JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For UG – R20

B. TECH - AGRICUTLTURAL ENGINEERING

(Applicable for batches admitted from 2020-2021)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA - 533 003, Andhra Pradesh, India

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

COURSE STRUCTURE

I Year - I Semester

S. No.	Course Code	Subject	L	T	P	Credits
1	BS1101	Mathematics I (Calculus & Differential Equations)	3	0	0	3
2	BS1102	Principles of Soil Science and Agronomy	3	0	0	3
3	HS1101	English	3	0	0	3
4	ES1103	Engineering Workshop and IT Workshop	1	0	4	3
5	BS1108	Engineering Physics	3	0	0	3
6	HS1102	English and Communication Skills Lab	0	0	3	1.5
7	BS1102	Soil Science and Agronomy Field Lab	0	0	3	1.5
8	BS1109	Engineering Physics Laboratory	0	0	3	1.5
	Total Credits					**19.5**

I Year – II Semester

S. No.	Course Code	Subject	L	T	P	Credits
1	BS1201	Mathematics II (Linear Algebra & Numerical Methods)	3	0	0	3
2	BS1210	Engineering Chemistry	3	0	0	3
3	ES1204	Engineering Mechanics	3	0	0	3
4	ES1201	Programming for Problem Solving Using C	3	0	0	3
5	ES1103	Engineering Drawing	3	0	0	3
6	ES1202	Programming for Problem Solving Using C Lab	0	0	3	1.5
7	BS1211	Engineering Chemistry Laboratory	0	0	3	1.5
8	ES1220	Machine Drawing and Computer Graphics	0	0	3	1.5
9	MC1201	Environmental Science	2	0	0	0
	Total Credits					**19.5**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year- I Semester

S. No	Course Code	Subject	L	T	P	Credits
1	BS	Mathematics III (Vector Calculus, Transforms and PDE)	3	0	0	3
2	PC	Surveying and Leveling	3	0	0	3
3	ES	Fluid Mechanics and Open Channel Hydraulics	3	0	0	3
4	ES	Properties and Strength of Materials	3	0	0	3
5	PC	Farm Power and Tractor Systems	3	0	0	3
6	PC	Surveying and Leveling Lab	0	0	3	1.5
7	ES	Fluid Mechanics and Open Channel Hydraulics Lab	0	0	3	1.5
8	PC	Field Operation and Maintenance of Tractors Lab	0	0	3	1.5
9	SOC	Agricultural Machinery Design using CAD/CAM Skill Oriented Course (Lab)	1	0	2	2
10	MC	Constitution of India				0
		Total Credits				**21.5**

II Year- II Semester

S. No	Course Code	Subject	L	T	P	Credits
1	PC	Heat and Mass Transfer	3	0	0	3
2	PC	Ground Water Hydrology, Wells and Pumps	3	0	0	3
3	PC	Theory of Structures	3	0	0	3
4	PC	Soil Mechanics	3	0	0	3
5	HSS	Managerial Economics and FinancialAnalysis	3	0	0	3
6	PC	Heat and Mass Transfer Lab	0	0	3	1.5
7	PC	Theory of Structures Lab	0	0	3	1.5
8	PC	Soil Mechanics Lab	0	0	3	1.5
9	SOC	Analysis/Simulation using MATLABSkill Oriented Course (Lab)	1	0	2	2
10		Industrial/Research Internship (Mandatory) 2 Months…to be evaluated in III year I semester				
		Total Credits				**21.5**
		Honors (Pool-1)/Minor Courses	3	1	0	**4**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester

S. No	Course Code	Subject	L	T	P	Credits
1	PC	Farm Machinery and Equipment - I	3	0	0	3
2	PC	Surface Water Hydrology	3	0	0	3
3	PC	Post Harvest Engineering of Cereals, Pulses and Oilseeds	3	0	0	3
4	OE	**Open Elective - I**	3	0	0	3
5	PE	**Professional Elective- I** 1. Seed Processing and Storage Engineering 2. Greenhouse Technology 3. Tractor Design and Testing	3	0	0	3
6	PC	Theory of Machines Lab	0	0	3	1.5
7	PC	Electrical Circuits Lab	0	0	3	1.5
8	SOC	Advanced Communication Skills Lab	1	0	2	2
9	MC	Professional Ethics and Human Values	2	0	0	0
10	PR	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester)				1.5
		Total Credits				**21.5**
		Honors (Pool-2)/Minor Courses	3	1	0	**4**

III Year - II Semester

S. No	Course Code	Subject	L	T	P	Credits
1	PC	Soil and Water Conservation Engineering	3	0	0	3
2	PC	Farm Machinery and Equipment - II	3	0	0	3
3	PC	Agricultural Process Engineering	3	0	0	3
4	PE	**Professional Elective II** 1. Food Packaging Technology 2. Watershed Management 3. Human Engineering and Safety	3	0	0	3
5	OE	**Open Elective - II**	3	0	0	3
6	PC	Soil and Water Conservation Engineering Lab	0	0	3	1.5
7	PC	Farm Machinery and Equipment Lab	0	0	3	1.5
8	PC	Agricultural Process Engineering Lab	0	0	3	1.5
9	SOC	Structural Design with ANSYS	1	0	2	2
10	MC	Employability Skills	2	0	0	0
11		Industrial/Research Internship (Mandatory) 2 Months… to be evaluated in IV year I semester				
		Total Credits				**21.5**
		Honors (Pool-3)/Minor Courses	3	1	0	**4**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year – I Semester

S. No	Course Code	Subject	L	T	P	Credits
1	PE	**Professional Elective III** 1. Irrigation and Drainage Engineering 2. Production Technology of AgriculturalMachinery 3. Food Plant Design and Management	3	0	0	3
2	PE	**Professional Elective IV** 1. Design of Soil and Water Conservation and FarmSystems 2. Food Process Equipment Design 3. Design of Agricultural Machinery	3	0	0	3
3	PE	**Professional Elective -V** 1. Micro Irrigation Engineering 2. Mechatronics in Agricultural Engineering 3. Dairy and Food Engineering	3	0	0	3
4	OE	**Open Elective III**	3	0	0	3
5	OE	**Open Elective - IV**	3	0	0	3
6	HSS	Universal Human Values: 2 Understanding Harmony	3	0	0	3
7	SOC	Computational Fluid Dynamics with FLUENT	1	0	2	2
8	PR	Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester)				3
		Total Credits				**23.0**
		Honors (Pool-4)/Minor Courses	3	1	0	**4**

IV Year – II Semester

S. No	Course Code	Subject	L	T	P	Credits
1	PR	Major Project	0	0	0	12
		Total Credits				**12.0**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS PROGRAMMME

S. No.	Course Name	L-T-P	Credits
POOL-1			
1	Management of Canal Irrigation System	3-1-0	4
2	Mechanics of Tillage and Traction	3-1-0	4
3	Post Harvest Engineering of Horticultural Crops	3-1-0	4
POOL-2			
1	Information Technology for Land and Water Management	3-1-0	4
2	Theory of Machines	3-1-0	4
3	Instrumentation and Process Control in Food Industry	3-1-0	4
POOL-3			
1	Landscape Irrigation Design and Management	3-1-0	4
2	Tractor Systems and Controls	3-1-0	4
3	Food Quality and Control	3-1-0	4
POOL-4			
1	Floods and Control Measures	3-1-0	4
2	Bio-energy Systems: Design and Applications	3-1-0	4
3	Aquacultural Engineering	3-1-0	4
MOOC's programme will be notified by HOD at the beginning of the semester with minimum 8/12 weeks in duration to earn the 2 credits.			

Professional electives which are not studied, in any form during the programme, can also be selected for Honors Program

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR PROGRAM
GENERAL TRACK

for II Year II Semester

Course No.	S. No.	Subject	L-T-P	Credits
1	1	Precision Farming Techniques for Protected Cultivation	3-1-0	4
	2	Wasteland Development	3-1-0	4

MINOR PROGRAM
SPECIALIZED TRACKS

Course No.	S. No.	Course Name	L-T-P	Credits
TRACK 1 Farm Machinery and Power Engineering				
2	1	Farm Machinery Design and Production	3-1-0	4
	2	Testing and Evaluation of Tractors and Farm Equipment	3-1-0	4
	3	Earth Moving Machines	3-1-0	4
TRACK 2 Soil and Water Engineering				
3	1	Sprinkler and Micro Irrigation Systems	3-1-0	4
	2	Minor Irrigation and Command Area Development	3-1-0	4
	3	Development of Processed Food Products	3-1-0	4
TRACK 3 Processing and Food Engineering				
4	1	Engineering Properties of Agricultural Produce	3-1-0	4
	2	Agricultural Structures and Environmental Control	3-1-0	4
	3	Food Waste and By-products Utilization	3-1-0	4
MOOC's programme will be notified by HOD at the beginning of the semester with minimum 8/12 weeks in duration to earn the 2 credits.				

