techniques.

TEXT BOOKS

1. Earle, R.L., “Unit operations in Food Processing”, Pergamon Press, Oxford, U.K, 1985.
2. McCabe, W.L., and Smith, J.C., “Unit Operations of Chemical Engineering”, Mc-Graw-Hill Inc., Kosaido Printing Ltd., Tokyo, 1990.
3. K.M Sahay and K.K. Singh “Unit operation of Agricultural Processing” Vikas Publication.

REFERENCE BOOKS

1. Coulson, J.M., and Richardson, J.F., “Chemical Engineering”, Vol. 1, The Pergamon Press, New York, 1977.
2. DG Rao ,”Fundamentals of Food Engineering” PHI Learning Private Limited, New Delhi

19UAG303	FUNDAMENTALS OF ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on the vector and scalar representation of forces and moments.
- To make the students to calculate the moment of inertia and centroid for different sections.
- To explain dynamics of particles and different types of friction.

UNIT I	BASICS & STATICS OF PARTICLES	9

Introduction - Units and Dimensions - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces - Vectors - Vectorial representation of forces – vector operation of forces- additions, subtraction, dot product, cross product- Coplanar Forces – rectangular components-Forces in space - Equilibrium of a particle in space Equivalent systems of forces - Principle of transmissibility

UNIT II	EQUILIBRIUM OF RIGID BODIES	9

Free body diagram - Types of supports and their reactions - stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis – vectorial representation of moments and couples-Scalar components of a moment - Varignon's theorem - Equilibrium of Rigid bodies in two dimensions.

UNIT III	PROPERTIES OF SURFACES AND SOLIDS	9

centroids and centre of mass- centroids of lines and areas- rectangular, circular, triangular areas by integration- T section, I section, Angle section, Hollow section by using standard formula- Theorem of Pappus- Area moment of inertia of plane areas- rectangular, circular, triangular areas by integration- T section, I section, angle section, hollow section by using standard formula

UNIT IV	DYNAMICS OF PARTICLES	9

Displacements, Velocity and acceleration, their relationship - Relative motion – curvilinear motion Newton's law of motion - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.

UNIT V	FRICTION	9

Frictional force - Laws of sliding friction- equilibrium analysis of simple systems with sliding friction- wedge friction- Rolling resistance –Screw jack friction – Belt friction.

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Explain the basic laws of mechanics.
2. Apply the vector operations to calculate forces in space.
3. Solve the problems dealing with moments, couple forces and support reaction in a system.
4. Apply the centroidal and axis theorem's to calculate moment for plane surfaces and mass moment of inertia for solids.
5. Solve the problem in the dynamics of particles and rigid bodies.
6. Summarize the Law of friction.

TEXT BOOKS:

1. Beer P, E. Russell Johnston Jr.,David F. Mazurek, Phillip J. Cornwell and Elliot R. Eisenberg "Vector mechanics for Engineers: Static and Dynamic", McGraw-Hill International, 8 Edition, 2004.
2. Kottiswaran.N, "Engineering Mechanics, Statics and Dynamics", Sri Balaji Publications, 2015

REFERENCE BOOKS:

1. Hibbeller.R.C, "Engineering Mechanics: Statics &Dynamics ", Pearson Education Asia Pvt. Ltd, 2010.
2. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics ", Pearson Education Asia Pvt. Ltd, IV Edition, 2006
3. Rajasekaran.S, Sankarasubramanian.G, "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd, 2000.

19UAG304	FUNDAMENTALS OF THEORY OF MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the concepts of machines, mechanisms and related terminologies.
- To impart knowledge to analyze a mechanism for displacement, velocity and acceleration at any point in a moving link
- To given idea about theory of gears, gear trains, cams and brakes.

UNIT I Analysis of Mechanisms 9

Mechanism- Definitions- kinematic links-types of constrained motion- kinematic pairs-kinematic chain- machine and mechanism- equation and criterion. Four bar chain-slider crank chain-double slider crank chain and their inversions. Techniques to obtain velocity and acceleration in different mechanisms.

UNIT II Friction in Machine Elements 9

surface contacts- sliding and rolling friction- friction in screw threads- friction in clutches-belt drives-friction in brakes.

UNIT III Kinematics of Cams 9

Classifications- pressure angle- undercutting. Displacement diagrams- uniform velocity, uniform acceleration and retardation, simple harmonic and cycloidal motions- graphical construction of displacement diagrams and layout of plate cam profiles for different types of followers- knife edges, roller, mushroom, flat type.

UNIT IV gears and gear train 9

classification of gears- gear tooth terminology- spur gear terminology and definitions-fundamental law of toothered gearing and involute gearing- length of path of contace and contact ratio- interference and undercutting, helical, rack and pinion gears (basica only). Gear trains- simple, compound and epicyclic gear trains, automotive transmission gear trains- differentials.

UNIT V Mechanism for controls 9

Governors- types- watt and porter- principle of operation- sensitivity and hunting. Turning moment diagram and flywheel- fluctuation of speed.

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Discuss the basics of mechanism and calculate velocity and acceleration in simple mechanisms
2. Examine friction in machine elements.
3. Construct different types of cam profile
4. Solve problems on gears and gear trains
5. Calculate the speed, lift of the governors and dynamic forces of mechanisms

TEXT BOOKS:

1. Khurmi R. S, Guptha J. K, " Theory of Machines" S. Chand CompanyLtd., Prentice Hall of India, Fourteeth Revised Edition, New Delhi, 2012.
2. Ramamurthi. V, " Mechanism and Machine Theory ", Narosa Publishing House, Second Edition, 2005

REFERENCE BOOKS:

1. Thomas Bevan, Theory of Machines", CBS Publishesrs and Distributors, 1984
2. Uicker J. J, Pennock G. R, Shigley, " Theory of Machines and Mechanism", (Indian Edition) Oxford University Press, 2003
3. Ghosh A, Mallick. A. K, " Theory of Mechanisms and Machines" , Affiliated East- West Pvt. Ltd, New Delhi, 1998
4. Rao J.S, Dukkipati R. V, "Mechanism and Machine Theory", Wiley- Eastern Ltd, New Delhi, 1992.

19UAG305	FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behavior of fluids under static conditions.
- The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy

UNIT –I PROPERTIES OF FLUIDS **9**

Introduction and significance of Fluid Mechanics in Agricultural Engineering. Fluid Properties, Types of fluids- Newton's law of Viscosity Newtonian and Non-Newtonian fluids. Pascal's law, Hydrostatic equation and its applications; Fluid pressure and measurement.

UNIT –II FLUID FLOW ANALYSIS **9**

Types of fluid flows - Streamline and Velocity potential lines- Basic equations governing fluid, Equation of Continuity and its application, Equation of motion – Derivation of Euler's equation, Bernoulli's equation and its application in fluid flow, Significance of Navier - Stoke's equation.

UNIT -III FLOW MEASUREMENTS **9**

Venturimeter – orifice meter – turbulent flow - Reynold's experiment – Reynold's number-Flow through pipes – laminar and turbulent flow in pipes - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-William‟s formula - Major and minor losses in pipes – hydraulic gradient line.

UNIT –IV OPEN CHANNEL FLOW **9**

Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal.Flow measurement in channels – notches – rectangular, Cipolletti and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow-critical flow and its computation.

UNIT –V DIMENSIONAL ANALYSIS & PUMPS 9

Fundamental and secondary dimensions dimensional homogeneity – Rayleigh and Buckingham Pi methods – relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies- Pumps –Classification and working principle of Centrifugal Pumps and Positive Displacement Pumps– performance characteristics and sizing of pumps, selection of pumps- Reciprocating pump.

TOTAL PERIODS : 45

TEXT BOOKS

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

REFERENCE BOOKS

1. Garde, R.J., Fluid Mechanics through problems. New Age International Publishers (P) Ltd., New Delhi, 2002.
2. Michael A.M. and S.D.Khepar, Water Well and Pump Engineering. Tata McGraw Hill Co. New Delhi, 2005.
3. Michael A.M. Irrigation Theory and Practice, Vikas Publishing House, New Delhi, 2008

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Ability to define the fundamental concepts of fluids and its flow measurements with dimensional analysis.	**Remember**
CO2	Ability to understand the properties of fluid, types of fluid flow measurements and fundamentals of dimensional homogeneity.	**Understand**
CO3	Ability to apply the laws for various equations and use of dimensional analysis with the characteristics of pumps	**Apply**
CO4	Analyze and design the simple pipe systems, flow measurement channels and pumps.	**Analysis**
CO5	Computation of discharge through notches, weirs and pumps.	**Evaluate**
CO6	Ability to create a suitable pump considering the fluid flow and its dimensional methods.	**Create**

19UAG306	PRINCIPLES AND PRACTICES OF CROP PRODUCTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- The students will know about the basic principles and practices of different types of crop production.
- The students will know the basic concepts of agricultural meteorology parameters

UNIT I INTRODUCTION TO AGRICULTURE **9**

Definition of agronomy – Factors affecting crop growth - Tillage – Definition – objectives – types of tillage -Crops and major soils - Classification – Economic and agricultural importance in India and Tamil Nadu - cropping systems – monoculture and multiple cropping – inter, mixed, relay, strip and multitier cropping.

Unit II INTRODUCTION TO AGRICULTURAL METEOROLOGY **9**

Meteorology – Agricultural meteorology – definition – Atmosphere –component and its importance. - Agro climatic zones of Tamil Nadu - weather forecasting services in India. Climatic classification basis and types –climatic classification India and TamilNadu. moonsoon in india and tamilnadu.

Unit III PRODUCTION PRACTICES OF FIELD CROPS – I **9**

Package of practices for important field crops – rice, maize, pulses – black gram, green gram and red gram - oilseeds -gingerly , groundnut and sunflower.

UNIT **IV PRODUCTION PRACTICES OF FIELD CROPS – II** **9**

Package of practices of cotton, Sugar crops-Sugarcane-,sweet sorghum and sugar beet, biofuel crops – Jatropa.

Unit V PRODUCTION PRACTICES OF HORTICULTURAL CROPS **9**

Important horticultural crops in Tamil Nadu.- Cultivation practices of vegetable crops – Brinjal, tomato, Bhendi and Chilli - fruit crops – Mango-Sapota.

TOTAL PERIODS : 45

TEXTBOOK

1. Singh. S.S. 2002. *Crop Management under Irrigated and Rainfed Conditions.* Kalyani Publishers, New Delhi.
2. Ghadekar, S.R. 2008. Text book on Agro meteorology. Agromet Publishers, Nagpur
3. Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, KrishiAnusandhanBhavan, Pusa, Newdelhi, 2005.
4. Reddy T. Sankara G.H. YellamandaReddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 1995.
5. Handbook of Agriculture. ICAR Publications, New Delhi.
6. Radha, T. and L. Mathew. 2007. Fruit Crops (Horticultural Science Series Vol. III), New India Publishers, New Delhi.

REFERENCE BOOK

1. *Crop Production Guide.* 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
2. Kumar, N.,"Introduction to Horticulture", Rajalakshmi Publications. Nagercoil,1993.
3. Kumar, N., Abdul Khader, M. Rangaswami, P. and I\rulappan, I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the tillage methods and cropping system.	Understand
CO2	Understand the basic concepts of agricultural meteorology.	Understand
CO3	Understand the cultivation practices of cereals, millets, pluses and oil seeds.	Understand
CO4	Understand the cultivation practices of sugar crop,fiber crops and biofuel crop.	Understand
CO5	To know the cultivation practices of fruit crops.	Evaluate
CO6	To know the cultivation practices of vegetable crops.	Create

19UAG307	SEMINAR	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To learn, practice, and critique effective scientific seminar skills.
- Students develop presentation skills that will be essential during their entire professional careers.

METHOD OF EVALUATION:

- **General Aspects of Oral Presentation:** Presented at level that is appropriate to the audience; clear and informative visual aids (simple, sufficient time); evident that presenter has practiced.
- **Introduction:** Overview of your problem area provided; unfamiliar terms introduced; appropriate literature abstracted and presented clearly; research hypothesis of the study identified.
- **Methods:** Brief overview of the equipment and materials used, and how obtained; brief overview of the experimental design used and any other parts of the methods employed; materials and/or equipment described; procedures followed to conduct the experiment presented
- **Results:** Anticipated and actual results reported; statistics clearly presented.
- **Discussion:** Implications if the hypothesis is supported clearly stated; implications if the hypothesis is not supported clearly stated; limitations of your study discussed; future research addressed
- **Questions:** Demonstrated knowledge of the material; poised and confident, but no bluffing; answered the question(s) asked (asked for clarification or restatement of the question)

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1	An active and engaged participant by analyzing, constructing/creating, and evaluating information presented in technical and/or scientific journals	**Apply**
CO2	Examine best practices and implement them for designing, developing and presenting a quality scientific presentation using ICT tools	**Analyze**
CO3	Practice critical evaluation of other students' work	**Evaluate**

19UAG308	AGRICULTURAL METEOROLOGY AND CROP HUSBANDRY LABORATORY	L	T	P	C
		3	0	0	1.5

OBJECTIVES

- The students will know the basic concepts of agricultural meteorology and recording various weather elements in observatory.
- The students will understand about solar radiation, temperature and relative humidity on crop production.
- To introduce the different crop production practices in wet land, dry land and garden land through hands on experience and demonstration.

LIST OF EXPERIMENTS

CYCLE-I

1.Site selection and layout for agromet observatory

2.Measurement of sunshine hours(sunshine recorder)

3.Measurement of rainfall -ordinary and self recording rain gauge

4.Measurement of wind speed and wind direction

5.To study the automatic weather station

6. Measurement of evaporation –open pan evaporimeter

CYCLE-II

7. Selection of Seeds and Seed bed and nursery preparation.

8. Working out of seed rate for different crops.

9. Practicing different methods of sowing and planting.

10. Work out the fertilizer requirement for different crops.

11. Irrigation methods for different crops.

12.Assessing maturity indices for harvesting of horticultural crops

TOTAL 30 PERIODS

OURSE OUTCOMES

After successful completion of this course the students will be able to,

- To know the basic concepts of agricultural meteorology and recording various weather elements in observatory.
- Work out the fertilizer requirement and water requirement for different crops.
- Calculate the optimum seed rate and water requirement for selected crops.
- Manage the weeds and pests for selected crop.
- Identify the crop maturity and harvesting technique.

LIST OF EQUIPMENT REQUIRED		
Sl.No	**Name of the Equipment**	**QUANTITY REQUIRED**
1.	A wet land / garden land	5/Cents/group of students
2.	Open/bore well	1
3.	Spade	15 Nos
4.	Hand hoe	15 Nos
5.	Tractor	1No
6.	Seed drill	1 No
7.	Mould board plough	1 No
8.	Cultivator	1 No
9.	Sprayer	1 No

19UAG309	FLUID MECHANICS LABORATORY	L	T	P	C
		0	0	3	1.5

Objectives

- To provide fundamental knowledge on properties of fluid flow and flow measuring devices
- To familiarize the determination of major and minor losses in pipes
- To get exposed to basic concept of stability of floating bodies
- To acquire knowledge on finding the efficiency of various types of pumps

LIST OF EXPERIMENTS

1.FLOW MEASUREMENT

1. Calibration of Rotometer
2. Flow through Venturimeter
3. Flow through circular Orifice
4. Determination of mean velocity of Pitot tube
5. Verification of Bernoulli's Theorem
6. Flow through a Triangular Notch
7. Flow through a Rectangular Notch

II.LOSSES IN PIPES

8. Determination of friction coefficient in pipes
9. Determination of losses due to bends, fittings and elbows

III.PUMPS

10. Characteristics of Centrifugal pump
11. Characteristics of Submersible pump
12. Characteristics of Reciprocating pump
13. Characteristics of Jet pump

TOTAL: 30 PERIODS

Course Outcomes

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

CO1	Apply the concept of fluid Mechanics to measure the various fluid static and Dynamic Parameters	**Apply**
CO2	Categorize the performance of flow measuring devices under varying flow conditions	**Analysis**
CO3	Demonstrate the concept of Stability of floating bodies	**Analysis**
CO4	Evaluate the performance characteristics of Pumps	**Evaluate**

LIST OF EQUIPMENT REQUIRED

S.No	Name of the Equipment	Quantity
1.	Rotometer	1Nos
2.	Venturimeter	1Nos
3.	Orifice meter	1Nos
4.	Triangular Notch	1Nos
5.	Rectangular Notch	1Nos
6.	Coefficient of friction apparatus	1Nos
7.	Pipe setup with bends, fittings and elbows for estimating losses	1Nos
8.	Centrifugal, Reciprocating,Submersible,Jet pump	1Nos
9.	Collecting tank, stop watch-1 no for each experiment	

		L	T	P	C
19UGM332	**BIOLOGY FOR ENGINEERING APPLICATIONS (Common to Agri, Civil, Chem, ECE, EEE & IT)**	2	0	0	P/F

OBJECTIVES:

- To provide a basic understanding of biological mechanisms of living organisms and the human biology from the perspective of engineers.
- To encourage engineering students to think about solving biological problems with engineering principles and tools.