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

OPEN ELECTIVE COURSES FOR
OTHER DEPARTMENT STUDENTS

Open Elective	S. No.	Subject	L-T-P	Credits
1	1	Principles of Soil Science and Agronomy	3-0-0	3
2	2	Farm Power and Tractor Systems	3-0-0	3
	3	Soil and Water Conservation Engineering	3-0-0	3
3	4	Ground Water Hydrology, Wells and Pumps	3-0-0	3
	5	Surface Water Hydrology	3-0-0	3
4	6	Post Harvest Engineering of Cereals, Pulses and Oilseeds	3-0-0	3
	7	Agricultural Process Engineering	3-0-0	3

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		3	0	0	3
MATHEMATICS-I (BS) (Calculus & Differential Equations) **(Common to all Branches for I Year B. Tech)**					

Course Objectives:

- To familiarize a variety of well-known sequences and series, with a developing intuition about the behaviour of new ones.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes: At the end of the course, the student will be able to

- utilize mean value theorems to real life problems (L3)
- solve the differential equations related to various engineering fields (L3)
- familiarize with functions of several variables which is useful in optimization (L3)
- apply double integration techniques in evaluating areas bounded by region (L3)
- students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems (L5)

UNIT – I: Sequences, Series and Mean value theorems: (10 hrs)

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders, Problems and applications on the above theorem.

UNIT – II: Differential equations of first order and first degree: (10 hrs)

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories – Electrical circuits.

UNIT – III: Linear differential equations of higher order: (10 hrs)

Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, $e^{ax}V(x)$ and $x^nV(x)$ – Method of Variation of parameters, Cauchy and Legendre's linear equations.

Applications: LCR circuit, Simple Harmonic motion.

UNIT – IV: Partial differentiation: (10 hrs)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and MacLaurin's series expansion of functions of two variables.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT – V: Multiple integrals: (8 hrs)

Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates.
Applications: Finding Areas and Volumes.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14th Edition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		3	0	0	3
PRINCIPLES OF SOIL SCIENCE AND AGRONOMY (BS)					

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

Unit I: **(10 h)**

Soil: Definition –soil as a three phase four component system-branches of Soil science difference between surface and sub surface soil, Rocks: Definition – classification of rocks based on mode of formation-igneous sedimentary and metamorphic rocks, Minerals: Definition, classification, primary, secondary, essential, accessory, silicate, non-silicate minerals, light and heavy minerals primary silicate minerals; quartz, feldspars-micas pyroxenes amphiboles secondary silicate; secondary minerals, Ca, Mg, S and Micronutrient containing minerals-chemical formulate, Weathering:- Definition-types of weathering physical weathering of rocks, agents of physical weathering, temperature, water, wind and glaciers, Chemical weathering, solution, hydration, hydrolysis carbonation-oxidation-reduction biological weathering role of plants and animals in weathering.

Soil formation: Soil forming factors –active and passive soil factors and their role in soil formation, Soil forming processes: Elluviation, illuviation, humification, calcification, laterization, podzolozation, salinization, alkalization and gleization, Soil Profile, Detailed description of theoretical soil profile, Soil physical properties: Soil separates and their properties. Specific surface, soil texture-definition-textural classes-methods of determination of soil texture, importance of soil structure,

Unit II: **(10 h)**

Soil structure; Definition-classification based on type, class and grade, factors influencing formation of aggregates-importance and management of soil structure, Soil structure; Definition-classification based on type, class and grade-factors influencing formation of aggregates-importance and management of soil structure, Soil consistency; Definition-forms of consistency and importance of soil consistency, Bulk density and particle density; factors influencing and their importance; porosity –types-calculation-importance, Soil water; structure of water and the effect of H-bonding on properties of water retention of water in soils-soil moisture tension-soil moisture potential –soil moisture constants.

Soil water movement; saturated, unsaturated and vapor flows, laws governing water flow-Darcy's and Poiseuille's law- Infiltration; Factors-importance. Evaporation; Factors influencing evaporation- Ways to minimize it-soil mulch-organic mulch, etc., Soil air; Composition of soil air-processes of gaseous exchange –soil aeration indices –and their importance (oxygen content-ODR-aeration porosity-redox potential) management of soil air, Soil temperature; influence of soil temperature on plant growth-factors influencing soil temperature-management of soil temperature. Soil color determination importance, Soil colloids: Definition-general properties-inorganic and organic colloids origin of charge on colloids (positive &negative).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Unit-III: **(10 h)**

Secondary silicate clay minerals (inorganic soil colloids) Kaolinite montmoriloniteillite their structures and properties, Ion exchange, Cation and anion exchange –factors influencing ion exchange capacity of soils importance of ion exchange calculation of base saturation and exchangeable acidity, Soil organic matter: importance of organic matter CN ration of organic matter and its importance, Soil biology;- Soil flora and fauna their characteristics role of beneficial organisms mineralization–immobilization, nitrogen fixation, nitrification, denitrification, solubilization of phosphorus and sulphur, Soil fertility:- Concepts of soil fertility and soil productivity:- definitions and differences Arnon's criteria of essentiality-essential and beneficial elements-factors influencing availability of nutrients. Problem Soils: Definition – Physical problems soil depth slope soil crust soil compaction drainage submergence (formation-adverseeffects-effectonsoilpropertiesandplantgrowthmanagement), Chemical problems– classification acid, saline, saline saline-sodic and calcareous soils-characteristics-nutrient availability in problem soils and their reclamation.

Unit-IV: **(10 h)**

Irrigation water: Quality of irrigation water-classification based on EC, SAR, RSC and Boron content-use of saline waters in agriculture, Soil taxonomy: New comprehensive system of soil classification (7^{th} approximation) soil orders and their characteristics, Important soil groups of India: Alluvial soils-black soils –red soils laterite soils and coastal soils.

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

Unit-V: **(8 h)**

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

Weeds- Influence of weeds on crop production, principles and practices of weed management, Basics on soil plant-water relationship, Types of Soil Erosion, Factors influencing soil erosion, Soil conservation, erosion preventive measures, Agronomic measures for soil and water conservation, Dry land Agriculture, Problems of Crop production in dry farming, Agronomic measure in reducing evapo-transpiration losses, Watershed management, aims and Objectives, Organic farming-Sustainable Agriculture, Definition, Principles and importance.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

TEXT BOOKS:

1. Principles of Agronomy, Yella Manda Reddy T & Shankar Reddy, Publications.
2. Nature and Properties of soils. Brady Nyle C and Ray R Well 2002. Pearson Education Inc., New Delhi.
3. Fundamental of Soil Science. Indian Society of Soil Science 1988. IARI, New Delhi.

REFERENCES:

1. Meteorology, William L Donn, 1965, McGraw-Hill Book. Co. New York.
2. Crop Production in Dry Regions, Arnon L 1972, Leonard Hill Publishing Co., London.
3. Manures and Fertilizers, Yawalkar K S and Agrawal J P, 1977, Agricultural Horticultural Publishing House, Nagpur.
4. Principle of Weed Science, Rao V S, 1992, Oxford and IBH Publishing Co. Ltd., New Delhi.
5. Soil Fertility and Fertilizers, Tisdale S L, Nelson W L, Beaton J D and Havlin J L 1995. Prentice-Hall of India, New Delhi.
6. Introduction to Soil Physics, Hillel D 1982. Academic Press, London.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		3	0	0	3
COMMUNICATIVE ENGLISH (HS)					

Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Learning Outcomes

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

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

Unit 1:

Lesson-1: A Drawer full of happiness from "**Infotech English**", Maruthi Publications

Lesson-2: Deliverance by Premchand from "**The Individual Society",**Pearson Publications. (Non-detailed)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Listening: Listening to short audio texts and identifying the topic. Listening to prose, prose and conversation.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.

Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.

Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit 2:

Lesson-1: Nehru's letter to his daughter Indira on her birthday from "**Infotech English**", Maruthi Publications

Lesson-2: Bosom Friend by Hira Bansode from "**The Individual Society",** Pearson Publications.(Non-detailed)

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings.**Reading**: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

Grammar: Use of articles and zero article; prepositions.

Pronunciation: Past tense markers, word stress-di-syllabic words

Unit 3:

Lesson-1: Stephen Hawking-Positivity 'Benchmark' from "**Infotech English**", Maruthi Publications

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Lesson-2: Shakespeare's Sister by Virginia Woolf from "**The Individual Society",** Pearson Publications.(Non-detailed**)**

Listening: Listening for global comprehension and summarizing what is listened to, both in speaking and writing.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed.Functional English:Complaining and Apologizing.

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.Critical reading.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing.E-mail etiquette, Writing CV's.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Pronunciation: word stress-poly-syllabic words.

Unit 4:

Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography from "**Infotech English**", Maruthi Publications

Lesson-2: Telephone Conversation-Wole Soyinka from "**The Individual Society",** Pearson Publications**.**(Non-detailed)

Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.Functional English: Permissions, Requesting, Inviting.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables.Writing SOP, writing for media.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Grammar: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Pronunciation: Contrastive Stress

Unit 5:

Lesson-1: Stay Hungry-Stay foolish from "**Infotech English**", Maruthi Publications

Lesson-2: Still I Rise by Maya Angelou from "**The Individual Society",** Pearson Publications.(Non-detailed)

Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides.Functional English: Suggesting/Opinion giving.

Reading: Reading for comprehension. RAP StrategyIntensive reading and Extensive reading techniques.

Reading for Writing: Writing academic proposals- writing research articles: format and style.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Pronunciation: Stress in compound words

Prescribed text books for theory for Semester-I:

1. "**Infotech English**", Maruthi Publications. (Detailed)

2."**The Individual Society",** Pearson Publications.(Non-detailed)

Prescribed text book for Laboratory for Semesters-I & II:

1. "**Infotech English**", Maruthi Publications. (with Compact Disc)

Reference Books:

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		1	0	4	3
ENGINEERING WORKSHOP AND IT WORKSHOP					

Engg Workshop

Course Objective: To impart hands-on practice on basic engineering trades and skills.
Note: At least two exercises to be done from each trade.

Unit 1:
Introduction to various carpentry tools, materials, types of wood and their characteristics and Processes or operations in wood working; Introduction to Smithy tools and operations; Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Casting processes; Classification, constructional details of center lathe, Main accessories and attachments.

Unit 2:
Main operations and tools used on center lathes. Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations.

Unit 3:
Types of drilling machines. Constructional details of pillar types and radial drilling machines. Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine.

Practical
Trade:

1. Carpentry	1. T-Lap Joint
	2. Cross Lap Joint
	3. Dovetail Joint
	4. Mortise and Tenon Joint
2. Fitting	1. Vee Fit
	2. Square Fit
	3. Half Round Fit
	4. Dovetail Fit
3. Black Smithy	1. Round rod to Square
	2. S-Hook
	3. Round Rod to Flat Ring
	4. Round Rod to Square headed bolt
4. House Wiring	1. Parallel / Series Connection of three bulbs
	2. Stair Case wiring
	3. Florescent Lamp Fitting
	4. Measurement of Earth Resistance
5. **Tin Smithy**	1. Taper Tray
	2. Square Box without lid
	3. Open Scoop
	4. Funnel
6. **IT Workshop**	1. Assembly & Disassembly of Computer

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IT WORKSHOP:

COURSE OBJECTIVES:

The objective of IT Workshop is to

1. Explain the internal parts of a computer, peripherals, I/O ports, connecting cables
2. Demonstrate basic command line interface commands on Linux
3. Teach the usage of Internet for productivity and self-paced lifelong learning
4. Describe about Compression, Multimedia and Antivirus tools
5. Demonstrate Office Tools such as Word processors, Spreadsheets and Presentation tools

Computer Hardware:

Experiment 1: Identification of peripherals of a PC, Laptop, Server and Smart Phones: Prepare a report containing the block diagram along with the configuration of each component and its functionality, Input/ Output devices, I/O ports and interfaces, main memory, cache memory and secondary storage technologies, digital storage basics, networking components and speeds.

Operating Systems:

Experiment 2: Internet Services:

- Web Browser usage and advanced settings like LAN, proxy, content, privacy, security, cookies, extensions/ plugins
- Antivirus installation, configuring a firewall, blocking pop-ups
- Email creation and usage, Creating a Digital Profile on LinkedIn
- Source control on Github, Hackerrank, Codechef, HackerEarth, etc.
- Google hangout/ Skype/ gotomeeting video conferencing
- archive.org for accessing archived resources on the web

Productivity Tools:

Experiment 3: Demonstration and Practice on archival and compression tools

- scanning and image editing tools
- OCR and text extraction
- audio players, recording using Mic, editing, podcast preparation
- video players, recording using webcam/camcorder, editing
- podcast, screencast, vodcast, webcasting

Office Tools:

Experiment 4: Demonstration and Practice on Text Editors like Notepad++, Sublime Text, Atom, Brackets, Visual code, etc.

Experiment 5: Demonstration and practice on Microsoft Word, Power Point

Experiment 6: Demonstration and practice on Microsoft Excel.

Experiment 7: Demonstration and practice on LaTeX and produce professional pdf documents.

Experiment 8: Cloud based productivity enhancement and collaboration tools:

- Store, sync, and share files with ease in the cloud using Google Drive
- Document creation and editing text documents in your web browser using Google docs
- Handle task lists, create project plans, analyze data with charts and filters using Google Sheets
- Create pitch decks, project presentations, training modules using Google Slides
- Manage event registrations, create quizzes, analyze responses using Google Forms
- Build public sites, internal project hubs using Google Sites
- Online collaboration through cross-platform support using Jamboard
- Keep track of important events, sharing one's schedule, and create multiple calendars using Google Calendar

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

TEXT BOOKS:

1. Computer Fundamentals, Anita Goel, Pearson Education, 2017
2. PC Hardware Trouble Shooting Made Easy, TMH

REFERENCES:

1. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr. N.B. Vekateswarlu, S. Chand

WEB RESOURCES:

1. https://explorersposts.grc.nasa.gov/post631/2006-2007/computer_basics/ComputerPorts.doc
2. https://explorersposts.grc.nasa.gov/post631/2006-2007/bitsnbyte/Digital_Storage_Basics.doc
3. https://www.thegeekstuff.com/2009/07/linux-ls-command-examples
4. https://www.pcsuggest.com/basic-linux-commands/
5. https://www.vmware.com/pdf/VMwarePlayerManual10.pdf
6. https://geek-university.com/vmware-player/manually-install-a-guest-operating-system/
7. https://gsuite.google.com/learning-center/products/#!/

COURSE OUTCOMES:

Students should be able to:

1. Assemble and disassemble components of a PC
2. Construct a fully functional virtual machine, Summarize various Linux operating system commands,
3. Secure a computer from cyber threats, Learn and practice programming skill in Github, Hackerrank, Codechef, Hacker Earth, etc.
4. Recognize characters & extract text from scanned images, Create audio files and podcasts
5. Create video tutorials and publishing, Use office tools for documentation, Build interactive presentations, Build websites, Create quizzes & analyze responses.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		3	0	0	3
ENGINEERING PHYSICS (ES)					

Unit-I: Wave Optics **12hrs**

Interference: Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications -Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits(Qualitative) – Grating - Dispersive power and resolving power of Grating(Qualitative).

Polarization: Introduction-Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

Unit Outcomes:

The students will be able to

- **Explain** the need of coherent sources and the conditions for sustained interference (L2)
- **Identify** engineering applications of interference (L3)
- **Analyze** the differences between interference and diffraction with applications (L4)
- **Illustrate** the concept of polarization of light and its applications (L2)
- **Classify** ordinary polarized light and extraordinary polarized light (L2)

Unit-II: Lasers and Fiber optics **10hrs**

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients – Population inversion –Lasing action- Pumping mechanisms – Ruby laser – He-Ne laser - Applications of lasers.

Fiber optics: Introduction –Principle of optical fiber- Acceptance Angle-Numerical Aperture-Classification of optical fibers based on refractive index profile and modes –Propagation of electromagnetic wave through optical fibers - Applications.