Module – 1 INTRODUCTION AND CLASSIFICATION 5

Introduction to Biology – Comparison of Biology and Engineering – Eye and Camera – Bird flying and Aircraft – Brownian motion and Thermodynamics – Classification – Unicellular or multicellular – Unicellular: Bacteria, Protozoa, Yeast – Multi Cellular: Animals, Humans, Plants, fungi etc. – Ultra structure: prokaryotes or eukaryotes – Habitat: aquatic or terrestrial.

Module – 2 DIGESTIVE & RESPIRATORY SYSTEMS – ENZYME 6

Study of digestive – Respiratory systems and their functions –.Enzyme – Classification of Enzyme – Mechanism of Enzyme activity – Enzymes for Industrial Applications: Waste management – Food processing industry – Beverages – Pharmaceutical – Paper Industry etc.

Module – 3 GENETICS AND BIO MOLECULES (Basics only) 7

Basics of Genes – DNA structure – Genes and hereditary – Genetic Code – Coding and decoding Genetic information – Gene Mapping – Gene Interactions – Mutations – Genetic disorders – Gene therapy – Biomolecules: Carbohydrates, lipids, nucleic acids, proteins. Biological Applications in Engineering: Genetic Algorithm – Computer Application in Genetic Engineering – Genetic Programming – Genetic Computers.

Module – 4 NERVOUS SYSTEM AND CELL SIGNALING 7

Central Nervous System: Brain and Spinal Cord – Peripheral Nervous System – Sensory Division – Motor Division – Neurons – sensory, motor, and interneurons – Signals –Transfer of Information – Bio Signals – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Electrooculography (EOG) – X-ray – CT Scan – MRI scan – Biological Applications in Engineering – Neurons and Neural Network.

Module – 5 BIOLOGY AND ITS INDUSTRIAL APPLICATION 5

Bioreactors – Biopharming – Recombinant vaccines – Cloning – Drug discovery –Bioremediation – Biofertilizer – Biocontrol – Biofilters – Biosensors – Biopolymers – Bioenergy – Biomaterials – Biochips.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1	Explain the fundamentals of living things, their classification, cell structure and biochemical constituents.	Understand
CO2	Apply the concept of plant, animal and microbial systems and growth in real life situations	Apply
CO3	Analyze biological engineering principles and procedures needed to solve societal issues.	Analysis

TEXT BOOKS

1. R.C.Dubey, “A Text book of Biotechnology”, S. Chand Higher Academic Publications, 2013.
2. R. Khandpur, “Biomedical instrumentation - Technology and applications”, McGraw Hill Professional, 2004.

REFERENCE BOOKS

1. Arthur T. Johnson, “Biology for Engineers”, CRC Press, Taylor and Francis, 2nd Edition, 2019.
2. Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, “Cell Biology and Genetics (Biology: The unity and diversity of life Volume I)”, Cengage Learning, 12th Edition, 2008.
3. Gerard J. Tortora and Bryan H.Derrickson, “Principles of Anatomy and Physiology”,15thEdition,Wiley publications, 2016.

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19UMA425	Probability, Statistics and Numerical Methods	3	1	0	4
2.	19UAG402	Tractor and Other Power Units	3	0	0	3
3.	19UAG403	Soil and Water Conservation Engineering	3	0	0	2
4.	19UAG404	Refrigeration and Air Conditioning for Agriculture Engineering	3	0	0	3
5.	19UAG405	Surveying and Levelling	3	0	0	3
6.	19UIT427	Object Oriented Programing in Python	3	0	0	3
7.	19UGS431	Reasoning and Quantitative Aptitude	2	0	0	1
8.	19UGM431	Gender Equality	1	0	0	P/F
PRACTICAL						
9.	19UAG407	Surveying and Leveling Laboratory	0	0	3	1.5
10.	19UAG408	Tractor and Farm Engine Laboratory	0	0	3	1.5
11.	19UIT428	Object oriented Programing Laboratory	0	0	3	1.5
TOTAL			**17**	**1**	**9**	**23.5**
TOTAL NO. OF CREDITS – 23.5						

15UMA425	PROBABILITY, STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	2	0	4

OBJECTIVES

- To make the student acquire sound knowledge of fundamentals and applications of statistics which will greatly help at the data analysis stage of comparative experiments.
- To familiarize the student with the applications of numerical methods in various fields, solving practical, technical problems occurring in Mechanical Engineering using scientific and mathematical tools

UNIT I PROBABILITY THEORY & DISTRIBUTIONS 9+6

Axioms of probability - Conditional probability - Total probability - Baye‟s theorem – Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Normal, Geometric, Uniform, Exponential and Gamma distributions.

UNIT II TESTING OF HYPOTHESIS 9+6

Sampling distributions - Normal, t, Chi-square and F distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

UNIT III DESIGN OF EXPERIMENTS 9+6

Completely Randomized Design(CRD) – Randomized Block Design(RBD) – Latin square design.

UNIT IV INTERPOLATION AND APPROXIMATION 9+6

Lagrangian Polynomials – Newton‟s divided difference interpolation – Newton‟s forward and backward difference interpolation – Interpolating with a cubic spline

UNIT V NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+6

Derivatives from difference tables – Divided differences and finite differences – Numerical integration by Trapezoidal and Simpson‟s 1/3 and 3/8 rules – Romberg‟s method – Two point and Three point Gaussian quadrature formulae – Double Integrals using Trapezoidal and Simpson‟s rules.

SUPPLEMENT TOPIC (for internal evaluation only)

Applications in real time problems

TOTAL : 75 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Apply the acquired knowledge of standard distributions in real life phenomena**.**
- Conduct and interpret hypothesis tests for a single population proportion.
- Design and analyze a process, to evaluate which process inputs have a significant impact on the process output using design of experiments.
- Use Interpolation technique for equal and unequal intervals to find new data points within the range of known data points.
- Find numerical integration for single and double integrals

TEXT BOOK

1. JOHNSON R.A. and GUPTA C.B., “Miller and Freund‟s Probability and Statistics for Engineers”, Pearson Education, New Delhi, 8th edition, (2011).
2. GREWAL, B.S. and GREWAL, J.S., “Numerical methods in Engineering and Science”, Khanna Publishers, New Delhi, 9th Edition, (2009).

REFERENCE BOOKS

1. WALPOLE. R.E., MYERS .R.H., MYERS S.L., and YE. K, “Probability and Statistics for Engineers and Scientists”, Pearson Education, New Delhi, 8th edition, (2007).
2. SPIEGEL M.R., SCHILLER J. and SRINIVASAN R.A., “Schaum‟s Outlines Probability and Statistics”, Tata McGraw Hill, New Delhi, (2004).
3. CHAPRA, S. C and CANALE, R. P., “Numerical Methods for Engineers”, Tata McGraw-Hill, New Delhi, 5th Edition, (2007).
4. GERALD, C. F. and WHEATLEY, P. O., “Applied Numerical Analysis”, Pearson Education, New Delhi, 6th Edition, (2006).

19UAG402	TRACTOR AND OTHER POWER UNITS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students to the different systems and working principles of tractor, power tiller, makes of tractors and power tillers.
- To acquire an in-depth knowledge on farm tractors and engine systems
- To develop skills on safe and efficient use of tractors

UNIT I TRACTORS **9**

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. Powertiller, Cost estimation and selection of tractor.

UNIT II ENGINE SYSTEMS **9**

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**

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

UNIT IV HYDRAULIC SYSTEMS **9**

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

UNIT V TRACTOR TESTING **9**

Types of tests- test procedure - need for testing evaluation of farm tractor -Test code for performance testing of tractors and power tillers. optimization of tractor field efficiency to save energy/fuel - alternative fuels for IC engines

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Classify tractors and engine construction features
- Understand the working principle of engine system
- Understand the working principle of transmission system
- Understand the working principle of hydraulic system.

TEXT BOOKS

- Jain, S.C. and C.R. Rai. Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 1999.
- Kirpal Singh, “Automobile Engineering Vol 1 &2”, Standard Publishers, VII Edition, New Delhi, 1997.
- Jain .K.K, Asthana .R.B, “Automobile Engineering”, Tata McGraw Hill Publishers, New Delhi 2002.

REFERENCE BOOKS

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.
2. Domkundwar A.V. A course in internal combustion engines. Dhanpat Rai & Co. (P) Ltd., Educational and Technical Publishers, Delhi,1999.
3. Jagadeeshwar Sahay, Elements of Agricultural Engineering, Standard Publishers Co., New Delhi,2010.

19UAG403	SOIL AND WATER CONSERVATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

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

UNIT I SOIL EROSION PRINCIPLES **9**

Introduction – Soil erosion – Types - Agents - Causes - Mechanics of soil erosion –factor affecting the soil erosion- Water erosion - Mechanics of Water Erosion – Types -Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion, Stream bank erosion - Factor affecting water erosion – Stages of gully erosion - Classification of Gully – Temporary Gully control structures – - Woven Wire Dams - Brush Dams - Loose Rock Dam- Permanent gully control structures - Drop Spillway, Drop Inlet, Chute Spillways.

UNIT II ESTIMATION OF SOIL EROSION **9**

Runoff – Components - Factor affecting the runoff - computation for soil conservation: SCS-CN method – Evolution of Universal Soil Loss Equation: Applications and Limitations - Problems – Modified Universal Soil Loss Equation – Revised Universal Soil Loss Equation-2 - Land use capability classification - Classification of eroded soils.

UNIT III EROSION CONTROL MEASURES **9**

Agronomical measures of water erosion control - Contour Cropping - Strip cropping – Mulching - Mechanical measures for water erosion control - Bunding - Types – Contour bund and Graded bund- Design Specification of Bunds - Mechanical measures for hill slopes – bench Terracing – Types – Maintenance – Grassed waterways: Purpose, construction and maintenance

UNIT IV WATER CONSERVATION MEASURES **9**

In-situ soil moisture conservation – Water harvesting Principles and Technique – Importance – Types: Rain/Runoff water harvesting – Flood water harvesting and Ground water Harvesting – Farm ponds: Components, Design, Construction and Protection – Check dams - Earthen dam – Retaining wall.

UNIT V SEDIMENTATION **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Gain fundamental knowledge on the concepts of erosion and sedimentation.
- Estimate the soil erosion by different methods
- To understand the erosion control measures
- Acknowledge the importance of soil and water conservation measures.
- Estimate sedimentation in reservoir and tanks.

TEXT BOOKS

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

19UAG404	FUNDAMENTALS OF THERMODYNAMICS FOR AGRICULTURE ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES

- To impart the basic thermodynamic principles and developing the skills to perform the analysis of thermodynamic system.
- To explain the general thermodynamic relations and thermodynamic properties.
- To familiarize the usage of steam tables, Mollier Chart and psychrometric chart

UNIT I BASIC CONCEPT AND FIRST LAW 12

Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics - concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics - application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II SECOND LAW 12

Second law of thermodynamics - Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 12

Properties of pure substances - Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes. properties table, Mollier chart, Standard Rankine cycle.

UNIT IV IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS 12

Gas mixtures - properties ideal and real gases, Avogadro's Law, Vander Waal's equation of state, general thermodynamic relations - Dalton's law of partial pressure, exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule -Thomson coefficient.

UNIT V PSYCHROMETRY 12

Psychrometry and psychrometric charts, Properties of atmospheric air, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling.

TOTAL : 60 PERIODS

NOTE: Use of Steam Table, Mollier Chart, Psychrometric Chart are permitted in the End Semester Examination.

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Explain the different thermodynamics laws and basic concepts.
2. Solve the problems based on Carnot cycle.
3. Use Mollier chart and steam tables for solving Rankine cycle problems.
4. Illustrate the various thermodynamic relations.
5. Discuss the properties of air and Psychometric process.

TEXT BOOKS

1. Nag.P.K, “Engineering Thermodynamics”, Tata McGraw-Hill, Third reprint, New Delhi, 2008.
2. Natarajan. E, “Engineering Thermodynamics”, Anuragam Publications, First Edition, 2012.

REFERENCE BOOKS

1. Rajput.R.K , “Engineering Thermodynamics”, Laxmi Publication, Fourth edition, New Delhi, 2010.
2. Holman.J.P, “Thermodynamics”, McGraw-Hill, Third Edition, 1995.
3. Venwylen, Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987.
4. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.

19UAG405	SURVEYING AND LEVELLING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the principle of surveying, various methods and applications to Agricultural Irrigation Engineering projects.

UNIT I FUNDAMENTALS AND CHAIN SURVEYING **9**

Definition- Classifications - Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging - well conditioned triangles – Errors in linear measurement and their corrections - Obstacles - Traversing – Plotting – applications- enlarging and reducing figures-Areas enclosed by straight lines - Irregular figures- digital Plan meter

UNIT II COMPASS AND PLANE TABLE SURVEYING **9**

Compass – Basic principles - Types - Bearing – Systems and conversions – Sources of Errors – Local attraction - Magnetic declination-Dip-Traversing – Plotting – Adjustment of Closing error – applications - Plane table and its accessories - Merits and demerits Radiation - Intersection - Resection –Two-point problem - three - point problem -- advantages and disadvantages - errors in plane tabling.

UNIT III LEVELLING **9**

Level line - Horizontal line - Datum - Bench marks -Levels and staves - temporary and permanent adjustments – Methods of leveling - Fly levelling - Check levelling - Procedure in levelling - Booking -Reduction - Curvature and refraction - Reciprocal levelling - sources of errors in leveling-Precise levelling - Types of instruments - Adjustments - Field procedure

UNIT IV LEVELLING APPLICATIONS **9**

Longitudinal and Cross-section-Plotting - Contouring - Methods – Characteristics and uses of contours- Plotting – Methods of interpolating contours – computation of cross sectional area and volumes - Earthwork calculations - Capacity of reservoirs - Mass haul diagrams

UNIT V THEODOLITE AND MODERN SURVEYING **9**

Theodolite - Types - Description - Horizontal and vertical angles - Temporary and Permanent adjustments – Heights and distances– Tangential and Stadia Tacheometry – Subtense methods - Stadia constants - Anallactic lens - Traversing - Gales table - Total Station- Global Positioning System (GPS).

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Possess the knowledge on the importance of chain surveying and its application in agriculture
- Apply and understand the principle of compass and plane table surveying
- Know the test procedure of leveling and different instruments used for leveling and its working principle
- Understand the leveling application
- Understand the different theodolite concepts and deep knowledge on modern surveying methods.

TEXT BOOKS

1. Kanetkar T.P., “Surveying and Levelling”, Vols. I and II, Standard Publishers, New Delhi 2008.
2. Punmia .B.C,”Surveying,” Vols. I and II, Laxmi Publications,2006.