Unit Outcomes:

The students will be able to

- **Understand** the basic concepts of LASER light Sources (L2)
- **Apply** the concepts to learn the types of lasers (L3)
- **Identifies** the Engineering applications of lasers (L2)
- **Explain** the working principle of optical fibers (L2)
- **Classify** optical fibers based on refractive index profile and mode of propagation (L2)
- **Identify** the applications of optical fibers in various fields (L2)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT III: Engineering Materials **8hrs**

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius- Mossotti equation- Piezoelectricity.

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization- Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of
magnetic materials: Dia, para, Ferro, antiferro & Ferrimagnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials- Eddy currents- Engineering applications.

Unit Outcomes:

The students will be able to

- **Explain** the concept of dielectric constant and polarization in dielectric materials (L2)
- **Summarize** various types of polarization of dielectrics (L2)
- **Interpret** Lorentz field and Claussius- Mosotti relation in dielectrics(L2)
- **Classify** the magnetic materials based on susceptibility and their temperature dependence (L2)
- **Explain** the applications of dielectric and magnetic materials (L2)
- **Apply** the concept of magnetism to magnetic devices (L3)

Unit-IV: Acoustics and Ultrasonics **10hrs**

Acoustics: Introduction – requirements of acoustically good hall– Reverberation – Reverberation time– Sabine's formula (Derivation using growth and decay method) - Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedial measures.

Ultrasonics: Introduction - Properties - Production by magnetostriction and piezoelectric methods
– Detection - Acoustic grating - Non Destructive Testing – pulse echo system through transmission and reflection modes - Applications.

Unit Outcomes:

The students will be able to

- **Explain** how sound is propagated in buildings (L2)
- **Analyze** acoustic properties of typically used materials in buildings (L4)
- **Recognize** sound level disruptors and their use in architectural acoustics (L2)
- **Identify** the use of ultrasonics in different fields (L3)

Unit-V: Crystallography and X-ray diffraction **8hrs**

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattice – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

X- ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

Unit Outcomes:

The students will be able to

- **Classify** various crystal systems (L2)
- **Identify** different planes in the crystal structure (L3)
- **Analyze** the crystalline structure by Bragg's X-ray diffractometer (L4)
- **Apply** powder method to measure the crystallinity of a solid (L4)

Text books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company
2. Engineering physics – D.K. Battacharya and Poonam Tandon, Oxford University press.
3. Engineering Physics by P.K.Palanisamy SciTech publications.

Reference Books:

1. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons
2. Engineering Physics – M.R.Srinivasan, New Age Publications
3. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
4. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		0	0	3	1.5
ENGLISH COMMUNICATION SKILLS LABORATORY (HS)					

TOPICS

UNIT I:

Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation,

UNIT II:

Word stress-di-syllabic words, poly-syllabic words, weak and strong forms, contrastive stress (Homographs)

UNIT III:

Stress in compound words,rhythm, intonation,accent neutralisation.

UNIT IV:

Listening to short audio texts and identifying the context and specific pieces of information toanswer a series of questions in speaking.

UNIT V:

Newspapers reading;Understanding and identifying key terms and structures useful for writing reports.

Prescribed text book: "**Infotech English**", Maruthi Publications.

References:

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		0	0	3	1.5
SOIL SCIENCE AND AGRONOMY FIELD LAB					

PART-A

To impose the knowledge of student on soil genesis, soil farming process structure, soil organic matte and chemical operation, etc.

It is helpful to the student to design farm implement in relation to soil and to maintain in soil health.

It is fine to the students to know the analyst of irrigation water, based on quality suitable crops will be selected.

PART-B

1. To enable the students to grow suitable agricultural crops and orchard crops and all farming practices.
2. To understand the soil, crop and machine specific parameters for design and development of forms machinery equipment & implements.
3. Students will be acquainted with seed processing equipment, soil and water engineering activating for efficient water and land producing and upcoming organic farming activity.

PART-A

Choose any six labs

1. Study of soil profile and collection of soil samples
2. Determination of bulk density ad particle density of soils
3. Determination of soil texture
4. Determination of Proctor moisture content
5. Determination of soil moisture at different tensions
6. Determination of hydraulic conductivity of soil
7. Determination of infiltration rate soil
8. Determination of soil strength and soil colour
9. Determination of pH and EC of soils
10. Determination of organic carbon content in soils
11. Estimation of available P & K of soils
12. Determination of anions and cations in irrigation water

PART-B

Choose any six labs

1. Visit to college farm
2. Study of meteorological instruments
3. Measurement of rainfall and evaporation
4. Practice of ploughing
5. Practice of pudding
6. Identification of crops and seeds
7. Identification of manures and fertilizers
8. Seed bed preparation for nursery
9. Practice of sowing
10. Soil moisture estimation by direct method
11. Practice of fertilizer application
12. Practice of intercultivation
13. Practice of weeding
14. Practice of harvesting

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - I Semester		L	T	P	C
		0	0	3	1.5
ENGINEERING PHYSICS LABORATORY (BS)					

(For All Non-Circuital Branches like ME, CE, Chemical etc)

(Any 10 of the following listed experiments)

List of Engineering Physics Experiments:

1. Laser: Determination of wavelength using diffraction grating.
2. Young's modulus of given material by Strain gauge method.
3. Study of variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
4. Determination of ultrasonic velocity in given liquid (Acoustic grating).
5. Determination of dielectric constant using charging and discharging method.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Estimation of Planck's constant using photoelectric effect.
8. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).
9. Determination of numerical aperture and acceptance angle of an optical fiber.
10. Determination of thickness of thin object by wedge method.
11. Determination of radius of curvature of given plano convex lens by Newton's rings.
12. Determination of wavelengths of different spectral lines in mercury spectrumusing diffraction grating in normal incidence configuration.
13. Determination of dispersive power of the prism.
14. Sonometer: Verification of laws of string.
15. Measurement of magnetic susceptibility by Kundt's tube method.

References:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
MATHEMATICS - II (BS) (Linear Algebra & Numerical Methods) **(Common to all Branches for I Year B. Tech)**					

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes: At the end of the course, the student will be able to

- develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel (L3)
- evaluate the approximate roots of polynomial and transcendental equations by different algorithms (L5)
- apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)
- apply numerical integral techniques to different Engineering problems (L3)
- apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3)

UNIT – I: Solving systems of linear equations, Eigen values and Eigen vectors: (10 hrs)

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss Elimination method – Eigenvalues and Eigen vectors and properties (article-2.14 in text book-1).

Unit – II: Cayley–Hamilton theorem and Quadratic forms: (10 hrs)

Cayley-Hamilton theorem (without proof) – Applications – Finding the inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.
Singular values of a matrix, singular value decomposition (text book-3).

UNIT – III: Iterative methods: (8 hrs)

Introduction – Bisection method – Secant method – Method of false position – Iteration method –Newton-Raphson method (One variable and simultaneous Equations) – Jacobi and Gauss-Seidel methods for solving system of equations numerically.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT – IV: Interpolation: (10 hrs)

Introduction – Errors in polynomial interpolation – Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

UNIT – V: Numerical differentiation and integration, Solution of ordinary differential equations with initial conditions: (10 hrs)

Numerical differentiation using interpolating polynomial – Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule– Solution of initial value problems by Taylor's series – Picard's method of successive approximations – Euler's method –Runge-Kutta method (second and fourth order).

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44^{th} Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
3. **David Poole,** Linear Algebra- A modern introduction, 4^{th} Edition, Cengage.

Reference Books:

1. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science,Tata Mc. Graw Hill Education.
2. **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
ENGINEERING CHEMISTRY (BS1210)					

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

COURSE OBJECTIVES

- ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- ***Express*** the increases in demand as wide variety of advanced materials are introduced; which have excellent engineering properties.
  Classify and discuss the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also ***summarized***.
- ***Relate*** the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
- ***Explain*** the importance and usage of water as basic material in almost all the industries; ***interpret*** drawbacks of steam boilers and also how portable water is supplied for drinking purposes.

UNIT I: POLYMER TECHNOLOGY 8 hrs

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.
Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).
Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).
Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers.

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Analyze*** the different types of composite plastic materials and ***interpret*** the mechanism of conduction in conducting polymers.

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION 10 hrs

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H_2-O_2, CH_3OH-O_2, phosphoric acid and molten carbonate).
Corrosion:-Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints (constituents, functions and special paints).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Utilize*** the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and c***ategorize*** the reasons for corrosion and study methods to control corrosion.

UNIT III: CHEMISTRY OF MATERIALS **10 hrs**

Part- A:

Nano materials:- Introduction, sol-gel method, characterization by (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]) with example (TiO_2), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications)

Thermal analysis techniques: Instrumentation and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

Part-B:

Refractories: - Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: - Definition, mechanism of lubricants, properties (definition and importance).

Cement: - Constituents, manufacturing, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ratio (AR), chemistry of setting and hardening, deterioration of cement.

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Synthesize*** nanomaterials for modern advances of engineering technology.
- ***Summarize*** the techniques that detect and measure changes of state of reaction.
- ***Illustrate*** the commonly used industrial materials.

UNIT IV: FUELS **10 hrs**

Introduction, calorific value, higher calorific value, lower calorific values, problems using Dulong's formula, proximate and ultimate analysis of coal sample and their significance, numerical problems, petroleum (refining-cracking), synthetic petrol (Fischer Tropsch and Bergius), petrol knocking, diesel knocking, octane and cetane ratings, anti-knocking agents, Introduction to alternative fuels (Bio-diesel, ethanol, methanol, natural gas, liquefied petroleum gas, compressed natural gas), Flue gas analysis by Orsat apparatus, rocket fuels.

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Differentiate*** petroleum, petrol, synthetic petrol and have knowledge how they are produced.
- ***Study*** alternate fuels and a***nalyse*** flue gases.

UNIT V: WATER TECHNOLOGY **8 hrs**

Hardness of water, determination of hardness by complexometric method, boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement), internal treatments, softening of hard water (zeolite process and related sums, ion exchange process), treatment of industrial waste water, potable water and its specifications, steps involved in purification of water, chlorination, break point chlorination-desalination (reverse osmosis and electro dialysis).

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Analyze*** the suitable methods for purification and treatment of hard water and brackish water.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Standard Books:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

Reference:

1. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
2. O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)
4. B. S. Murthy, P. Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press (latest edition)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
ENIGINEERING MECHANICS (BS1204)					

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT I

Objectives: The students are to be exposed to the concepts of force and friction, direction and its application.
Introduction to Engg. Mechanics – Basic Concepts.
Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.
Friction: Introduction**,** limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT II
Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.
Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

UNIT III
Objectives: The students are to be exposed to concepts of center of gravity. The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.
Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures
Centre of Gravity: Centre of gravity of simple body (from basic principles), center of gravity of composite bodies, Pappus theorems.
Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT IV
Objectives: The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.
Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics- Work Energy method and applications to particle motion- Impulse momentum method.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT – V

Objectives: The students are to be exposed to rigid motion kinematics and kinetics

Rigid body Motion: Kinematics and kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse momentum method.

TEXT BOOK:

1. Engg. Mechanics - S. Timoshenko & D.H. Young., 4th Ed., McGraw-Hill publications.

Course outcomes:

1. The student should be able to draw free body diagrams for FBDs for particles and rigid bodies in plane and space and problems to solve the unknown forces, orientations and geometric parameters.
2. He should be able to determine centroid for lines, areas and center of gravity for volumes and their composites.
3. He should be able to determine area and mass movement of inertia for composite sections
4. He should be able to analyze motion of particles and rigid bodies and apply the principles of motion, work energy and impulse – momentum.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
PROGRAMMING FOR PROBLEM SOLVING USING C (ES1201)					

COURSE OBJECTIVES:

The objectives of Programming for Problem Solving Using C are

1) To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
2) To gain knowledge of the operators, selection, control statements and repetition in C
3) To learn about the design concepts of arrays, strings, enumerated structure and union types. To learn about their usage.
4) To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
5) To assimilate about File I/O and significance of functions

UNIT I

Introduction to Computers: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers

Introduction to the C Language: Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers.

Structure of a C Program: Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

UNIT II

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.

Selection & Making Decisions: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions

Repetition: Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples

UNIT III

Arrays: Concepts, Using Array in C, Array Application, Two Dimensional Arrays, Multidimensional Arrays, Programming Example – Calculate Averages

Strings: String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code

Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application

UNIT IV

Pointers: Introduction, Pointers to pointers, Compatibility, L value and R value

Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application

Processor Commands: Processor Commands

UNIT V

Functions: Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Text Input / Output: Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions
Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

TEXT BOOKS:

1. Programming for Problem Solving, Behrouz A. Forouzan, Richard F. Gilberg, CENGAGE
2. The C Programming Language, Brian W. Kernighan, Dennis M. Ritchie, 2ed, Pearson

REFERENCES:

1. Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill
2. Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson
3. Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh, OXFORD

COURSE OUTCOMES:

Upon the completion of the course the student will learn

1) To write algorithms and to draw flowcharts for solving problems
2) To convert flowcharts/algorithms to C Programs, compile and debug programs
3) To use different operators, data types and write programs that use two-way/ multi-way selection
4) To select the best loop construct for a given problem
5) To design and implement programs to analyze the different pointer applications
6) To decompose a problem into functions and to develop modular reusable code
7) To apply File I/O operations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
ENGINEERING DRAWING (ES1103)					

Course Objective: Engineering drawing being the principal method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

Unit I

Objective: To introduce the students to use drawing instruments and to draw polygons, Engg. Curves.

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, involutes, tangents & normal for the curves.

Scales: Plain scales, diagonal scales and vernier scales

Unit II

Objective: To introduce the students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to another plane.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

Unit III

Objective: The objective is to make the students draw the projections of the plane inclined to both the planes.

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

Unit IV

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

Unit V

Objective: The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer Aided Design, Drawing practice using Auto CAD, Creating 2D&3D drawings of objects using Auto CAD

Note: In the End Examination there will be no question from CAD.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L. Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGraw-Hill Publishers
4. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age

Course Outcome: The student will learn how to visualize 2D & 3D objects.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	3	1.5
PROGRAMMING FOR PROBLEM SOLVING USING C LAB (ES1202)					

Course Objectives:

1) Apply the principles of C language in problem solving.
2) To design flowcharts, algorithms and knowing how to debug programs.
3) To design & develop of C programs using arrays, strings pointers & functions.
4) To review the file operations, preprocessor commands.

Exercise 1:

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

Exercise 2:

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3:

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number.

Exercise 4:

1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum. 1 + 1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5:

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.

Exercise 6:

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

Exercise 7:

1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8:

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Exercise 9:

1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10:

1. Write a program in C to demonstrate the use of &(address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11:

1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12:

1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13:

1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc() function.

Exercise 14:

1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc() function. Understand the difference between the above two programs
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15:

1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

Exercise 16:

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.

Course Outcomes:

By the end of the Lab, the student

1) Gains Knowledge on various concepts of a C language.
2) Able to draw flowcharts and write algorithms.
3) Able design and development of C problem solving skills
4) Able to design and develop modular programming skills.
5) Able to trace and debug a program

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	3	1.5
ENGINEERING CHEMISTRY LABORATORY (BS1211)					

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn^{+2} using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Cu^{+2} using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe^{+3} by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of iso-electric point of amino acids using pH-metry method/conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg^{+2} present in an antacid.
13. Determination of $CaCO_3$ present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.
17. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

Outcomes: The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	3	1.5
MACHINE DRAWING AND COMPUTER GRAPHICS LABORATORY					

Out comes:

1. Practical skills on preparing manual drawings of model isometric view of the objects, machine components, assembly drawings of different joints.
2. Practice on drawing of missing views; principles of dimensions and their methods.
3. Practical skills on sectioning concepts and its drawing & mechanical parts.
4. Practical skills on types of rivet heads & parts, square headed and hexagonal nuts, bolts, different types lock nuts, stands machine screws.
5. Practical knowledge on components of CAD and its hardware requirements, terms & command in Auto CAD software for practice.
6. Practical skills on drawing of riveted joints and thread fasteners, computer graphics in agricultural engineering applications, practice of commands in Auto CAD software.
7. Practical skills on 2-D drawings and projects in Auto CAD.