REFERENCE BOOKS

1. Basak. V.N, 1994, “Surveying and Levelling”, Tata McGraw hill publications, New Delhi.

19UIT427	OBJECT ORIENTED PROGRAMMING IN PYTHON	L	T	P	C
		3	0	0	3

OBJECTIVES

- To acquire programming skills in core python
- To learn about the usage of python shell for running programs
- To understand the different data types available in python.
- To acquire object oriented skills in python
- To understand the creation and usage of various modules and packages.

UNIT I FUNDAMENTALS OF PYTHON PROGRAMMING **9**

Introduction – Data types – variables –Basic I/O operations – Decision Making – Loops – Modules and packages – Organizing modules –Third party libraries – Case study.

UNIT II PYTHON DATA STRUCTURES **9**

Python Data structures – Tuples and named tuples – Dictionaries – counters – Lists – Sorting lists – Sets – Extending built-ins – Queues – FIFO Queue – LIFO Queue – priority queue – Case study.

UNIT III OBJECT ORIENTED PROGRAMMING METHODOLOGIES **9**

Object oriented programming – creating python classes – Initializing objects –– Python object recognition – Data and behavior – Wrapping data in behavior using properties – Objects and classes - Abstraction – overview of inheritance and its types – Case study.

UNIT IV INHERITANCE AND POLYMORPHISM **9**

Python built-in functions – Default arguments – variable arguments – Lists – unpacking arguments – Basic inheritance – Extending built-ins – Overriding and super – Multiple inheritance – polymorphism – Abstract base classes – case study.

UNIT V PYTHON STRINGS AND EXCEPTION HANDLING **9**

Strings – String manipulation – String formatting – Escaping braces – Keyword arguments – Container lookups - object lookups – Exception handling – Raising exception – Effects of exception – Handling the exception - Exception hierarchy – Creating our own exceptions – case study.

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Infer the principles of object-oriented problem solving and programming and Outline the essential features and elements of the C++ programming language. **(Remember/Understand)**
- Apply the concepts of class, method, constructor, instance, data abstraction, function abstraction, inheritance, overriding, overloading, and polymorphism. **(Apply)**
- Analyze problems and implement simple python applications using an object-oriented software engineering approach.**(Analysis)**
- Design user interface using Tkinter and turtle graphics for application development.**(Design)**
- Use modern tools for the creation of various application software using python modules.**(Modern Tool Usage)**
- Function effectively as a member or leader in a team by participating in the development of software Project using oops concepts in python. **(Individual and team member)**

TEXT BOOKS

1. Python 3 Object Oriented Programming - Second Edition by Dusty Phillips

REFERENCE BOOKS

1. Python crash course – 2nd Edition, “A hands-on project based introduction to programming” by Eric matthes.
2. Learning Python – 5th Edition by mark lutz – O’Reilly media
3. Introduction to python, Kenneth A. Lambert, Cengage.

15UGS431	REASONING AND QUANTITATIVE APTITUDE (Common to ALL Branches)	L	T	P	C
		1	0	0	1

OBJECTIVES

- To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude.
- To familiarize the student with various principles involved in solving mathematical problems.
- To develop an understanding of the basic concepts of reasoning skills.

UNIT I QUANTITATIVE APTITUDE 8

Ratio and Proportion - Averages – Percentages – Problems on ages – Profit and Loss – Simple and Compound Interest -– Time – Speed –Distance - Time and Work – Permutation and Combination - Alligation or Mixture – Probability – Clocks – Calendars.

UNIT II VERBAL AND NON VERBAL REASONING 7

Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out – Venn Diagrams - Data Sufficiency – Data interpretation –– Syllogism - Coding – Decoding.

TOTAL : 15 PERIODS

COURSE OUTCOMES

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

- Select an appropriate technique to solve the quantitative problems within the stipulated time. **(Apply)**
- Apply Verbal and Non Verbal Reasoning skills to solve the problems based on the logical and analytical reasoning. **(Apply)**
- Analyse the direction to solve equations involving one are more unknowns. **(Analyse)**

WEBSITES:

www.m4maths.com, www.indiabix.com, www.fresherworld.com, www.campusgate.co.in, www.indianstudyhub.in, www.tcyonline.com.

TEXT BOOKS:

1. Dr. R.S.AGARWAL, “Quantitative Aptitude”, S. Chand Publications, New Delhi, 20th Edition, (2013).
2. ABIJIT GUHA, “Quantitative Aptitude for Competitive Examinations”, Tata McGraw Hill Publication, New Delhi, 4th Edition, (2011).
3. R.V.Praveen, “Quantitative Aptitude and Reasoning”, PHI Learning Pvt. Ltd., Delhi, 2nd Edition, (2013).

REFERENCES

1. ASHISH AGGARWAL, “Quick Arithmetic”, S. Chand Publications, New Delhi, 6th Revised Edition, (2014).
2. Dr.V.A.SATHGURUNATH’S “A Guide for Campus Recruitment”, Sagarikka Publications, Thiruchirapalli, 3rd Edition, (2011).

19UAG407	SURVEYING AND LEVELLING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To train the student to acquire skill in operation various surveying and leveling instruments

LIST OF EXPERIMENTS

I CHAIN SURVEYING

1. Ranging, Chaining and Pacing
2. Chain traversing

II COMPASS SURVEYING

3. Triangulation Problem
4. Compass traversing

III PLANE TABLE SURVEYING

5. Radiation
6. Intersection – Two point problem
7. Triangulation problem – Bessel's Method

IV THEODOLITE SURVEYING

8. Measurement of horizontal & vertical angles
9. Tangential & Stadia Tacheometry

V LEVELLING

10. Fly levelling using Dumpy level
11. Fly levelling using Tilting level
12. Check levelling

VI DEMONSTRATION OF TOTAL STATION AND GPS

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

- Calculate the area based on the principle of chain surveying.
- Calculate the area based on the principle of compass surveying.
- Calculate the area based on the principle of plane table surveying.
- Calculate the area based on the principle of theodolite surveying.
- Work out the problems based on the principle of leveling

LIST OF EQUIPMENT REQUIRED

Sl.No	Name of the Equipment	QUANTITY REQUIRED
1.	Chain link	10
2.	Compass	10
3.	Theodolite	10
4.	Dumpy Level	10
5.	Plane Table	10
6.	Ranging rods	10
7.	Leveling Staff	10
8.	Measuring tape – 30 m	10
9.	Other accessories required for	10

19UAG408	TRACTOR AND FARM ENGINE LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To make the student knowledgeable in dismantling and assembling of different systems of **tractor**

LIST OF EXPERIMENTS

1. Introduction and selection of farm tractors
2. Hand tools used in garage
3. Dismantling of Engine from Tractor
4. Piston and cylinder and cranking system - Disassembling and assembling cylinder head and valves
5. Fuel System dismantling and assembly
6. Lubricating and Cooling System - Dismantling & Reassembly
7. Dismantling and assembling of a tractor clutch system
8. Front Axle, Gears – Dismantling and Assembling
9. Tractor Rear Axle, Gears - Disassembling & Assembling
10. Brake Linkages, Operation, Assembly and Disassembly of Axle
11. Tractor Power Steering - Disassembling and Assembling
12. Determination of Centre of Gravity of Tractors

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

- Gain Knowledge in dismantling and assembly of IC engine of a farm tractor
- Understand the concept of tractor actuation system
- Gain Knowledge in dismantling and assembly of different systems of a farm tractor
- Assembling and dismantling of the fuel and cooling systems of a farm tractor
- Selection of tractors for area specific cultivation

LIST OF EQUIPMENT REQUIRED

Sl.No	Name of the Equipment	Quantity
1.	Tractor	**1 Nos**

19UAG408	OBJECT ORIENTED PROGRAMMING IN PYTHON LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To interpret the use of procedural statements like assignments, conditional statements, loops and function calls.
- To infer the supported data structures like lists, dictionaries and tuples in Python.
- To understand the need for Object-oriented programming concepts in Python.

LIST OF EXPERIMENTS

1. Develop a program to implement basic I/O operations in python.
2. Develop a program to demonstrate decision making and loops in python.
3. Develop a python program to demonstrate lists, tuples and dictionary
4. Develop a python program to demonstrate sets and queues.
5. Develop a python program to demonstrate object initialization.
6. Develop a python program to demonstrate wrapper behavior using properties.
7. Develop a python program to implement single and multiple inheritance.
8. Develop a python program to implement single and multiple polymorphism and abstract classes.
9. Develop a python program to implement string handling and string formatting.
10. Develop a python program to implement Exception handling.

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

- Describe the Python language syntax including control statements, loops and functions to write programs for a wide variety problem in mathematics, science, and games**.(R/U)**
- Implement the concepts of Object-oriented programming as used in Python using encapsulation, polymorphism and inheritance**.(APPLY)**
- Examine the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data**.(ANALYSIS)**
- Design user interface using various inbuilt-modules and packages in python **(Design)**
- Select and apply appropriate tools to implement the advanced concepts of python programming **(Modern Tool Usage)**
- Function effectively as a member or leader in a team by participating in the development of software Project using oops concepts in python. **(Individual and team member)**

HARDWARE REQUIRED

1. Personal Computers – 30 Nos.

SOFTWARE REQUIREMENT

- Python 3.0 and above, Windows/Linux OS, IDEs – Pycharm (optional)

19UAG501	IRRIGATION AND DRAINAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the necessity of planning an irrigation system to provide water at the right time and right place.
- To understand the basic concepts for planning, design and Management
- To understand the design and management of land drainage works in cultivated areas
- Study about water conservation structures.
- To understand to the Design and Management of canal Irrigation

UNIT I WATER RESOURCES AND IRRIGATION REQUIREMENT 9

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

UNIT II METHODS OF IRRIGATION 9

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

UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9

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

UNIT IV CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT 9

Classification of canals- Alignment of canals – Design of irrigation canals– Regime theories - Canal Head works – Canal regulators - Canal drops – Cross drainage works – Canal Outlet-Escapes –Lining and maintenance of canals - Excess irrigation and waterlogging problem - Command area - Concept, Components of CADP - On Farm Development works, Farmer‟ s committee - its role for water distribution and system operation - rotational irrigation system.

UNIT V AGRICULTURAL DRAINAGE 9

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

TOTAL PERIODS : 45

TEXTBOOK

1. Dilip Kumar Majumdar., “Irrigation Water Management”, Prentice-Hall of India, New Delhi,2008

REFERENCE BOOK

1. Basak, N.N., “Irrigation Engineering”, Tata McGraw-Hill Publishing Co, New Delhi, 2008
2. Murthy, V.V.N. Land and water management, Kalyani publishing, New Delhi, 1998.
3. Garg, S.K., “Irrigation Engineering,” Laxmi Publications, New Delhi, 2008.

COURSE OUTCOMES At the end of the course student will be able to		
CO1	The students will have knowledge and skills on Planning, design, operation and management of reservoir system	**Remember/Understand**
CO2	The student will gain knowledge on different methods of irrigation including canal irrigation.	**Apply**
CO3	Analysis Irrigation efficiency in canal Irrigation.	**Analysis**
CO4	Design and Management of water conservation structures.	**Design**
CO5	Measurement of water flow in dam and canal	**Modern Tool Usage**
CO6	Planning an irrigation system to provide water at the right time and right place.	**Individual and team member**

19UAG502	AGRICULTURALFARMMACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To familiarize the students with different machinery used for tillage, sowing, planting, inter-cultivation and plant protection operations of agricultural crop production.
- It also enables to understand the basics of designing and maintaining the machines used for these operations.`

UNIT I FARM MECHANIZATION AND TILLAGE EQUIPMENTS 9

Introduction to farm power- Different sources. Farm mechanization-Objectives-benefits and different operation. Tillage –objectives–Classification– Primary tillage implements and Secondary tillage implements – types- animal drawn Ploughing methods. Types of farm implements – trailed and mounted. Field capacities and cost economics- Problems.

UNIT I SOWING AND PLANTING EQUIPMENT 9

Seeding methods, Seed drill - Components, Calibration, Seed metering mechanisms, Test for seed uniformity. Furrow openers – types. Planters – Potato planter, Sugarcane planter, Zero till drill, Strip till drill, Rice and Vegetable transplanters - Problems

UNIT III PLANT PROTECTION EQUIPMENT 9

Weeding and Intercultural equipment – types. Sprayers' Basic components, Types and working principle, Spray characteristics - determination of particle size and distribution - factors affecting drift, Care and maintenance-Problems. Fertilizer application equipment - Variable rate application of fertilizers and chemicals. Dusters - types - mist blower cum duster - other plant protection devices, care and maintenance.

UNIT IV THRESHING AND HARVESTING EQUIPMENTS 9

Threshing mechanics –Working principles - types of threshers. - straw combines and grain combines. Principles and types of cutting mechanisms, Construction and adjustments of shear and impact type cutting mechanisms, Crop harvesting machinery-mowers, Windrowers, Reapers, reaper binders and forage harvesters, Bailers, Forage chopping and handling equipment.

UNIT V TESTING AND ERGONOMICS 9

Testing of farm machine, Test codes and procedure, Interpretation of test results, Selection and management of farm machines for optimum performance. Ergonomics-Introduction, Role of ergonomics in agriculture

TOTAL PERIODS : 45

TEXTBOOK

1. Jagdishwar Sahay. 2006. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.
2. R.A. Kepner, Bainer Roy, and E. C. Barges, “Principles of Farm Machinery”, 2nd edition, CBS Publishers and Distributors, Delhi, 2005.

REFERENCE BOOK

1. H. P. Smith, “Farm Machinery and Equipment”, 6th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
2. M. L. Mehta, S. R. Verma, S. K. Misra, and V. K. Sharma, “Testing and Evaluation of Agricultural Machinery”, 2nd edition, Daya Publishing House, New Delhi, 2005.

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the working principles of tillage implements and usage of harvesting, threshing and plant protection equipment	**Remember/Understand**
CO2	Apply ergonomic principles for different agricultural tools and equipment design	**Apply**
CO3	Analyze the importance of testing and evaluation of agricultural machines and different standard codes available for testing in India.	**Analysis**
CO4	Design the different cost effective agricultural tools with available inputs.	**Design**
CO5	Abreast the students with mathematical, experimental and computational skills for solving different field problems with modern tool	**Modern Tool Usage**
CO6	Work individual or as team for transforming available technology to farming society	**Individual and team member**

19UAG503	MICRO IRRIGATION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students to the fundamental knowledge in Pumps for Irrigation use.
- Application of micro-irrigation in different land situations to introduce the concept of micro-irrigation and design a Sprinkler & Drip irrigation system.
- Design, planning and layout of the micro-irrigation systems for efficient/optimum management of water.
- Design and installation of sprinkler irrigation system
- Application of micro-irrigation in different land situations.

UNIT I WATER LIFTS AND PUMPS **9**

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

Unit II PUMP VALVES **9**

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 **9**

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

UNIT **IV DRIP IRRIGATION DESIGN** **9**

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

Unit V SPRINKLER IRRIGATION DESIGN **9**

Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance- Sprinkler dischargeWater distribution pattern

TOTAL PERIODS : 45

TEXTBOOK

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 BOOK

1. Modi, P.N., and Seth, S.M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 1991.
2. Jack Keller and Rond Belisher., “Sprinkler and Trickle Irrigation”, Vannistrand Reinhold, New York, 1990.
3. Sivanappan R.K., “Sprinkler Irrigation”, Oxford and IBH Publishing Co., New Delhi, 1987.
4. Keller.J and D. Karmeli, “Trickle Irrigation Design”, Rainbird Sprinkler Irrigation Manufacturing Corporation, Glendora, California, USA.