Course Objectives:

1. Preparation of manual drawings with dimensions from Model and Isometric drawings of objects and machine components
2. Assembly drawings of machine components – Screw jack, knuckle joint, stuffing box and cotter joint
3. Drawing of missing views
4. Dimensioning methods and principles of dimensioning
5. Concept of sectioning, revolved and oblique section (Explanation of full sectioning and half sectioning concepts)
6. Sectional drawing of simple machine parts – Foot step bearing, shaft support, stuffing box
7. Types of rivet heads and riveted joints (Processes for producing leak proof joints, Symbols for different types of welded joints)
8. Square headed and hexagonal nuts and bolts
9. Different types of lock nuts, studs, machine screws
10. CAD System components and computer hardware for CAD
11. Explanation of draw tool bar commands in AutoCAD software
12. Drawing of riveted joints and thread fasteners
13. Computer graphics for agricultural engineering applications
14. Practice in the use of basic and drawing commands on AutoCAD
15. Generating simple 2-DdrawingswithdimensionsusingAutoCAD
16. Small projects using CAD

REFERENCES:

1. Elementary Engineering Drawing. Bhat. N.D. 1995. Charotar Publishing House, Anand.
2. MachineDrawing.BhattN.DandPanchalV.M.1995.CharotarPublishingHouse,Anand.
3. Machine Drawing. Narayana K.L. Kannaiah P. and Venkata Reddy K. 1996. New Age International Ltd., New Delhi.
4. Mastering CAD / CAM with Engineering Subscription Card. Ibhrahim Zeid, McGraw-Hill Science / Engineering / Math; 1st Edition (May 21,2004).
5. Principals of CAD / CAM / CAE/ Systems. Kunwoo Lee, Addison –Wesley.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

I Year - II Semester		L	T	P	C
		2	0	0	0
ENVIRONMENTAL SCIENCE (MC1201)					

Learning Objectives:
The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

UNIT-I:
Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance –Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects; Role of information technology in environment and human health.
Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT-II:
Natural Resources: Natural resources and associated problems.
Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.
Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.
Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT-III:
Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT – IV Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his wellbeing.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT – V Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3. Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference:

1. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
MATHEMATICS-III (Vector Calculus, Transforms and PDE)					

Course Objectives:

- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Course Outcomes: At the end of the course, the student will be able to

- interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- estimate the work done against a field, circulation and flux using vector calculus (L5)
- apply the Laplace transform for solving differential equations (L3)
- find or compute the Fourier series of periodic signals (L3)
- know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- identify solution methods for partial differential equations that model physical processes (L3)

UNIT –I: Vector calculus: (10 hrs)

Vector Differentiation: Gradient– Directional derivative – Divergence– Curl– Scalar Potential.
Vector Integration: Line integral – Work done – Area– Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and problems on above theorems.

UNIT –II: Laplace Transforms: (10 hrs)

Laplace transforms – Definition and Laplace transforms of some certain functions– Shifting theorems – Transforms of derivatives and integrals – Unit step function –Dirac's delta function Periodic function – Inverse Laplace transforms– Convolution theorem (without proof).
Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

UNIT –III: Fourier series and Fourier Transforms: (10 hrs)

Fourier Series: Introduction– Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.
Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties (article-22.5 in text book-1)– inverse transforms – Convolution theorem (without proof) – Finite Fourier transforms.

UNIT –IV: PDE of first order: **(8 hrs)**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

UNIT – V: Second order PDE and Applications: (10 hrs)

Second order PDE: Solutions of linear partial differential equations with constant coefficients –Non-homogeneous term of the type e^{ax+by} ,$\sin(ax+by)$, $\cos(ax+by)$, $x^m y^n$.
Applications of PDE: Method of separation of Variables– Solution of One-dimensional Wave, Heat and two-dimensional Laplace equation.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.
3. **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
SURVEYING AND LEVELING					

Course Objectives:
Surveying and leveling curriculum which is re-oriented to the needs of non-circuital branches of graduate engineering courses offered by JNT University: Kakinada that serves as a transit to understand the branch specific advanced topics. The course is designed to:

UNIT – I (9 hrs)
INTRODUCTION: Overview of plane surveying (chain, compass and plane table), Objectives, Principles and classifications. Distance measurement conventions and methods; use of chain and tape, Electronic distance measurements, Meridians, Azimuths and Bearings, declination, computation of angle.

UNIT – II (7 hrs)
LEVELING AND CONTOURING: Concept and Terminology, Temporary and permanent adjustments- method of leveling. Characteristics and Uses of contours- methods of conducting contour surveys and their plotting.

UNIT – III (10 hrs)
COMPUTATION OF AREAS AND VOLUMES: Area from field notes, computation of areas along irregular boundaries and area consisting of regular boundaries. Embankments and cutting for a level section and two level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits.

UNIT - IV (8 hrs)
THEODOLITE: Theodolite, description, uses and adjustments – temporary and permanent, measurement of horizontal and vertical angles. Principles of Electronic Theodolite. Trigonometrical leveling, Traversing.

UNIT – V (14 hrs)
TACHEOMETRIC SURVEYING:
Stadia and tangential methods of Tacheometry. Distance and Elevation formulae for Staff vertical position. Types of curves, design and setting out – simple and compound curves.
INDTRODUCTION TO ADVANCED SURVEYING : Introduction to geodetic surveying, Total Station and Global positioning system, Introduction to Geographic information system (GIS).

TEXT BOOKS:
1. "Surveying (Vol – 1, 2 & 3), by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi
2. Duggal S K, "Surveying (Vol – 1 & 2), Tata Mc-Graw Hill Publishing Co. Ltd. New Delhi, 2004.
3. Text book of surveying by C. Venkataramaiah, University Press.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCES:

1. Arthur R Benton and Philip J Taety, Elements of Plane Surveying, McGraw Hill – 2000
2. Arora K R "Surveying Vol 1, 2 & 3), Standard Book House, Delhi, 2004
3. Chandra A M, "Plane Surveying", New age International Pvt. Ltd., Publishers, New Delhi, 2002.
4. Chandra A M, "Higher Surveying", New age International Pvt. Ltd., Publishers, New Delhi, 2002.
5. Surveying and levelling by R. Subramanian, Oxford university press, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS					

Objective: To enable the students to design efficient water conveyance systems like canals, channels and pipes from places of origin to delivery points by acquiring knowledge on the principles of mechanics of fluids, water measurement and regulation and open channel hydraulic principles.

Outcomes:

Acquaintance of skills on basic principles of fluid, their properties, flow patterns, classificationof flow regimes etc.,

Impart knowledge on boundary layer theory and their principals, alynamies of fluid flow andtheories of flow regimes – energy calculations.

Development of skills on Buoyancy principals, flow measuring devises, their flow dynamics. Skill development on flow through pipes & their concepts, dynamics of mix flow principles ofdimensional analysis and similitude, open channel flow dynamic.

Skill development on open channel flow dynamics, concepts & principles, their design procedures.

Unit – I:

Fluids-Definitions-classification-properties, dimensions. Fluid pressure–Introduction–measurement of fluid pressure, peizometer tube manometry, types of manometers. Mechanical gauges-Bourdon's tube pressure gauge, diaphragm pressure gauge, dead weight pressure gauge. Fluid static force on submerged surfaces, total force on horizontal, vertical and inclined surfaces. Center of pressure of an inclined immersed surface, center of pressure of a composite section. Pressure on a curved surface and its applications. Kinematics of fluid flow– Introduction, continuity of fluid flow, Types of flow lines.

Unit –II:

Boundary layer theory- Thickness of boundary layer, Thickness of boundary layer in a laminar flow, Thickness of boundary layer in a turbulent flow, Prandtl's experiment of boundary layer separation. Dynamics of fluid flow – Various forms of energy in fluid flow, frictional loss, general equation. Bernoulli's theorem, Euler's equation of motion. Practical applications of Bernoulli's theorem, verturimeter, pitot tube, orifice meter.

Unit – III:

Buoyancy of flotation – metacentric height. Flow through orifices (measurement of discharge)

– Types of orifices, jet of water, vena contracta, hydraulic coefficients, experimental method for hydraulic Coefficients, discharge through a rectangular orifice. Flow through orifices (measurement of time) – Time of emptying a square, rectangular or circular tank through an orifice at its bottom, time of emptying a hemispherical tank through an orifice at its bottom. Time of emptying a circular horizontal tank through an orifice at its bottom. Time of emptyinga tank of variable cross-section through an

orifice. Flow through mouthpieces – Types of Mouthpieces; Loss of head of a liquid flowing in a pipe, discharge through a mouthpiece. Flow over notches- Types of notches, discharge over a rectangular notch, triangular notch, stepped notch. Time of emptying a tank over a rectangular notch, triangular notch. Flow over weirs – Types of weirs, discharge over a weir, Francis's formula for discharge over a rectangular weir (effect of end contractions), Bazin's formula for discharge over a rectangular weir, velocity of approach, determination of velocity of approach.

Unit – IV:

Flow through simple pipes – Loss of head in pipes, Darcy's formula for loss of head in pipes, Chezy's formula for loss of head in pipes. Transmission of power through pipes, Time of emptying a tank through a long pipe, Time of flow from one tank into another through a long pipe. Flow through compound pipes – Discharge through a compound pipe (pipes in series), discharge through pipes in parallel, equivalent size of a pipe, discharge through branded pipes from one reservoir to another. Dimensional analysis and similitude – Rayleigh's method and Buckingham's pi theorem. Types of similarities, dimensional analysis, dimensionless numbers, introduction to fluid machinery. Open channel hydraulics- classification of open channel and definitions. Chezy's formula for discharge through an open channel.

Unit – V:

Bazin's formula for discharge through open channel, numerical problems on design through open channel, Kutter's formula for discharge, problems on design. Manning's formula for discharge through an open channel. Channels of most economical cross sections – Conditions for maximum discharge through a channel of rectangular section, trapezoidal section, circular section. Specific energy concept - Specific energy of a following fluid, specific energy diagram, critical depth, type of flows, critical velocity. Velocity and pressure profiles in open channels. Hydraulic jump, types of hydraulic jumps, depth of hydraulic jump, loss of head due to hydraulic jump.

TEXT BOOKS:

1. Hydraulics and Fluid Mechanics, Modi P M and Seth S. M. 1973. Standard Book House,Delhi.
2. Open Channel Hydraulics, Chow V T, 1983, McGraw Hill Book Co., New Delhi.

REFERENCES:

1. A Text book of Hydraulics, Fluid Mechanics and Hydraulic Machines, Khurmi, R. S. 1970., S. Chand & Company Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
PROPERTIES AND STRENGTH OF MATERIALS					

Objective: To enable the students to know about different materials used for engineering constructions like buildings, roads, farm structures and metals and other materials for manufacturing farm equipment, implements, dairy and food processing equipment.

Outcomes:

Skill development on basic properties of engineering materials and their uses, testing ofmaterials.

Knowledge development on properties and application of difference of concrete, varieties, distempers, glass, rubber and plywood, plastics, iron-based materials, alloys etc., Development of skill on stress – strain analysis of beams under different types of loadingpatterns.

Acquaintance of skill on Euler's theory and buckling load, analysis on columns & differenttypes of columns.

Skill development on different types of joints (Riveting), welding analysis cantilever, fixed,continuous beams, theory of moments and their analysis.

Unit- I:

Properties of engineering materials, classifications of rocks, sources of stones and natural bed of stones, properties, varieties and uses of stones, properties, composition and uses of bricks, classification and tests of bricks, properties, varieties and uses of tiles, properties, varieties and uses of Lime, Properties, varieties and uses of Cement, Properties, varieties anduses of cement mortar, properties.

Unit - II

Varieties and uses of concrete, properties, varieties and uses of sand, properties, varieties and uses of paints, properties, varieties and uses of varnishes, properties, varieties and uses of distempers. Characteristics and uses of glass, rubber, plywood, plastics. Characteristics and uses of wrought iron, cast iron, steel, aluminium, copper, nickel; Alloys of Aluminium and its properties, Alloys of Copper and its properties, Alloys of Nickel and its properties; Definition and types of timber, seasoning of timber, industrial timber and uses of timber, Methods of heat treatment of steel.

Unit-III:

Introduction – Stresses, tensile, compressive and shear-strains, units-elastic curv- Elastic limit Poisons ratio, stresses in uniformity tapered circular sections, stresses in bars of composite, sections, thermal stresses and strains in simple bars and composite bars; Elastic constants- Young's modulus, bulk modulus and shear modulus - relation between them; Stresses on oblique planes, Mohr's circle method; Direct stresses in one plane, direct stresses in two planes- accompanied by shear stress. Deflection of beams, relation between slope, deflection and radios of curvature. Methods of finding out slopes and deflections of beams, double integration method. Slope and deflection equations of a simply supported beam with

a central point load, simply supported beam with eccentric point load. Simply supported beam with a uniformly distributed load, Columns and struts.

Unit-IV:

Euler's column theory. Assumptions of Euler's column theory; Buckling load-derivations, types of end conditions of columns, both ends hinged, both ends fixed, one end fixed and other hinged; Expression for buckling load of a column with one end fixed other free, with one end fixed and other hinged, expression for buckling load of a column with both ends hinged, with both ends. Fixed types of end conditions of columns, both ends hinged, both ends fixed, one end fixed and other is hinged and one end fixed and other end is free. Types of end conditions of columns, both ends hinged, both ends fixed, one end fixed and other is hinged and one end fixed and other end is free. Limitations of Euler's formula Rankine's formula for columns.

Unit-V:

Riveted joints, types of joint strength of a rivet and riveted joint, efficiency of a riveted joint. Design of riveted joints, eccentric riveted connections, Welded joist, types of welded joints, strength of welded joints, technical terms. Design of welded joints, eccentric welded joints. Dams, forces acting, stressed at the base of dam. Stability of dams, design of base width of dams. Propped cantilever and beams – Deflection and slope equations; Fixed and continuous beams – Deflection and slope equations, Super position theorem – Claypeyron's theorem of three moments, application of Clayperon's theorem of three moments, Moment distribution methods. Analysis of statistically - indeterminate beams.

TEXT BOOKS:

1. Engineering Materials, Rangwala, S.C.1994. Charotar Publishing House, Anand.
2. Strength of Materials by Ramamrutham S. 2003. Dhanapathrai & Sons, Nai Sarak, NewDelhi.

REFERENCES:

1. Material of constructions Deshpande R S 1977. United Book Corporation, Poona.
2. Manufacturing Process. Hazra Choudhury 1985. Media Promoters and PublishersPrivate Limited, Bombay.
3. Workshop Technology (Part-I) Chapman W.A.J. 1994. Aronold Publishers, New Delhi.
4. Engineering Materials. Rangwala S.C. 1994. Charotar Publishing House, Anand.
5. Mechanics of Structures (Vol.I) Junnarkar S.B. 2001 - Charotar Publishing House,Anand.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
FARM POWER AND TRACTOR SYSTEMS					

Objective: To enable the students for acquiring the knowledge pertaining to systems like transmission system clutch, types of clutches, types of Gear, sliding, constant mesh type tractor power out lets like P. T.O, belt pulley, drawbar, traction theory rolling, resistance, rim pull, crawler tractor.

Outcomes:

Skill development on farm power sources classification I.C engine components & construction, operating systems.

Skill development on fuel supply ignition, cooling & lubrication electrical ignition, fuels & their properties, governing systems of IC engines, power transmission, clutches & its applications.

Acquaintance of knowledge on clutch types, concepts & principles, single & multiple plate clutches, working mechanism, gear theory and principles, differential unit of its functions, final drive & its applications.

Skill development on principles of fluid coupling &torque connector, brakes principles, classification & friction concepts of hydraulic system in factors.

Skill development on tractor powers outlets, P.T.O and its applications, Tractor testing and its main components, CG estimation, Tractor chassis its mechanics.

Unit-I:

Source of farm power – Conventional and non conventional energy sources, classification of tractor and I.C engines, study of I.C engine components and their construction, operating principles and functions, Engine systems and their construction details and adjustment.

Unit-II:

Valves and valve mechanism, fuel and air supply stems, cooling and lubricating systems, electrical and ignition systems, I.C engine fuels and their properties, detonation and knocking in IC engines, Study of properties of coolants, antifreeze and anti corrosion materials, Lubricant types & study of their properties – Engine governing systems. Introduction to transmission system – Power transmission system of tractor – Functions of a power transmission system. Clutch – Necessity of clutch in a tractor, essential features of good clutch, principal working of clutch, clutch repairs and maintenance.

Unit-III:

Types of clutch – Friction clutch, dog clutch and fluid coupling, friction clutch – Single plate clutch or single disc clutch, multiple plate clutch or multiple disc clutch, cone clutch. Single plate clutch or single disc clutch – Constructional details and principle of working mechanism. Multiple plate clutch, splinted sleeve clutch type – Constructional details and principle of working mechanism ratchet and pawl arrangement mechanism – Constructional details and principle of working mechanism. Gears – Necessity for providing gear box, Selective sliding type, constant mesh type, Mechanical advantage in gears, torque ratio in gears, working of gear box. Differential unit and final drive – Differential, functions of crown wheel, differential lock, functions, final drive – functions

of final drive.