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the working principles and characteristics of different pumps and valve of different irrigation system	Remember/Understand
CO2	Apply their knowledge on measurement of water flow quantities In horticulture for increasing yields through water use efficiencies	Apply
CO3	Analysis the Irrigation efficiency based on soil condition for varies crops	Analysis
CO4	Design the different components of micro irrigation systems and lay out for efficient water, fertilizer and pesticides application	Design
CO5	Create and development of new irrigation techniques for various crops in agriculture and horticulture	Create
CO6	Evaluate and optimize of irrigation efficiency using various irrigation methods.	Individual and team member

19UEC507 **CREATIVE THINKING AND INNOVATION**

L	T	P	C
0	0	2	1

PREAMBLE

Creativity is vital in nearly every industry and occupation. Creativity and innovation are key to generation of new ideas and methods of improving goods and services for customer satisfaction. This course enhances the creative thinking and innovation skills of the students. Being creative helps one to be a better problem solver in all areas of life and work.

COURSE OBJECTIVES

- To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- To transform innovative ideas into successful businesses
- To use a range of creative thinking tools to develop Out of the Box Ideas

Course Content

Introduction to Creativity and Innovation- Creative Techniques - Problem Identification through Brain Storming - Solution Identification through Creative Techniques - Presentation on the Innovative Idea - Market Analysis - Revenue and Business Model - Preparation of promotional aids - Customer Feedback Analysis.

List of Activities

Duration	What does the Faculty do?	What do the students do?
Week 1	Explains creativity and innovation	Team Formation (Team Size: 3)
Week 2	Explains the Creative Techniques (Through Video / Presentation)	Discovering Consumer Need through Need Analysis (Customer Segment)
Week 3	Facilitates the brain storming	Problem Identification through brain storming
Week 4	Facilitates problem solving	Identify the solution for the chosen problem through creative techniques
Week 5	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 6	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 7	Explains about the Market Research / Competitor Analysis, Revenue Model and Business Model	Market Analysis after the explanation
Week 8	Facilitates the students work	Preparation of Innovation Development Plan, Business Development Plan and Financial Plan
Week 9	Facilitates the students work	Preparing product promotional material
Week 10	Facilitates the students work	Improvement through Feedback

Total Hours: 30 Periods

Assessment Pattern

1. Internal Assessment: Presentation on the Innovative Idea
2. End Semester Assessment:
    - Submission of Business Plan
    - Presentation on My Startup Idea (Evaluator : From Industry)

Course Outcomes

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

1. Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice **(Valuing – Affective Domain)**
2. Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development **(Organization – Affective Domain)**
3. Adapt themselves to work in a group as a member or a leader for efficiently executing the given task **(Organization – Affective Domain)**

19UAG508	IRRIGATION AND DRAINAGE LABORATORY	L	T	P	C
		3	0	0	1.5

COURSE OBJECTIVES

- To develop competency to design water conveyance systems and different irrigation systems in the field.
- To design appropriate techniques for effective irrigation systems.
- Understand the usefulness and design consideration under steady and non-steady state drainage
- To design appropriate techniques for effective drainage systems.

LIST OF EXPERIMENTS

1. To study various instruments in the Meteorological Laboratory.
2. Determination of infiltration rate using double ring and digital infiltrometer.
3. Determination of soil moisture wetting pattern for irrigation scheduling
4. Design of Drip irrigation system.
5. Design of Sprinkler irrigation system
6. Measurement of flow properties in open irrigated channels (flumes, notches)
7. Determination of uniformity coefficient for drip irrigation system
8. Design and Problems on Irrigation Drainage in agriculture field
9. To conduct experiment on disc filter for micro irrigation systems
10. Measurement of uniformity coefficient of sprinkler irrigation method.
11. Cost analysis of surface and sub-surface drainage system.
12. Design of surface drainage systems

TOTAL PERIODS : 30

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Understand the working principles of different irrigation system and varies drainage system	**Remember/Understand**
CO2	Apply their knowledge to identify the suitable irrigation system in water scarcity area	**Apply**
CO3	Analysis the irrigation technique to solve an identified agricultural drainage problem.	**Analysis**
CO4	Design and development of irrigation system for different agriculture and horticulture crops	**Design**

Sl.No	**LIST OF EQUIPMEN TS REQUIRED**	**QTY**
1.	Meteorological lab with Cup counter anemometer, Sunshine recorder, Open pan evaporimeter, Stevenson's screen - Dry bulb, wet bulb thermometers, recording and non-recording type rain gauge etc.	Each 1 No
2.	Double ring infiltrometer	1 No
3.	Digital infiltrometer	1 No
4.	Parshall flume, cut throat flume	1 No
5.	V notch, Rectangular notch and trapezoidal notch	1 No
6.	Drip irrigation system with all accessories	I SET
7.	Sprinkler irrigation system with all accessories	I SET
8.	Required number of stop watches	10 NOs
9.	Weighing balance	1No
10.	Catch cans, measuring jars	10 NOs

15UAG509	AGRICULTURAL FARM MACHINERY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To practice the different types farm machinery in the field on tillage, sowing, plant protection, harvesting and threshing.
- To know the adjustments of farm machines, dismantling and reassembling of a disc harrow, seed-cum fertilizer drill and sprayer, engine pumps.
- To recognize the working principle of various machines used in field.

LIST OF EXPERIMENTS

1. Determination of field capacity and field efficiency of primary tillage implements.
2. Field capacity and field efficiency of secondary tillage implements.
3. Draft and fuel consumption measurement for different implements.
4. Estimation of cost of operation of various implements.
5. Calibration of seed drill and problems.
6. Study of sprayers, dusters and measurement of nozzle discharge and field capacity.
7. Study of various types of potato harvesters, constructional details, materials and working.
8. Study of various types of groundnut harvesters, constructional details, materials and working & performance
10. Study of various types of groundnut harvesters, constructional details, materials and working & performance.
11. Study of combine harvester – Cutting and conveyance mechanisms – Calculations
12. Study of combine harvester – Threshing and cleaning mechanisms – Calculations
13. Study of various types of threshers, constructional details, materials and working & performance.

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

CO1	Understand the working principles performance of different farm equipment's	**Understanding/Remember**
CO2	Apply their knowledge to identify the suitable implements/tool to solve identified problems system in water scarcity area	**Apply**
CO3	Design and develop and modification of indigenous harvesting machines/methods as per the need of the area and farmers	**Design**
CO4	Evaluate the performance of efficiency to identify the suitable harvester for water lagging area	**Evaluate**

LIST OF EQUIPMENT REQUIRED		
Sl.No	**Name of the Equipment**	**QUANTITY REQUIRED**
1.	Tractor	1 No
2.	Mould board plough	1 No
3.	Disc Plough	1 No
4.	Seed drill	1 No
5.	Sub soiler	1 No
6.	Puddler and trampler	1 Each
7.	Paddy drum seeder	1 No
8.	bailer	1 Each
9.	Multi crop thresher	I Nos
10	Cultivator	1 Nos
11.	Different types of weeder	Each 1 Nos
12.	Different types of sprayers	Each 1 Nos

19UGS532	SOFT SKILLS LABORATORY	L	T	P	C
		3	0	0	1.5

COURSE OBJECTIVES

- To develop a requisite knowledge in Communication skills and Soft skills.
- To enhance the students' acumen in honing the skills to meet the Global changes and Industrial needs.

UNIT I SPEAKING SKILLS **9**

Conversational Skills - Self Introduction - Group Discussion - Public Speaking - Presentation Skills

UNIT I WRITING SKILLS **9**

Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation

UNIT III READING AND LISTENING SKILLS **9**

Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking

UNIT IV SOFTSKILLS **9**

Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution

UNIT V INTERVIEW SKILLS **9**

Types of Interviews – Body Language – Professional Grooming – Basic Etiquette

TOTAL PERIODS : 45

REFERENCE BOOK

1. Skills for Success, Listening and Speaking – Level 4 by Brooks and Margret – Oxford University Press, Oxford 2011 Edition.
2. Professional Communication by Raman, Meenakshi and Sangeetha Sharma – Oxford University Press, 2014 Edition.
3. Developing Soft Skills by Sherfield, Robert M, R J Montgomery and Patricia G Moody – PearsonEducation Publishers.

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Answer the queries precisely after carefully listening to the conversation orspeech	Affective domain - Responding
CO2	Communicate orally with fluency and clarity in each contextual situation	Affectivedomain - Responding
CO3	Debate with clarity of thought and expression to convey their ideas politely to others	Affective domain - Valuing
CO4	Apply correct usage of English grammar in writing, fluent speaking and comprehending.	Cognitive Domain - Apply

19UAG601	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To acquire knowledge about the fundamentals of groundwater occurrence and their Exploitation.
- To understand the well hydraulics so as to locate wells for the extraction of ground water.
- To choose appropriate pumps for a given well and their maintenance

UNIT I PRECIPITATION AND ABSTRACTIONS 10

Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods-Interception - Evaporation. Horton's equation, pan evaporation measurements and evaporation suppression - Infiltration-Horton's equation - double ring infiltrometer, infiltration indices.

UNIT II RUNOFF **9**

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical - Strange"s table and SCS methods – Stage discharge relationships-flow measurements- Hydrograph – Unit Hydrograph – IUH.

UNIT III FLOOD AND DROUGHT **8**

Natural Disasters-Flood Estimation- Frequency analysis- Flood control- Stream gauging - discharge rating curves, flood peak.Definitions of droughts-Meteorological, hydrological and agricultural droughts- IMD method-NDVI analysis- Drought Prone Area Programme (DPAP).

UNIT IV RESERVOIRS **8**

Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve.

UNIT V GROUNDWATER AND MANAGEMENT 10

Origin- Classification and types - properties of aquifers- governing equations – steady and unsteady flow - artificial recharge - RWH in rural and urban areas.

TOTAL PERIODS : 45

TEXT BOOKS

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

REFERENCE BOOKS

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

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the basic concept of precipitation, abstraction, runoff table, flood disasters, reservoirs and water management.	**Understand**
CO2	Examine the methods of precipitation, abstraction, SCS, Flood and drought and classify the reservoirs and origin the water management.	**Apply**
CO3	Structure the equation used for evaporation, runoff with hydrograph and explaining drought mechanism and types of flow in reservoirs.	**Analysis**
CO4	Asses the rain gauge method with SCS method and DPAP and estimate the storage capacity with artificial discharge in groundwater management.	**Evaluate**
CO5	Adopt the method of data for precipitation, abstraction and estimate the life of reservoirs in rural and urban areas.	**Create**
CO6	Use modern tools for the estimation of rainfall and run off methods	**Modern tools**

19UAG602	DESIGN OF AGRICULTURAL MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce to the students to the basic concepts of design of agricultural machineries.
- To get through the detailed design & drawing of various components of agricultural machineries.

UNIT I STRESSES IN MACHINE MEMBERS 9

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

UNIT II DESIGN OF POWER TRANSMISSION SYSTEMS 9

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

UNIT III DESIGN OF SHAFTS AND COUPLINGS 9

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

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

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

UNIT V DESIGN OF GEARS AND BEARINGS 9

Gears - spur gear and helical gear - terminology - strength of gear teeth - Lewis equation - Buckingham equation. - Failure of gear teeth. Design of bearings – sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions.

TOTAL : 45 PERIODS

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

TEXT BOOKS

1. Khurmi R.S and Gupta J.K, A Textbook of Machine Design, Euarsia publication house, 2005.
2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 2003.

REFERENCE BOOKS

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

CO1	Understand, the design procedure and selection of materials.	**Understand**
CO2	Apply a fasteners such as rivets, bolts and cotter joints properly in machines and real life practice according to the given load conditions.	**Apply**
CO3	Apply design concepts for the components subjected to static and cyclic loading.	**Apply**
CO4	Analyze power transmitted by shafts and couplings, also can design it.	**Analyze**
CO5	Design the alternate machine component with Nano materials	**Design**
CO6	Evaluate stress and load along with deformations of various types of springs	**Evaluate**

		L	T	P	C
19UAG603	**GROUND WATER AND WELL ENGINEERING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

- Fundamentals of surface and subsurface flow, emphasizing the role of ground water in the hydrologic cycle, the relation of groundwater flow to geologic structure, and the management of contaminated groundwater.
- To enable the students to have knowledge on occurrence and movement of ground water, analyzing the data of pumping test and artificial recharge of ground water methods.

UNIT I GROUND WATER AND WELLS **9**

Definitions, Origin of groundwater, Water budget, Groundwater Scenario- Global and Indian Perspectives; Types of rocks, Groundwater hydrologic cycle, Occurrence and movement of ground water, Vertical distribution of groundwater, Darcy's law, Aquifer and its types; Aquifer characteristics- Permeability, Transmissivity, Specific yield, Specific retention, Porosity,Leakage factor, Hydraulic resistance, Classification of wells, Steady and transient flow into partially, Fully and non-penetrating tube wells and open wells.

UNIT II DESIGN OF WELLS **9**

Design of open well, Groundwater exploration techniques, Methods of drilling of wells, Percussion, Rotary, Reverse rotary, Design of assembly and gravel pack, Installation of well screen, Completion and development of well, Groundwater hydraulics, Determination of aquifer parameters by different methods such as Theis, Jacob and Chow' s etc., Recovery method, Well interference, Multiple well systems.

UNIT III GROUND WATER MODELLING **9**

Surface and subsurface exploitation and estimation of ground water potential, Quality of ground water, Artificial groundwater recharge techniques, Salt water intrusion, Groundwater basin management.

UNIT IV PUMPS AND CLASSIFICATION **9**

Water lifting devices, Different types of pumping machinery, Classification of pumps, Component parts of centrifugal pumps, Pump selection, Installation and Troubleshooting.

UNIT V WORKING OF PUMPS **9**

Design of centrifugal pumps, Performance curves, Effect of speed on head capacity, Power capacity and efficiency curves, Effect of change of impeller dimensions on performance characteristics, Hydraulic ram, Propeller pumps, Mixed flow pumps and their performance characteristics, Priming-self priming devices, Roto dynamic pumps for special purposes such as deep well turbine pump and submersible pump.

TOTAL PERIODS : 45

TEXT BOOK

1. D. K. Todd, “Groundwater Hydrology”, 2nd Edition, John Wiley and Son, New York, 2006.
2. H. M. Raghunath, “Groundwater”, 3rd Edition, New Age International, 2007.

REFERENCE BOOK

1. V. V. N. Murty and M. K. Jha, “Land and Water Management Engineering”, 6th edition, Kalyani Publishers, 2013.
2. M. Michael. “Irrigation Theory and Practice”, 2nd edition, Vikas Publishing House, 2008.
3. V. T. Chow, “Hand Book of Applied Hydrology”, McGraw Hill, New York, 2012.

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Understand the basic knowledge on different types of wells and pumps and hydraulic conductivity measurement techniques.	**Understand**
CO2	Apply their knowledge in modelling and uses of different methods used for estimation of ground water potential.	**Apply**
CO3	Analyze Interpret geophysical exploration data for scientific source finding of aquifers.	**Analysis**
CO4	Analyse radial flow towards wells in confined and unconfined aquifers.	**Analysis**
CO5	Evaluate the process of artificial recharge for increasing groundwater potential.	**Evaluate**
CO6	Creative and effective measures for controlling saline water intrusion and apply appropriate measures for groundwater management.	**Create**

		L	T	P	C
19UGS636	**NDIAN CONSTITUTION**	**1**	**0**	**0**	**P/F**

Pre-requisites: Nil

COURSE OBJECTIVES

- The students will be exposed to fundamental rights & duties in Indian Constitution.
- The students will be given knowledge on the components of the parliamentary system to prepare for the process of their career development.
- The student will have knowledge on powers and functions of Local bodies and Indian polity to appear for various competitive exams such as UPSC, TNPSC and RRB…
- The student will know about the functions of judiciary and electoral process followed in the country.

UNIT I INTRODUCTION ON INDIAN CONSTITUTION

Preamble - Salient features of the Constitution of India. Fundamental Rights - its restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) - Fundamental Duties: its Scope and significance in Nation building - Constitution components: schedule, parts and articles of constitution- important Amendments of constitution.

UNIT II PARLIAMENTARY SYSTEM

Parliamentary System – parliamentary system of other countries - Indian parliamentary system-Federal System – LS and RS, Centre-State Relations-Election of member of parliaments- Union Executive - President, Prime Minister, Union Cabinet. State Legislature - State Executives –election of MLA- Governor, Chief Minister, State Cabinet.

UNIT III JUDICIARY AND ELECTION COMMISSION

Supreme Court of India: Structure, Power and Functions of Supreme Court-- Judicial Reviews - Judicial Activism. High Court and Subordinate Courts: Structure, Power and Functions. – Lok adhalats. Elections- Electoral Process - Election Commission of India - Election Laws – Emergency Provisions - types of Emergencies and its consequences.

UNIT IV LOCAL ADMINISTRATION

Local Administration: Powers and functions of Municipalities and Panchayats System- Panchayat Raj- Co–operative Societies and Constitutional and Non-constitutional Bodies.

COURSE OUTCOMES:

On completion of this course, students will be,

CO1: able to apply knowledge of the fundamental rights and duties prescribed by Indian Constitution to prepare for various competitive examinations.

CO2: able to manage complex societal issues in society with the knowledge of judiciary and local administration.

CO3: able to interpret the societal, health, safety, legal and cultural issues with understanding of parliamentary system and electoral process through self-learning skills.

CO4: able to understand the ethical responsibilities of municipalities, panchayats and co-operative societies.

CO5: able to understand and distinguish the functioning of the parliamentary system followed in various countries.

TEXT BOOKS:

1. Shubham Singles, Charles E. Haries, et al., “Constitution of India and Professional Ethics” by Cengage Learning India Private Limited, 2018.
2. Subhash C. Kashyap,”Our Constitution: An Introduction to India’s Constitution and constitutional Law”, NBT, 2018.
3. Brij Kishore Sharma,“Introduction to the Constitution of India”, PHI Learning Pvt. Ltd., New Delhi, 2011.
4. M.V.Pylee, “An Introduction to Constitution of India”, Vikas Publishing, 2002.
5. Durga Das Basu, “Introduction to the Constitution on India”, Prentice Hall, 2001.

19UAG607	PRODUCT DEVELOPMENT PROJECT	L	T	P	C
		0	0	8	4

COURSE OBJECTIVES

To use the knowledge acquired in agricultural engineering to do a mini project, which allows the students to come up with designs, fabrication or algorithms and programs expressing their ideas in a novel way

STRATEGY

Identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication. Demonstrate the novelty of the project through the results and outputs.

TOTAL PERIODS : 60

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Formulate a real world problem, identify the requirement and develop the design solutions.	**Analyze**
CO2	Express the technical ideas, strategies and methodologies	**Apply**
CO3	Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.	**Apply**
CO4	Test and validate through conformance of the developed prototype and analysis the cost effectiveness.	**Create**
CO5	Prepare report and present the oral demonstrations	**Evaluate**

		L	T	P	C
19UAG608	**CAD FOR AGRICULTURAL ENGINEERING**	0	0	3	1.5

COURSE OBJECTIVES

- To draft the agricultural engineering implements/tools using Computer Aided Design

LIST OF EXPERIMENTS

1. Introduction to AUTOCAD Software – To Study the application of all the tools
2. Draw the simple tractor components and mark dimensions
3. Draw an isometric component of simple gear
4. Create an isometric component drawing of piston
5. Create a two dimensional sketch diagram of connecting rod
6. Create an isometric component drawing of crankshaft
7. Create an isometric component drawing of cylinder
8. Create an isometric component drawing of crankcase
9. Create an isometric component drawing of cam shaft
10. Create an isometric component drawing of a valve
11. Create a 3D drawing of IC engine assembly
12. Create a two dimensional sketch diagrams of KVIC Model Biogas Plant

TOTAL PERIODS : 30

COURSE OUTCOMES

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

CO 1	Understand application of different tools of AutoCAD	**Understand**
CO 2	Apply the different option to visualize different views of tractor engine components	**Apply**
CO 3	Apply CAD to draw a two dimensional view of varies model biogas plant	**Apply**
CO 4	Design and develop a three dimensional assembly model consisting of many components of tractor engine	**Design**

LIST OF EQUIPMENT REQUIRED

Sl.No	**Name of the Equipment**	**Quantity**
1.	Computer	30 Nos
2.	Software – AutoCAD	1 Nos

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Understand the working principles of different irrigation system and varies drainage system	Remember/Understand
CO2	Apply their knowledge to identify the suitable irrigation system in water scarcity area	Apply
CO3	Analysis the irrigation technique to solve an identified agricultural drainage problem.	Analysis
CO4	Design and development of irrigation system for different agriculture and horticulture crops	Design

Sl.No	**LIST OF EQUIPMEN TS REQUIRED**	**QTY**
1.	Meteorological lab with Cup counter anemometer, Sunshine recorder, Open pan evaporimeter, Stevenson's screen - Dry bulb, wet bulb thermometers, recording and non-recording type rain gauge etc.	Each 1 No
2.	Double ring infiltrometer	1 No
3.	Digital infiltrometer	1 No
4.	Parshall flume, cut throat flume	1 No
5.	V notch, Rectangular notch and trapezoidal notch	1 No
6.	Drip irrigation system with all accessories	I SET
7.	Sprinkler irrigation system with all accessories	I SET
8.	Required number of stop watches	10 NOs
9.	Weighing balance	1No
10.	Catch cans, measuring jars	10 NOs

19UGS633	INTERPERSONAL SKILLS LABORATORY	L	T	P	C
		0	0	3	1.5

LIST OF EXERCISES

Part - A : Communication and Leadership Projects

I) Speech Projects

1. The Open up Speech (Prepared Speech)
2. Speech Organizing to the Point (Prepared Speech)
3. Table Topics Speech

II) Evaluation Projects

4. Speech Evaluation
5. TAG (Timer, Ah Counter and Grammarian) Evaluation

III) Leadership Roles

6. Speech Master of the Day
7. General Evaluator
8. Table Topics Master

Part - B : Problem-Solving and Decision- Making Project

IV) Quality Circle Project

COURSE OUTCOMES

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

1. Communicate orally with fluency and clarity in a given contextual situation **(Responding - Affective Domain)**

2. Evaluate a speech and offer constructive evaluation of the speech **(Evaluating - Cognitive Domain)**

3. Adapt themselves to work in a group as a member or a leader for efficiently executing the given task **(Organization – Affective Domain)**

4. Analyze a problem and find appropriate solution **(Analyze - Cognitive Domain)**

5. Take decision by organizing relevant information and defining alternatives **(Create - Cognitive Domain)**

19UME701	FARM MANAGEMENT AND FINANCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart the fundamental knowledge and basic concepts of Economics and Farm Management
- To understand the types of resources and Investment analysis in agriculture sector
- Farm financial analysis, Investment and Budgeting for farms

UNIT I FARM MANAGEMENT **9**

Agricultural Economics – definition and scope – Farm Management – definition – scope- Classification of farms – Basic concepts in farm management - Relationship between farm management and other basic sciences - Farm layout – Farm records and accounts – Farm appraisal techniques – Valuation.

UNIT II LAWS OF ECONOMICS **9**

Basic laws of economics – demand and supply concepts – law of increasing, diminishing and constant returns – Equi-marginal returns - Product relationship – Production function – definition and types – Production function curves – Optimum level of input use – Economies of scale external and internal economies and diseconomies - Cost concepts – types - Opportunity cost – comparison of costs – Factor relationship – concepts.

UNIT III COST CURVES **9**

Principle of substitution – isoquant, isocline, expansion path, ridge line and least cost combination of inputs-Product-product relationship – Production possibility curve, isorevenue line and optimum combination of outputs – Cost curves –Optimum input and output levels – Factor –factor relationship – Least cost combination of inputs – Estimation of cost of cultivation and cost of production of crops - annual and perennial crops – Preparation of interview schedule and farm visit for data collection.

UNIT IV MANAGEMENT OF RESOURCES **9**

Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks in production process – Management of resources – types of resources- land, labour, capital and measurement of their efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis – Investment analysis – Discounting techniques.

UNIT V FARM MANAGEMENT AND FINANCIAL ANALYSIS **9**

Farm management- need and analysis – Farm financial analysis – Balance sheet – Income statement – Cash flow analysis – Farm investment analysis – Time comparison principles – Farm planning – Elements of farm planning – Whole farm planning and partial planning – Farm level management system – Farm budgeting – whole farm budgeting and partial budgeting – Estimation of credit - examples of farm planning and budgeting.

TOTAL : 45 PERIODS

COURSE OUTCOMES

After successful completion of this course the students will be able to,

- Understand the basic concepts of farm management
- Solve the problems in farm with different laws of economics
- Work out breakeven point for different machineries in farm
- Manage the resources in farm with different methods
- Elaborate different elements of farm planning

TEXT BOOKS

1. Johl, S.S., and Kapur, T.R., „Fundamentals of Farm Business Management", Kalyani publishers, Ludhiana, 2007.
2. Subba Reddy, S., Raghu Ram, P., Neelakanta Sastry T.V and Bhavani
3. Devi, I., „Agricultural Economics" Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

REFERENCE BOOKS

1. Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.

2. Subba Reddy, S., and Raghu Ram, P. „ Agricultural Finance and Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.

19UAG702	CROP PROCESS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the processing technology of various agricultural products including cereals, pulses, oilseeds, fruits, vegetables and animal products.
- To expose the students to the fundamental knowledge of food, its properties and different methods of food processing.

UNIT I PROCESSING OF AGRICULTURAL PRODUCTS 9

Scope and importance of food processing, Post-harvest losses, Principles and methods of food processing, Processing of farm crops, cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed, Processing of animal products, Minimal processing.

UNIT II SIZE REDUCTION 9

Principle of size reduction, grain shape, size reduction machines, Crushers, grinders, cutting machines etc.,Operation, Efficiency and power requirement, Rittinger's, Kick' sand Bond' s equation, Fineness modulus.

UNIT III MIXING 9

Theory of mixing, Types of mixtures for dry and paste materials, Rate of mixing and power requirement, Mixing index.

UNIT IV SEPARATION 9

Theory of separation, Size and unsized separation, Types of separators, Size of screens, Sieve analysis, Capacity and effectiveness of screens, Pneumatic separation

UNIT V MATERIAL HANDLING 9

Scope and importance of material handling devices, Study of different types of material handling systems-Belt, Chain and screw conveyor, Bucket elevator, Pneumatic conveying, Gravity conveyor; Design consideration, Capacity and power requirement.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Chakravarty, “Post Harvest Technology of Cereals, Pulses and Oil Seeds”, 3rd edition, Oxford and IBH Pub. Co., Calcutta, 2008.
2. K. M. Sahay and K. K. Singh, “Unit Operation of Agricultural Processing”, 2nd edition, Vikas Publishing, New Delhi, 2004.

REFERENCE BOOKS

1. P. H. Pande, “Principles of Agricultural Processing-A Text Book”, 2nd edition, Kalyani Publishers, Ludhiana, 2006.
2. T. K. Bose and S. K. Mitra, “Fruits, Tropical and Subtropical”, 3rd edition, Naya Prakash, Calcutta, 2001.
3. R. L. Earle, “Unit Operations in Food Processing”, 2nd edition, Pergamon Press, Oxford, UK, 1985.
4. P. J. Fellows, “Food Processing Technology, Principles and Practice”, 3rd edition, Ellis Horwood, USA, 2009.

COURSE OUTCOMES

The student will be able to

CO 1	Gain basic knowledge about processing of various agricultural products including cereals, pulses, oilseeds, fruits, vegetables and animal products	**Understanding**
CO 2	Apply their knowledge to reduce the post harvesting losses	**Apply**
CO 3	Analyze the different type of screen to identify and select the suitable screen based on crop types.	**Analyze**
CO 4	Design of different types of mixers for homogeneous mixing of different food ingredients.	**Design**
CO 5	Create and develop an indigenous material handling equipment for multi crop	**Create**
CO 6	Evaluate the performance efficiency of different types of material handling equipment and varies screen.	**Evaluate**

19UME703	INTRODUCTION TO GREEN ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To aware of the various basic aspects of energy and their uses and impart knowledge about the different classifications of energy sources and major renewable energy sources and technologies.
- To familiarize the students with different bioenergy sources and production technology.

UNIT I INTRODUCTION **9**

Introduction to energy: Classification-Energy and environment- Concept of Renewable Energy Sources (RES)-Clean Development Mechanism-Role of renewable energy for mitigation of Global warming, Classification of RES - Solar, Wind, Geothermal, Biomass, Ocean energy sources Comparison of renewable energy sources with non renewable sources. Energy inputs for agricultural production.

UNIT II SOLAR ENERGY **9**

Solar energy: Fundamentals and basic principles- Solar radiation measurement, Basic Principles of Solar thermal energy conversion, Flat plate and Concentrating collectors, different solar thermal devices, Applications and gadgets- Solar drying, Solar still Solar Photo voltaic electricity production: Principles of Photo voltaic energy production-p-n junctions, Solar cells, PV Systems- Cell characteristics.

UNIT III WINDENERGY **9**

Wind energy: Energy available in wind, General formula, Lift and drag. Basics of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Power coefficient- Betz limit-Operational parameters of wind turbines-torque coefficient-tip speed ratio. Types of wind turbine rotors, Working principle of wind power plant.

UNIT IV THERMO-CHEMICAL ENERGY CONVERSION OF BIOMASS **9**

Bio-energy: Thermo-chemical energy conversion of biomass – Biomass combustion-Combustion of Biomass and stoves. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification - Types of gasifiers, construction and working of different types of gasifiers, various types of biomass cook stoves for rural energy needs.

UNIT V BIOCHEMICAL ENERGY CONVERSION OF BIOMASS **9**

Biochemical energy conversion of biomass: Anaerobic digestion process-types of biogas plants-Basic design aspects of Biogas plants-operational and environmental parameters affecting biogas generation and usages, advantages and disadvantages of biogas plant slurry. Liquid bio-fuels.Basic principles for the production of alcohol and biodiesel.

TOTAL : 45 PERIODS

TEXT BOOKS

1. G.D.Rai,2013, " Non-Conventional Energy Sources" , Khanna Publishers, Delhi. 2013.

REFERENCE BOOKS

1. Mathur, A.N and Rathore N.S. 1992," Biogas production, management and utilization Himanshu Publication. Delhi.
2. Rathore N. S., Kurchania A. K. and Panwar N. L. 2007. " Non-Conventional Energy Sources" , Himanshu Publications.
3. Rathore N. S., Kurchania A. K. and Panwar N. L. 2007. " Renewable Energy, Theory and Practice" , Himanshu Publications.
4. Sukhatme, S.P and Nayak, J.K 2010, " Solar Energy: Principles of Thermal Collection and Storage" , Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi.
5. Tiwari, G. N and Ghoshal, M. K 2005, " Renewable Energy Resources: Basic Principles and Applications" . Narosa Pub. House. Del.

COURSE OUTCOMES **completion of the course, student will able to**		
CO 1	Identify and understand the fundamentals of renewable energy sources and the use of renewable energy for agricultural Applications.	**Understand**
CO 2	Apply renewable energy sources in agriculture energy sector.	**Apply**
CO3	Analyzing the usage and maintenance of different renewable energy devices.	**Analyze**
CO 4	Analyze the principle of construction and working of the various renewable energy devices.	**Analyze**
CO 5	Design and development of solar water heater, solar cooker, windmill, biogas plant and gasifier.	**Design**
CO6	Evaluate the performance efficiency of different renewable energy gadgets based on arid and semi-arid conditions	**Evaluate**

15UGM731	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C
		2	0	0	P/F

OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values
- To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of „Engineering Ethics‟ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg‟s theory – Gilligan‟s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS PYROLYSIS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **9**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of conduct – Corporate Social Responsibility.

TOTAL : 45 PERIODS

COURSE OUTCOME

After successful completion of this course the students will be able to,

- Enumerate the Moral value of human.
- Implemented the engineering ethics in the professional life
- Identify the role of engineering as social experimenters
- Assess the safety and risk and also known about the Professional Rights ,Employee Rights, Intellectual Property Rights
- List out the global issues of multinational corporate Social responsibility.

TEXT BOOKS

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOKS

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, „ Value Education‟, Vethathiri publications, Erode, 2011

WEB SOURCES

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

19UAG707	SUMMER INTERNSHIP	L	T	P	C
		0	0	2	1

OBJECTIVES

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

STRATEGY

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.

OUTPUTS

After the successful completion of this training, the student will be able to

- Learn more about yourself and your skills, identifying areas for improvement.
- Propose and analyze the knowledge gained through academic learning in the classroom to the work environment.
- Identify the career development opportunity for a position in order to pursue a particular interest or career option.
- Identify the technical skills, best practices and knowledge required in the workplace.
- Identification of Problem for final year Project

19UAG708	AGRICULTURAL PROCESSING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

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

LIST OF EXPERIMENTS

1. Determination of moisture content of grains by oven method and moisture meter.
2. Determination of porosity of grains.
3. Determination of coefficient of friction and angle of repose of grains.
4. Determining the efficiency of bucket elevator and screw conveyor
5. Evaluation of groundnut decorticator
6. Determination of cooking properties of parboiled and raw rice
7. Performance evaluation of a belt conveyor.
8. Performance evaluation of a bucket elevator.
9. Performance evaluation of a screw conveyor.
10. Problems using psychrometric chart.
11. Design of dryers.

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

CO 1	Understand the various operations of food processing such as cleaning, grading, size reduction, mixing, filtration and material handling	**Understand**
CO 2	Apply their knowledge to identify the suitable material handling equipment to reduction of cost for various agricultural products.	**Apply**
CO 3	Design and development of indigenous material handling for multi crop agricultural produces.	**Design**
CO 4	Evaluate the efficiency and power requirements of belt conveyor, screw conveyor, bucket elevator	**Evaluate**

LIST OF EQUIPMENT REQUIRED

Sl.No	Name of the Equipment	Quantity
1.	Porosity apparatus	1 Nos
2.	Coefficient of friction apparatus	1 Nos
3.	Angle of repose – round type and L type	1No
4.	Groundnut decorticator	I each
5.	Thin layer dryer	1No
6.	Bucket elevator and screw conveyor	I each
7.	Parboiling drum	I No
8.	Hot air oven	1No
9.	Dessicator	1No
10.	Cabinet dryer	1 No

19UAG709	GREEN ENERGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To understand basic working principle and to design and develop various renewable energy gadgets.

LIST OF EXPERIMENTS

1. Estimation of solar energy availability at a locality
2. Estimation of the calorific value of fuels.
3. Design of biogas plant
4. Design of solar pv system
5. Design of solar dryer
6. Design of gasifier for agro waste
7. Performance evaluation of solar cooker
8. Determination of solar water heater
9. Design of solar tunnel dryer
10. Study the different types of windmill
11. Study the biofuel production
12. Experiment on biogas production by bottling
13. Visit to renewable energy power production facilities.

TOTAL : 30 PERIODS

COURSE OUTCOMES After the successful completion of this course, the student will be able to		
CO 1	Identify and understand the fundamentals of renewable energy sources	**Understand**
CO 2	Ability to apply their knowledge renewable energy sources in agriculture energy sector to reduce cost of production	**Apply**
CO 3	Analyzing the usage and maintenance of different renewable energy devices.	**Analyze**
CO 4	Design and development of solar water heater, solar cooker, windmill, biogas plant and gasifier	**Design**

LIST OF EQUIPMENT REQUIRED

Sl.No	**Name of the Equipment**	**Quantity**
1.	Wind mill	1 Nos
2.	Solar cooker - boxtype	1 Nos
3.	Solar water heater	1Nos
4.	Biogas plant	I Nos
5.	Solar tunnel dryer	1Nos
6.	Solar PV plant	I Nos

15UAG804	PROJECT WORK	L	T	P	C
		0	0	12	6

OBJECTIVES

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

STRATEGY

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

TOTAL: 180 PERIODS

COURSE OUTCOMES

At the end of the course student will be able to

CO 1	Design/Develop sustainable solutions for societal issues with environmental considerations applying the basic engineering knowledge.	**Design**
CO 2	Analyze and review research literature to synthesize research methods including design of experiments to provide valid conclusion.	**Apply**
CO 3	Utilize the new tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice.	**Modern tools**
CO 4	Test and Evaluate the performance of the developed solution using appropriate techniques and tools.	**Evaluate**
CO 5	Apply management principles to function effectively in the project team for project execution.	**Apply**

19UAG901	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart the knowledge on the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.
- To expose the various manufacturing methods employed in industries

UNIT I PROPERTIES OF METALS **9**

Engineering materials - Property definitions– Iron-carbon equilibrium diagram- Ferrous metals and alloys, Non Ferrous metals and alloys – manufacturing processes and properties. Heat treatment of steels – purpose and method of heat treatment. Annealing, normalizing- hardening- tempering- surface hardening.

UNIT II FORMING AND WELDING PROCESS **9**

Mechanical working of metals - hot working processes – hot rolling- hot forging- spinning extrusion- drawing-piercing. Cold working processes -Cold rolling- shot peening. Smithy and forging operations- types. Welding process - arc welding – Polarity – Types- electrodes. Gas welding –gas flames- gas welding technique –gas cutting of metals. Sheet metal work – tools.

UNIT III MOULDING AND CASTING PROCESS **9**

Pattern making – pattern materials- Types of pattern – core boxes- core prints Foundry – moulding tools - moulding sand- Properties- Moulding- moulding materials- types of moulds- methods of moulding. Special casting process – permanent moulding- slush casting- die casting- centrifugal casting investment casting- shell moulding – continuous casting.

UNIT IV MACHINING PROCESS **9**

Lathe - principal parts – types – working principles -basic operations – lathe accessories -. Drilling machine, shaper, planer- principal parts-working principle- operations-. Grinding machine, milling machine, principal parts – types - basic operations

UNIT V ADVANCED MANUFACTURING PROCESS **9**

Manufacturing process for plastics -compression moulding- transfer moulding- injection moulding - jet moulding and blow moulding- Calendaring-casting- slush casting- laminating-. Joining. Modern machining methods, Electro discharge machining (EDM), wire cut Electro discharge machining (WEDM), advantages and limitations. Advanced manufacturing technologies.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

1. Study the properties of different metal
2. Apply the appropriate welding process for different joining.
3. Discuss the various casting processes.
4. Study the principles of lathe, Grinding and milling machine
5. Gain knowledge advanced manufacturing process

TEXT BOOKS

1. Khurmi, R.S. and J.K. Kupta. 2000. A Textbook of workshop Technology. Publication division of NIRJA construction and development Co. (P) Ltd. Ramnagar, New Delhi-110055.
2. Sharma, P.C. 2004. A textbook of Production Technology. S. Chand & Company Ltd. Ram Nagar, New Delhi-110055.

REFERENCE BOOKS

1. Khanna, O.P. 1990. A textbook on welding technology. Dhanpat Rai. New Delhi.
2. Hajra Chowdry, S.K.1986. Elements of Workshop Technology, Vol.I & II. Manufacturing Process.Asian Book Co., New Delhi.
3. Adithan, M. and A.D.Gupta. 2001. Manufacturing technology. New Age International (p) Ltd. Publishers, Chennai.

		L	T	P	C
19UAG902	**SOIL AND WATER CONSERVATION STRUCTURES**	3	0	0	3

COURSE OBJECTIVES.

- To present the concepts of Runoff 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 of soil and water conservation structures to solve issues related to soil and water management
- Students get sound knowledge Water storage structures
- Study about trenching and diversion structures.

UNIT I RUN OFF MEASUREMENTS USING WEIRS **9**

Weirs - Classification of Weirs-Broad crested weir- Sharp-Crested Weir -Rectangular Weirs-Cipolletti Weirs- V- Notch Weir Operation- Limitations

UNIT II RUN OFF MEASUREMENTS USING FLUMES **9**

Flumes- Types - Advantages - disadvantage- Parshall Flume-Installation of Parshall flume- Flow Measurement -Operating Principle- Applications

UNIT III WATER STORAGE STRUCTURES **9**

Earthen Embankment- types - Homogeneous- Diaphragm- method of construction-Seepage Analysis- farm ponds - design and consideration- pond types

UNIT IV DESIGN REQUIREMENTS OF GULLY CONTROL STRUCTURES **9**

Gully Control Structures - Temporary Structures- types - design -Permanent Structures- Drop-Chute - Drop Inlet-Planning for Gully Control.

UNIT V TRENCHING AND DIVERSION STRUCTURES **9**

Types of Trenching- Continuous Trenches- In-line Trench - Staggered Trenches-Contour Trenching- Site Specification for Trenching- Design of Trenches-Diversion – Criteria for Selection- Design Specification

TOTAL PERIODS : 45

TEXT BOOK

1. Ghanshyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2000.

REFERENCE BOOK

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

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Gain fundamental knowledge on the concepts of Runoff Measurement	**Understand**
CO2	Application of Runoff Measurement using Flumes and Weirs	**Apply**
CO3	Technical Analysis of water storage structures	**Analysis**
CO4	Technical feasibility and economic viability of erosion control structures.	**Design**
CO5	Use modern tool for measurement Runoff in canals.	**Modern Tool Usage**
CO6	Acknowledge the importance of water harvesting structures.	**Individual and team member**

		L	T	P	C
19UAG903	**WATERSHED PLANNING AND MANAGEMENT**	3	0	0	3

COURSE OBJECTIVES

- 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
- Application and benefits of watershed management
- Analyzing water conservation practice and structures.
- Evaluate of watershed development programs in India

UNIT I INTRODUCTION **9**

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

UNIT II WATERSHED PLANNING **9**

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

UNIT III WATERSHED MANAGEMENT **9**

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 IV WATER CONSERVATION PRACTICES **9**

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

UNIT V WATERSHED DEVELOPMENT PROGRAMME **9**

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

TOTAL PERIODS : 45

TEXTBOOK

1. Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi

REFERENCE BOOK

1. Gurmel Singh et al. 2004. Manual of soil and water conservation practices. Oxford & IBH publishing Co. New Delhi.
2. Tripathi R.P. and H.P.Singh 2002, Soil erosion and conservation, Willey Eastern Ltd., New Delhi
3. Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi.

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Study watershed characteristics	**Understand**
CO2	Identify watershed management problems and land use planning	**Apply**
CO3	Understand the principles of hydrologic and hydraulic structures	**Analysis**
CO4	Design and application of water conservation technologies	**Design**
CO5	Evaluate watershed Development programmes.	**Modern Tool Usage**
CO6	Techno economic analysis of watershed.	**Individual and team member**

19UAG904	LANDSCAPE DESIGN AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Know different design procedure and installation of irrigation systems for different landscapes
- Assess the power requirement of irrigation system and thus selection of pump
- Acquaint with AutoCAD in landscape irrigation design
- Gain in-depth knowledge on different components of landscape irrigation and other equipments used in it.
- Evaluate the different landscape irrigation systems

UNIT I INTRODUCTION AND CONVENTIONAL METHOD OF LANDSCAPE IRRIGATION **9**

Conventional method of landscape irrigation- hose irrigation system, and portable sprinkler with hose pipes -Hose irrigation system and portable -sprinklers with hose pipes

UNIT II MODERN METHODS OF LANDSCAPE IRRIGATION **9**

Modern methods of landscape irrigation- pop-up sprinklers, spray pop-up sprinkler, shrub adopter, drip irrigation and bubblers; merits and demerits of conventional and modern irrigation systems

UNIT III TYPES OF LANDSCAPES **9**

Types of landscapes and suitability of different irrigation methods- water requirement for different landscapes -segments of landscape irrigation systems- main components of modern landscape - irrigation systems

UNIT IV LANDSCAPE IRRIGATION SYSTEMS SELECTION CRITERIA **9**

Main Components of modern -landscape irrigation systems and selection criteria - Types of pipes, pressure ratings, sizing and selection -Pressure ratings of different pipes required - different landscape irrigation systems

UNIT V AUTOMATION SYSTEM OF LANDSCAPE IRRIGATION **9**

Automation system for landscape irrigation- main components, types of controllers and their application, design of modern landscape irrigation systems, operation and maintenance -Power requirement landscape irrigation systems

TOTAL PERIODS : 45

TEXTBOOK

1. Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing House New Delhi

REFERENCE BOOK

1. Singh Neeraj Pratap, 2010. Landscape irrigation and Floriculture Terminology Bangalore
2. Smith Stephen W. 1996 Landscape Irrigation: Design and Management. Amazon.in
3. Basic Irrigation Design Principles. Oct 29, 2014 Southwest Turfgrass Association. Recreational Landscape Conference and Expo. Albuquerque, NM.

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Know about the different conventional and modern methods of landscape irrigation	**Understand**
CO2	Know about various types of landscapes and their suitability with regard to different irrigation methods	**Apply**
CO3	Understand the different methodologies to compute the water requirement in different landscape situations	**Analysis**
CO4	Design the modern landscape irrigation systems	**Design**
CO5	Know about Modern methods of landscape CAD design	**Modern Tool Usage**
CO6	Filed demonstration, know how to make automation of the landscape irrigation system	**Individual and team member**

19UAG905	ENERGY AUDITING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Objectives

- To acquaint and equip the students in energy auditing in industries and house hold sectors for increasing energy efficiency

UNIT I ENERGY SCENARIO **9**

Energy scenario – classifications – global Primary energy reserves – energy needs of growing economy – energy pricing – energy sector reforms – energy security – energy conservation – future strategy – energy conservation acts – global environment issues – ozone layer depletion – global warming – loss of bio diversity – climate change problem and response – the conference of the parties – Prototype Carbon Fund – sustainable development.

UNIT II ENERGY MANAGEMENT **9**

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

UNIT III ENERGY MANAGEMENT IN BOILERS **9**

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

UNIT IV ENERGY MANAGEMENT IN ELECTRICAL SYSTEM **9**

Electrical systems – introduction – electricity billing – load management – power factor – improvements and benefits – energy audit in electrical utilities methodology – energy conservation opportunities in motors – efficiency – energy efficient motors – motor losses – analysis –compressed air system.HVAC and refrigeration system – load estimation- fans and blowers – fan performance – centrifugal pumps – energy conservation in lighting systems.

UNIT V ENERGY AUDITING IN INDUSTRIES AND REPORTING **9**

Energy auditing case studies. Industrial energy auditing and conservation measures - Policy recommendations. Energy auditing report preparation - Production process and energy conservation opportunities in Aluminium, Automobile, Chemical and Agro based industries. Waste heat recovery – classification – advantages- applications - saving potential. Clean Development Mechanism – principles and project format. Renewable energy gadgets – performance – energy efficiencies.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

- Gaining knowledge in energy scenario
- Understand the concept of conservation of energy
- Apply the energy management principles in boilers.
- Analysis the energy management concept in electrical system
- Prepare and Evaluate the energy audit report

TEXT BOOKS

1. Craig B. Smith, 1981. Energy Management Principles, Applications, benefits and savings. Pergamon Press Inc.
2. Guide books for National Certification Examination for Energy Managers and Energy Auditors, Book 1 – 4, 2005 Bureau Energy Efficiency, New Delhi.
3. Murgai, M.P. and Ram Chandra, 1990.Progress in Energy Auditing and Conservation - Boiler Operations, Wiley Eastern Ltd.,
4. Murphy, W.R. and McKay, G. 1982. Energy Management. Butterworth and Co., Publishers Ltd., London.
5. Richard Porter and Tim Roberts, 1985.Energy saving by Waste recycling. Elsevier applied science publishers.

REFERENCE BOOKS

1. Guide book for National Certification Examination for Energy Managers and Energy Auditors, Book 1. General aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency.
2. Handbook of refractories by D.N. Nadhi, Tata McGraw, New Delhi, 1987.

19UAG906 FUNDAMENTALS OF HEAT AND MASS TRANSFER

L	T	P	C
3	0	0	3

- The course is intended to build up necessary background for the understanding of the physical behavior of the various modes of heat transfer, like, conduction, convection and radiation.
- To understand the application of various experimental heat transfer correlations in engineering calculations.

UNIT I CONDUCTION **9**

Basic Concepts - Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - General Differential equation of Heat Conduction - Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction - Conduction through Plane Wall, Cylinders and Spherical systems - Composite Systems - Conduction with Internal Heat Generation - Extended Surfaces - Unsteady Heat Conduction - Lumped Analysis - Use of Heislers Chart.

UNIT II CONVECTION **9**

Basic Concepts - 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 flows - Flow over Bank of tubes - Free Convection - Dimensional Analysis - Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III RADIATION **9**

Basic Concepts, Laws of Radiation - Stefan Boltzman Law, Kirchoff's Law Emissive power– Black Body Radiation - Grey body radiation, Radiation heat transfer between surfaces, -Shape Factor Algebra - Electrical Analogy - Radiation Shields –Introduction to Gas Radiation.

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

Nusselt's theory of condensation- Regimes of pool boling and flow boiling and Flow boiling,correlations in boiling and condensation.Heat exchanger Types-tube arrangements, single and multi tube types, parallel, counter and cross flow - Heat Exchanger Analysis - LMTD Method and NTU Methods –effectiveness method- Overall Heat Transfer Coefficient - Fouling Factors

UNIT V MASS TRANSFER **9**

Basic Concepts - Diffusion Mass Transfer - Fick's Law of Diffusion – Steady state Molecular Diffusion - Convective Mass Transfer Rate equations. Mass diffusion in binary mixtures, Momentum, Heat and Mass Transfer Analogy - Convective Mass Transfer Correlations.

TOTAL : 45 PERIODS

NOTE: Use of Steam Tables, HMT tables are permitted in the End Semester Examination.

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Explain the modes of heat and mass transfer **(Understand)**
2. Apply the concepts of heat and mass transfer to various applications **(Apply)**
3. Analyse the steady state and transient heat conduction problems. **(Analyse)**
4. Design the heat exchangers by using LMTD and NTU Method. **(Evaluate)**
5. Evaluate the parameters of radiative heat exchange process between surfaces **(Evaluate)**
6. Conduct heat transfer experiments by using ANSYS Software. **(Analyse)**

TEXT BOOKS:

1. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International, 2010.
2. Frank.P.Incropera, David P. DeWitt “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, 2007.

REFERENCE BOOKS:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2010
2. .Kothandaraman C.P, “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2006
3. Holman J.P, “Heat and Mass Transfer,” Tata McGraw-Hill, 2004.
4. Nag P.K, “Heat Transfer”,Tata McGraw Hill, New Delhi, 2007.

		L	T	P	C
15UAG907	**DESIGN AND CONSTRUCTION OF GREENHOUSE**	3	0	0	3

OBJECTIVES

- Scope and development of greenhouse technology
- Function and features of greenhouse
- Construction materials and methods of construction
- Instrumentation and & computerized environmental control systems
- Application of greenhouse & its repair & maintenance

UNIT I INTRODUCTION **9**

Introduction, Importance and scope of Green house, Types-Single span – multi span – Tunnels – Shade houses-Naturally ventilated Green house, Site selection – orientation, and layout**.**

UNIT II GREEN HOUSE DESIGN **9**

Construction of Green house, Fastening and stretching the film, Standards, Load calculations, Construction – Foundations, Floors, Frame, Structural components. Erection procedure, Cover materials- types – properties

UNIT III GREEN HOUSE MATERIAL AND SOLAR RADIATION **9**

Solar radiation – Diffused radiation – Inside and Outside greenhouse radiation– Thermal analysis of greenhouse – Steady and unsteady state analysis. Air changes – Cooling – Negative and Positive pressure system – pad material – desired properties – pad area and Fan to pad distance – Fans – Airflow rate – Water flow rate – Bleed off ratio

UNIT IV DESIGN AND COMPONENTS OF GREENHOUSE **9**

Introduction to instrumentation and automation in green house. Measurement of, temperature, photosynthesis, relative humidity, leaf area index. Design of irrigation system-Drip irrigation - Components - Dripper- types Pump capacity - Installation- Operation -maintenance of Drip irrigation system

UNIT V COST ANALYSIS OF GREENHOUSE PRODUCTION **9**

Root media for soil and soil less culture, Design of drainage system for soil less culture. Properties of root medium. Estimation of irrigation water requirement of Greenhouse crops, Installation and calibration of Tensiometers in green houses. Economic analysis of green house

TOTAL PERIODS : 45

TEXTBOOK

1. Tiwari G.N. and Goyal R.K. 1998 Green house Technology – Fundamentals,
2. Design, Modelling and applications, Narosa Publishing House, New Delhi.

REFERENCE BOOK

1. Barre H.J. and Sammet L.L. 1990 Farm Structures, McGraw Hill Book Co., New York.
2. Christian Von Zabeltitz and W. O. Baudoin. 1999. Green houses and shelter structures
3. fortropical regions, FAO Plant Protection paper, Rome

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Understand the importance of protected cultivation in farming	**Understand**
CO2	Know about various components, shape, types of green houses	**Apply**
CO3	Know about greenhouse cooling and heating systems, environmental parameter and control, ventilation systems	**Analysis**
CO4	To assess different root media, micro-irrigation, fertigation, planting techniques in green house cultivation	**Design**
CO5	Crop management inside a green house	**Modern Tool Usage**
CO6	Measure different climatic parameters and indicators, ventilation, air temperature, cooling load inside a functional poly house	**Individual and team member**

		L	T	P	C
19UAG908	**IOT APPLICATION IN AGRICULTURE ENGINEERING**	3	0	0	3

OBJECTIVES

- To understand the concept of IoT
- Understand how IoT technologies can be used in agriculture systems.
- Know the application of IoT in Agriculture.
- Understand how to collect and analyze data with IoT for precision agriculture systems.
- Application of AI in Agriculture Drones

.

UNIT I INTRODUCTION TO IOT IN AGRICULTURE **9**

The internet of things for agriculture -crop management devices - soil monitors - devices are typically placed throughout fields -collect data -specific to crop farming.

UNIT II IOT BASED END-TO-END FARM MANAGEMENT SYSTEM **9**

The internet of things for agriculture -crop management devices - soil monitors - devices are typically placed throughout fields -collect data -specific to crop farming.

UNIT III ENVIRONMENT CONTROL SYSTEMS **9**

Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

UNIT IV PRECISION FARMING **9**

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

UNIT V CROP STRESS AND CONTROL **9**

Assessment of plant greenness -photosynthetic active biomass-Crop stress-irrigation management-Weed stress-Insect activity- pesticide control

TOTAL PERIODS : 45

TEXTBOOK

1. Sravanan. R. 2011. Information and communication technology for Agriculture and rural Development. New India Publishing Agency, New Delhi.

REFERENCE BOOK

1. FAO. 1998. Land and water Resources information Systems. FAO Land and Water Bulletin 7,Rome
2. ICFAI Business School(IBS) 2012. Information Technology and systems. IBS Center for Management Research, Hyderabad. Climate-Smart Agriculture- Source Book. 2013. Food and Agriculture Organization, Rome.

COURSE OUTCOMES At the end of the course student will be able to		
CO1	Understand the IT and its application in natural resources management	**Understand**
CO2	Know about internet application tools in farm management	**Apply**
CO3	Database management	**Analysis**
CO4	Design and application of farming support system	**Design**
CO5	Development of mobile apps and sensors in farm management	**Modern Tool Usage**
CO6	Get exposure on IoT technology for farm management	**Individual and team member**

19UAG909	DESIGN OF FOOD PROCESSING EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To acquaint and equip the students with the design features of different food processing equipments being used in the industries

UNIT I DESIGN OF PULPER, CRUSHER AND STORAGE TANKS **9**

Application of engineering principles related to design and selection of food processing equipment - design consideration of pumps - design of pressure vessels and pipe lines - design aspects of storage tanks, design of sterilizers and process vats - design of pulper and crushers – design considerations – materials of construction – installation and operation.

UNIT II DESIGN OF FILTERS, HEAT EXCHANGERS AND EVAPORATORS **9**

Design of filtration process - installation and operation - design consideration of membrane separation process - ultra filtration - reverse osmosis - design of heat exchangers – plate heat exchanger, shell and tube heat exchangers - design of finned type heat exchanger – materials of construction – installation and operation - design of single effect evaporators – applications - multiple effect evaporators- Installation and maintenance..

UNIT III DESIGN OF DRYERS AND EXTRUDERS **9**

Design of dryers – cabinet / tray dryer, fluidized bed dryer, vacuum dryer, spray dryer, heat pump dryer, foam mat dryer and freeze dryer – design considerations, installation, operation and maintenance - design considerations of food extruders – single and twin screw extruders – installation, operation and maintenance of food extruders.

UNIT IV DESIGN OF COLD STORAGE AND FREEZERS **9**

Design of cold storage – factors to be considered – estimation of cooling load – construction and operation-construction, installation and maintenance of cold storage -design consideration for controlled atmospheric storage and modified atmospheric storage of perishables-design of freezers – types of freezers – design considerations – construction and operation-design of frozen storage – installation and operation..

UNIT V DESIGN OF MIXING, SIZE REDUCTION AND CONVEYING EQUIPMENTS **9**

Design consideration of mixing and blending equipments – design of agitators and scale up – operation and maintenance - design consideration of size reduction equipments- installation and maintenance-design consideration of material conveying equipments- belt conveyor-pneumatic conveyor- screw conveyor – installation and maintenance- design of plant lay out for a food industry-design of wiring, water supply, drainage-sanitation plan for a food industry.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

- Design and evaluate the crushers and storage tanks
- Apply the design principles of heat exchangers and Evaporators
- Design and study the performance of dryer
- Understand the concept of cold storage design
- Apply the knowledge to design material handling equipments

TEXT BOOKS

1. Joshi, M.V and V.V.Mahajani. 2004 Process Equipment Design (3rd edition). New India Publishing Agency, New Delhi.
2. Phirke, P.S. 2004. Processing and conveying equipment design. Jain Brothers, New Delhi

REFERENCE BOOKS

1. Farrell, A.W. 1983. Engineering for dairy and food products. John Wiley and Sons, New York.
2. George D.Saravacos and Athanasios E.Kostaropouos. 2002. Hand Book of Food Processing Equipment. Kluwer Academic/Plenum Publishers, 233 Spring Street, New York.
3. Hall, C.W and T.J. Hedrick. 1971. Drying of milk and milk products. AVI Publishing Co., West Port, Connecticut.
4. Jowitt, R.(Ed.), 1980. Hygienic Design and operation of food plant. Ellis Horwood, Chichester.
5. Leniger and Beverloo. 1975. Food process engineering. Reidal Publishing Co. Holland.
6. Perry, R.H and C.H.Chilton.1998. Chemical engineering handbook. McGraw Hill, Tokyo.

19UAG910	AGRICULTURAL EXTENSION	L	T	P	C
		3	0	0	3

Objectives

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

UNIT I COMMUNICATION AND PROGRAMME PLANNING 9

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 9

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 9

Modern communication sources – internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kissan Call Centre (KCC), mobile phone.

UNIT IV DIFFUSION AND ADOPTION 9

Diffusion – meaning and elements. Adoption – meaning –adopter categories and factors influencing adoption, stages of adoption, Innovation decision process and attributes of innovation consequences of adoption.

UNIT V CAPACITY BUILDING 9

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

TOTAL : 45 PERIODS

COURSE OUTCOME

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

- Discuss communication and programme planning characteristics
- Study the types of extension teaching methods
- Ability to use the modern communication gadgets
- Understand the diffusion and adoption
- Describe capacity building

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,

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

19UAG911	DRYING AND STORAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To apply basic concepts of drying and storage in real life situations.
- To acquaint the students with traditional and modern storage structures.

UNIT I INTRODUCTION TO DRYING **9**

Moisture content and methods for determination, Importance of EMC and methods of its determination, EMC curve and EMC model, Principle of drying, Theory of diffusion, Mechanism of drying- Falling rate, Constant rate, Thin layer, Deep bed and their analysis; Critical moisture content, Drying models.

UNIT I APPLICATIONS OF DRYING **9**

Calculation of drying air temperature and air flow rate, Air pressure within the grain bed, Shred's and Hukill's curve, Different methods of drying including puff drying, Foam mat drying, Freeze drying; Study of different types of dryers- Performance, Energy utilization pattern and efficiency; Study of drying and dehydration of agricultural products.

UNIT III INTRODUCTION TO STORAGE **9**

Types and causes of spoilage in storage, Conditions for storage of perishable products, Functional requirements of storage, control of temperature and relative humidities inside storage, Calculation of refrigeration load.

UNIT IV MECHANISM OF STORAGE STRUCTURE **9**

Modified atmospheric storage and control of its environment, Air movement inside the storage, Storage of grains, Destructive agents, Respiration of grains, Moisture and temperature changes in stored grains; Conditioning of environment inside storage through natural ventilation, Mechanical ventilation, Artificial drying.

UNIT V STORAGE STRUCTURES **9**

Grain storage structures such as Bukhari, Morai, Kothar, Silo, CAP, Warehouse - Design and control of environment; Storage of cereal grains and their products,Storage of seeds, Hermetically sealed and air-cooled storages- Refrigerated, Controlled atmosphere, Modified atmospheric and frozen storages; Storage condition for various fruits and vegetables under cold and CA storage system; Economic aspects of storage.

TOTAL PERIODS : 45

TEXTBOOK

1. A. S. Mujumdar, “Drying Technology in Agriculture and Food Science”, Oxford and IBH Publishing House, 2000.
2. K. M. Sahay and K. K. Singh, “Unit Operations of Agricultural Processing”, 2nd edition, Vikas Publishing House, New Delhi, 2004.

REFERENCE BOOK

1. J. L. Multon, “Preservation and Storage of Grains, Seeds and their By-products: Cereals, Oil Seeds, Pulses and Animal Feed”. 1st edition, CBS Publishing and Distributions, Delhi, 1989.
2. S. Vijayaraghavan, “Grain Storage Engineering and Technology”, 1st edition, Batra Book Service, New Delhi, 1993.
3. W. L. McCab and J. C. Smith, “Unit Operation in Chemical Engineering”, 7th edition, McGraw Hill, Tokyo, 2005.

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the basic concept of drying and storage structures	**Understand**
CO2	Apply the basic concepts of drying and storage structures for design of various dryers and storage structures	**Apply**
CO3	Analyze the different dryers and structures to increase self-life of agricultural produces.	**Analysis**
CO4	Design and development of dryer and storage structures for local crops.	**Design**
CO5	Evaluate the economical dryers for local crops	**Evaluate**
CO6	Work individual or as team for identify the suitable storage structure to increase the farmer economic	**Individual and team member**

19UAG971	ORGANIC FARMING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study about organic cultivation aspects of different crops.
- To impart the students about importance of agricultural farming in recent trends.

UNIT I Introduction **9**

Ecology and Principles of ecology. Biodiversity: importance and measure to preserve biodiversity. Organic farming: - History of organic farming - global scenario –pre requisites for Organic farming -: status and improvement strategies – conservation tillage.

Unit II CONCEPTS AND PRINCIPLES **9**

Farming system - Definition - Scope - principles and concepts - classification – Collective and cultivation – Advantages and disadvantages– Problems of agriculture - Types of farming – organic and integrated farming system - Importance and advantages. Impacts of green revolution farming – Fate of chemicals in agro ecosystem.

Unit III NUTRIENT SOURCES **9**

Organic sources of nutrients – on farm and off farm sources – organic waste recycling-methods - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers. Panchagavya and other organic solutions – Preparation and usage.

UNIT **IV PEST AND DISEASE MANAGEMENT** **9**

Bio intensive pest and diseases management - physical, cultural, mechanical and biological methods – non-chemical weed management methods: preventive, physical, cultural, mechanical and biological control measures - good crop husbandry practices.

Unit V CERTIFICATION AND EXPORTS **9**

Organic certification – NPOP guidelines - Certification agencies in India – crop production standards - Quality considerations - labeling and accreditation process - marketing and export opportunities.– soil, nutrient, weed, water, pest and disease management – benefits and problems in organic farming: promotional activities.

TOTAL PERIODS : 45

TEXTBOOK

1. Nicholas lampkin 1994. Organic farming. Farming press London.
2. Arunkumarsharma 2008. A Hand book of organic farming. Agrobios Publishers.

REFERENCE BOOK

1. Dahama, A.K.2009. Organic farming for sustainable agriculture, Agrobros publishers.
2. Veeresh, G.K. 2010. Organic farming, Cambridge university press.
3. SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the types of farming and impacts of green revolution farming.
CO2	Elaborate the concepts of organic farming and its principles
CO3	Explain about nutrient sources in organic farming.
CO4	Outline the pest and disease management in organic farming.
CO5	Explain about certification in organic farming.
CO6	Explain about export in organic farming.

19UAG972	BASICS OF LANDSCAPE GARDENING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the concepts of garden landscaping
- To expertise the students in applied gardening concepts
- To develop entrepreneurship skills in landscape gardening
- Study about special type of garden and practices.
- Applications of CAD in landscape garden designing.

UNIT I CONTEMPORARY AND FUTURISTIC LANDSCAPE GARDENING 9

Understanding contemporary and futuristic attitudes to open space garden designs in India – Mughal influence, European influence, Japanese influence, British influence. Latest trend in landscape design – Landscape industry – Landscape profession – India and World.

UNIT II PLANTS AND PURPOSE 9

Plants specific to ecological considerations – Indigenous, native and exotic plant species for sustainable greening – Plants for container growing – Plants for instant gardens – Plants for spring, summer, winter and autumn.

UNIT III PLANTS AND DESIGN 9

Functional uses of plant material – Architectural uses of plant material – Visual plant characteristics – Aesthetic uses of plant material – Planting design process and principles – master plan and design development – planting program

UNIT IV SPECIAL TYPES OF GARDEN AND PRACTICES 9

Vertical garden – roof garden – Terrace garden – Skyrise garden – Bur lapping – Scenic gardens and roadways – Garden with water features and water conservation – Garden for residential and Corporate, civil bodies and urban extensions

UNIT V TURFING AND COMPUTER AIDED DESIGNING 9

Turfing - Turf grasses - Types, species, varieties, hybrids - Selection of grasses for different locations - Advances in turf establishment - Turf management - Irrigation, nutrition, special practices, aerating, rolling, soil top dressing, use of turf growth regulators (TGRs) and micronutrients, turf mowing - Applications of CAD in landscape garden designing.

TOTAL PERIODS : 45

TEXT BOOK

1. Booth, N.K. 1983.Basicelements of landscape architecture designs

REFERENCE BOOK

1. Bose, T.K., R.G. Maiti, R.S. Dhua and P. Das. 1999. Floriculture and Landscaping
2. Christine Wein-Ping Yu .1987. Computer-aided Design: Application to Conceptual Thinking in Landscape Architecture Floriculture Today.
3. Randhawa, G.S. and A. Mukhopadhay. Floriculture in India, Allied publication

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the concepts of garden landscaping
CO2	Study the function of design materials
CO3	Study the characteristics of different plants
CO4	Gain the knowledge of different types of gardening and their practices
CO5	Study the turf characteristics and apply the CAD in gardening
CO6	Filed visit near landscape garden

19UAG973	AGRICULTURAL FARM STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To acquaint and equip the students with farm structures design and construction techniques.
- Understand basic farm management skills, such as farm organization and operation techniques.

UNIT I FARMSTEAD PLANNING AND GRAIN STORAGE **9**

Different types of farm buildings- farm site selection- building arrangement- indigenous food grain storage structures- need for good storage- modern grain storage and concrete bins-threshing and drying floors.

UNIT II HOUSING OF DAIRY CATTLE AND POULTRY **9**

Planning and designing dairy barns- stall barns and loose houses- milking parlor-waste management -poultry housing requirements- common types of poultry houses and their planning-introduction to aquacultural systems

UNIT III FARM FEED STORAGE STRUCTURES AND MACHINERY SHED **9**

Silo-requirement- Types of silo, over ground, underground and others- Design of silos- covered an open space -Machinery sheds- Site Selection-Types and shapes of building- Space requirements-Farm shops, building requirement and space requirement- Fencing, types of fences-fence posts.

UNIT IV RURAL ROADS, FARM WATER SUPPLY AND SEWAGE DISPOSAL **9**

Survey and planning- Geometrical design- Pavement design- Construction and maintenance Typical rural culverts of different sizes, their hydraulic and structural design and construction Sources of water supply- Estimation of quantity for different consumption-Capacity requirements of storage tanks- distribution systems- Design of septic tanks and sanitary structures

UNIT V GREEN HOUSES **9**

Types- Functional Design-Structural material and design-Orientation, ventilation, cooling and types of cladding material – Type design - Water management in green houses.

TOTAL PERIODS : 45

TEXTBOOK

1. Ojha, T.P. and Michael, A. M. (2012). “Principles of Agricultural Engineering”, Vol.-I (Sixth Edition), Jain Brothers, New Delhi.
2. Sharaf, S. (2012). “Green House Management of Horticultural Crops”, Oxford Book Company, New Delhi

REFERENCE BOOK

1. Van Lier, H.N. (1999). “CIGR Handbook of Agricultural Engineering, Vol. I- Land and Water Management Engineering”, ASAE, USA.
2. Bartali, E. H. and Frederick, W. (1999). “CIGR Handbook of Agricultural Engineering, Vol. II- Animal Production and Aquacultural Engineering”, ASAE, USA.

COURSE OUTCOMES

At the end of the course student will be able to

CO1	Understand the design procedures of different housing system Study the layout concepts of machinery shed
CO2	Identify and design the grain storage structures
CO3	Analysis and locate the drainage and farm road
CO4	Design the different components of green house
CO5	Study the layout concepts of machinery shed

15UAG974	AGRIBUSINESS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment
- Apply the acquired knowledge and practical skills to run an agribusiness, develop a business plan.

UNIT I AGRIBUSINESS MANAGEMENT **9**

Concept – components of agribusiness – forms of agribusiness firms. Management - concept – functions of management – managerial roles and skill (Mintzbergs) required atvarious levels of management.

UNIT II MANAGEMENT FUNCTIONS **9**

Planning – steps and types of plans. Organizing – basis for Departmentation. Staffing – human resource planning process. Directing –techniques of direction. Coordination and control - types

UNIT III AGRICULTURAL MARKETING **9**

Functional areas of Agri-business - Production and Operations management - functions, planning physical facilities and managing quality. Agro-inputs and products inventory management – raw material procurement, inventory types, and costs. Marketing management.

UNIT IV AGRICULTURAL BUSINESS FINANCE **9**

Forms of agri-business organizations - Role of lead bank in agribusiness finance – Financial management. Acquiring capital-Budget analysis. Concepts and determinants Business project scheduling of raw material procurement - production management – launching products (branding, placement) - Input marketing promotion activities

UNIT V MARKET PROMOTION AND HUMAN RESOURCES **9**

Agricultural products - marketing promotion activities - product pricing methods. District Industries Centre - Consumer survey - Agricultural inputs retailing - Market potential assessment- types of distribution channels - Return on Investment - Personnel management. Recruitment, selection and training - Technology in Agri Business

TOTAL PERIODS : 45

TEXT BOOK

1. Koontz.H and Weihrich.H, 2013, „Principles of Management‟, Tata McGraw Hill, New Delhi.
2. Howard H Fredrick and Donald F Kuratko, 2010, „Entrepreneurship – Theory, Process, Practice‟, Cengage Learning Publishers, Melbourne
3. Rao, V.S.B, and P.S. Narayana, 2004, „Principles and Practices of Management‟, Konark Publishing Pvt. Ltd. New Delhi.
4. Himanshu, “Agri Business Management – Problems and prospects”, Ritu Publications,

REFERENCE BOOK

1. Chandra Prasanna, “Projects: Preparation, Appraisal, Budgeting and Implementation”, Tata McGraw Hill Publications, New Delhi, 2001.
2. Kotler, P., “Marketing Management. Analysis, Planning and Control”, Prentice Hall Inc., New York, 2001

COURSE OUTCOMES

At the end of the course student will be able to

CO1 Understand management concepts and principles.

CO2 Study the concept and application of management in agribusiness

CO3 Analyze production, consumption and marketing of products.

CO4 Study the Importance of agri-business organization and banks.

CO6 Promote agri-products in market with distribution channels.

19UAG861	MUSHROOM CULTIVATION TECHNOLOGY	L	T	P	C
		1	0	0	1

OBJECTIVES

- To gain knowledge in mushroom production methods and designing mushroom farm

Introduction to mushrooms - historical development and importance, medicinal and poisonous mushroom. Collections and identification of morphology of different mushrooms. Mushroom spawn production- methods of isolation and purification of mushroom. Acquaintance with infrastructure, equipment and machineries required in the mushroom cultivation process. Methods for preparation of spawn. Cultivation techniques of Volvariella, Pleuratus and milky mushroom. Care of mushroom beds. Study of contaminants and diseases limiting mushroom production. And mushroom processing. Post-harvest technology- preservation. Development of small unit model for mushroom cultivation.

TOTAL : 15 PERIODS

COURSE OUTCOME

After completion of this course, the students will able to

- Understand the cultivation practices of different types of mushroom production
- become an efficient agricultural entrepreneur

TEXTBOOKS

1. Mushroom Cultivation in India - B.C.Suman and V.P.Sharma
2. Mushroom Growing for Everyone - G. Roy
3. Mushroom Production and Processing - V.N.Pathak, N.Yadav and M.Gaur

REFERENCES

1. Aneja, K. R. 1996. Experiments in Microbiology, Plant Pathology, Tissue culture and cultivation Mushroom (2nd Edition). WishwaPrakashan, New Delhi.
2. Bahl, N. 2000. Handbook on Mushrooms. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Chadha, K.L. and S.R. Sharma. 1995. Mushroom Bio-technology - Advances in Horticulture. vol. 13. Malhotra Publishing House, New Delhi

		L	T	P	C
19UAG862	**VERMICOMPOST TECHNOLOGY**	1	0	0	1

OBJECTIVES

- To gain knowledge in vermicomposting for bio conservation of biodegradable waste.

Identification of raw materials, availability, types and segregation of wastes – Characterization – Preparation of Coimbatore method of composting – Windrow compost making – Vermicomposting – Acceleration of composting and enrichment of compost with bio-inoculants- Instrumentation techniques in compost analysis – Monitoring the changes during composting – Compost maturity analysis – Physical, Chemical and biological maturity tests – Quality standards – Economics of compost making and marketing – Field visit to small scale compost units – Agro-industrial composting sites and municipal waste composting – Preparation of large scale composting project.

TOTAL:15PERIODS

COURSE OUTCOME

After completion of this course, the students will able to

- Learn to design vermicomposting systems for recycling of all types of waste.

TEXTBOOKS

1. Balakrishnamoorty 2005. Environmental Management .Prentice- Hall of India Private Ltd. New Delhi.
2. Sharma, P.D. 2009, Ecology and Environment, Rastogi Publications, Meerat, India

19UAG863	ENTREPRENEURSHIP IN AGRICULTURE	L	T	P	C
		1	0	0	1

OBJECTIVES

- To Gain knowledge about entrepreneurship in agriculture

Concept of entrepreneurship; entrepreneurial and managerial characteristics; Assessing overall business environment in the Indian economy. Globalisation and the emerging business / entrepreneurial environment. Overview of Indian social, political and economic systems and their implications on agricultural entrepreneurs.

TOTAL:15PERIODS

COURSE OUTCOME

After completion of this course, the students will able to

- Learn to become an efficient agricultural entrepreneur.

TEXTBOOKS

1. Balakrishnamoorty 2005. Environmental Management .Prentice- Hall of India Private Ltd. New Delhi.
2. Sharma, P.D. 2009, Ecology and Environment, Rastogi Publications, Meerat, India

19UAG864	AI IN AGRICULTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain knowledge on various technologies in information and communication for Agriculture
- To introduce the students to areas of agricultural systems in which IT and computers play a major role
- To expose the students to IT applications in precision farming, environmental control systems,

UNIT I AI IN AGRICULTURE

Introduction to AI in agriculture – History of AI in agriculture – challenges of adopting AI – uses of AI – scope of AI in agriculture – impact of AI on agriculture sector – applications of AI – benefits of AI in agriculture – disadvantages of AI -Precision agriculture and agricultural management – Ground based sensors- Agriculture Drones**.**

TOTAL PERIODS : 15

TEXTBOOK

1. National Research Council, “Precision Agriculture in the 21st Century”, National Academies press

REFERENCE BOOK

1. Peart, R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, Newyork , 2004
2. Hammer, G.L., Nicholls, N., and Mitchell, C., “Applications of Seasonal Climate”, Springer, Germany, 2000

COURSE OUTCOMES

At the end of the course student will be able to

CO1	To understand the IT applications in environmental control systems	**Understand**
CO2	The students shall be able to understand the IT applications in precision farming.	**Apply**

19UAG865	SEED PRODUCTION TECHNOLOGY	L	T	P	C
		1	0	0	1

OBJECTIVES

- To study about seed production methods
- To impart the students about importance of quality and certification of the seed

Seed – importance – quality characteristics – history of seed industry- classes of seed - - seed multiplication ratio– Seed certification – phases – procedures field inspection – field counts – contaminants - post harvest inspection – seed standards - bagging – tagging –Seed testing - importance – seed lot – seed sample - sampling methods- Seed Act and Rules –Central Seed Committee-- Seed Control Order1983 – New policy on seed development / New Seed Policy 1988– National Seed Policy2002 - Seed Bill 2004.

TOTAL:15PERIODS

COURSE OUTCOME

After completion of this course, the students will able to

- Study the seed production industry
- Elaborate the concepts of seed production and storage technique
- Gain knowledge about quality control of the seed
- Study the pest and disease management in horticultural crops.
- Gain knowledge about seed certification

TEXTBOOKS

1. P.S.Arya. 1995. Vegetable seed production principles. Kalyani Publishers. New Delhi.
2. S.P.Singh. 1999. Seed production of commercial vegetables. Kalyani Publishers. New Delhi.

REFERENCES

1. K.Vanangamudi et al., 2006. Advances in Seed Science and Technology. Vol. 2. Quality seed production in vegetables. Agrobios (India), Jodhpur. Agrobiosindia.com
2. R.Umarani, R.Jerlin, N.Natarajan, P.Masilamani and A.S.Ponnuswamy (2006) Experimental Seed Science and Technology, Agrobios, Jodhpur.
3. T.S.Verma and S.C.Sharma (2000) Producing Seeds of Biennial Vegetables in Temperate Regions. ICAR, New Delhi.

19UAG866	SOLAR PV SYSTEM	L	T	P	C
		1	0	0	1

OBJECTIVES

- To study photovoltaic power generation technologies

Solar photovoltaic (PV) systems - Components of Solar PV system - Working principle of solar cell - Types of solar cell – efficiency - Applications of solar PV system - home lighting system - Solar Pump – Types - Advantages - Solar Street Light - Solar Lantern - Solar PV power plants - Solar PV fencing and other advanced application - Advantages. Design of PV systems

TOTAL : 15 PERIODS

COURSE OUTCOME

After completion of this course, the students will able to

- Understand the concept of solar PV system
- Design a PV powered system for domestic and industrial applications

TEXTBOOKS

1. Chetan Singh Solanki. 2011. Solar Photovoltaics: Fundamentals, technologies and Applications. ISBN: 978-81-203-4386-3, PHI Learning Pvt. Limited, New Delhi