Unit-IV:

Fluid coupling and torque connector, brake mechanism, requirements of good braking systems, classification of brakes, Mechanical brake and hydraulic brake – Working mechanism. Steering mechanism – Qualities of steering mechanism, main parts of steering mechanism types of steering boxes, working of hydraulic steering. Hydraulic control system – Working principals, basic components of hydraulic system – Types of hydraulic system, position control, draft control, mixed control, precautions for hydraulicsystem.

Unit-V:

Tractor power outlets – P.T.O., construction details; Belt pulley constructional details, tractor power out let, draw bar, construction details. Traction - Traction efficiency, method for improving traction, coefficient of traction, rolling resistance, wheel slip or track slip, Rimpul - crawler tractor. Tractor testing – Preparation for tests, types of tests, test at the main power take off, test at varying speeds at full load, test at varying load, belt or pulley shaft test, drawbar test, tractor engine performance. Determination of centre of gravity, Suspension method, balancing method, weighing method. Tractor chassis machines, functions of chassis frame. Tractor chassis – Mechanics of tractor chassis.

TEXT BOOKS:

1. Farm Tractor Maintenance and Repair. Jain. S.C. and Roy C.R. 1984. TMH Publishing Co. Ltd., New Delhi.
2. Tractors and their power units. Lijedhal J.B. Carleton W.M. Turnquist P. K. andSmith D.W. 1984. AVI Publishing Co. Inc., Westport, Connecticut.

REFERENCES:

1. Farm Gas Engines and Tractors. Fred J.R. 1963. Allied Publisher Pvt. Ltd., Bombay.
2. Farm Machines and their Equipment. Nakra C.P., 1986. Dhanpet Rai and Sons. 1982Nai Sarak, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		0	0	3	1.5
SURVEYING AND LEVLEING LAB					

(Any 10 of the following listed 15 experiments)

LIST OF EXPERIMENTS:

1. Survey of an area by chain survey (closed traverse) & Plotting.
2. Determination of distance between two inaccessible points with compass.
3. Surveying of a given area by prismatic compass (closed traverse) and plotting after adjustment.
4. Radiation method, intersection methods by plane Table survey.
5. Two point and three-point problems in plane table survey.
6. Fly leveling (differential leveling).
7. An exercise of L.S and C.S and plotting.
8. One exercise on contouring.
9. Study of theodolite in detail - practice for measurement of horizontal and vertical angles.
10. Measurement of horizontal angles by method of repetition and reiteration.
11. Trigonometric Leveling - Heights and distance problem (Two Exercises).
12. Heights and distance using Principles of tacheometric surveying (Two Exercises).
13. Area determination, traversing contouring using total station.
14. Determination of remote height and state out using total station.
15. Distance, gradient, Difference in height between two inaccessible points using total station.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		0	0	3	1.5
FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS LAB					

Outcomes:

1. Imparting practical skills on determination of metacentric height and Bernouli's theorem.
2. Exposure to practical skills on measurement of discharge with venturimeter and pilot tubes.
3. Acquiring practical skills on determing discharge coefficient of rectangular, triangular and trapezoidal weir and orifices.
4. Imposing practical skills on flow measurement ……. Broad crested weirs and open channels.
5. Imposing practical skills on determination of head losses in pipes, roughness coefficient of open channels.
6. Practical exposes on determination of velocity and pressure in open channels, construction of flownet problems on flownets.

Practical

1. Determination of metacentric height
2. Verification of Bernouli's theorem
3. Measurement of discharge with a venturimeter
4. Measurement of velocity with a pilot tube
5. Determination of coefficient of discharge of rectangular weir
6. Determination of coefficient of discharge of triangular weir
7. Determination of coefficient of discharge of trapezoidal weir
8. Determination of hydraulic coefficient of orifices
9. Experiment on broad crested weir
10. Determination of head losses in pipes
11. Experiments on open channels
12. Determination of roughness coefficients of open channels
13. Measurement of velocity and pressure profiles in open channels
14. Construction of flownet
15. Problems on construction of flownet

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		0	0	3	1.5

FIELD OPERATIONSAND MAINTENANCE OF TRACTORS LAB

Objectives: To enable the students for acquiring the knowledge pertaining to maintenance of tractors like periodical maintenance (50 to 100 hours, 200 to 250 hours, 480 to 500 engine working hours, 960 to 1000 hours) and trouble shooting and remedial measures of all systems - fuel system, lubrication system, cooling system and ignition system.

Outcomes:

1. Improved practical skills on air kind fuel filtration systems, lubrication system and theirmaintenance in tractors.
2. Practical skills improvement on maintenance of transmission and radiators cooling systems in tractor.
3. Practical skills development on maintenance of tractor ignition and hydraulic systems.
4. Practical knowledge on periodical maintenance of tractors, emission of smoke, clutch andbrake system maintenance.
5. Practical skill development on maintenance of train machinery and implements.
6. Practical knowledge on tractor on-off practice of tractors.

1. Tractor Systems - maintenance of air fuel system – cleaning of air cleaners – frequent troubles and Remedies – process to remove air lock in the diesel engine – precautions in handling diesel fuels in diesel engine.
2. Maintenance of lubrication system – frequent troubles and remedies – troubles in lubricationsystem excessive oil consumption – care and maintenance of lubrication system.
3. Maintenance of transmission system – general maintenance – differential troubleshooting – Frequent troubles and Remedies.
4. Maintenance of cooling system and cleaning of radiators - frequent troubles and remedies – cooling system troubles – over heating – slow warm up of the engine – careand maintenance of cooling system.
5. Maintenance of ignition system – care and maintenance of batteries – Frequent troubles and remedies – causes of ignition failure in battery system.
6. Maintenance of hydraulic system – working principle – basic components of hydraulic system – types of hydraulic system – frequent troubles and remedies – repairs and maintenance of hydraulic system – precautions of hydraulic system.
7. Periodical maintenance of tractors – at 8 – 10 engine working hours – at 50 – 60 engine working hours and at 100-120 engine working hours
8. Periodical maintenance of tractors – at 200-250 engine working hours, at 480-500 engine working hours and at 960 – 1000 engine working hours.
9. Emission of smoke – over heating of engines - maintenance of clutch brakes hydraulic problems.
10. Maintenance of agricultural machinery before and after use like primary tillage implements,

    M.B. plough, disc plough and secondary tillage implements - harrows, seed drills, weeders,cultivators.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

11. Starting and stopping practice of the tractor and familiarization with instrumentationpanel and controls
12. Driving in forward and reverse gears, driving safety sales and study bean trepanned.

REFERENCES:

1. Elements of Agricultural Engineering. Jasgishwara Sahay 1992. Agro Book Agency,Patna.
2. Farm Tractor Maintenance and Repair. Jain S.C. and Roy C.R. 1984. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. Tractors and their Power units. Liledahi J.B. Carleton W.M. Turnquist P.K. andSmith D.W. 1984. AVI Publishing Co., Inc., Westport, Connecticut.
4. Farm Machines and their Equipment. Nakra C.P. 1986 Dhanpet Rai and Sons. NewDelhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		1	0	2	2
AGRICULTURAL MACHINERY DESIGN USING CAD/CAM					

LIST OF EXPERIMENTS

1. Application of computers for designing and Overview of CAD window – explanation of various options on drawing screen.
2. Study of draw tool bar and practice on draw tool bar.
3. Study on dimension and dimensional editing tool bar and Practice on dimensiontoolbar.
4. Study of OSNAP, and application OSNAP.
5. Study on layer command and modifying drafting.
6. Practice on mirror, offset and array commands.
7. Practice on trim, extend, chamfer and fillet commands.
8. Practice on copy, move, and scale and rotate commands.
9. Practice on rotate and trim commands.
10. Drawing of 2 D- orthographic projections using draw tool bar.
11. Drawing of 2 D- orthographic projections and dimensioning using draw tool bar.
12. Drawing of isometric projections.
13. Practice on creating boundary, region, hatch and gradient commands.
14. Practice on Editing polyline-PEDIT and Explode commands.
15. 2D - Drawing of knuckle joint.
16. Drawing of hexagonal, nut and bolt.
17. Practice on 3-D commands- Extrusion and loft commands.
18. Practice on 3-D commands on sweep and press pull commands.
19. Practice on 3-D Commands- revolving and joining commands.
20. Demonstration on CNC machine and simple problems.

TEXT BOOK:

1. Rao P.N. 2002, “CAD/CAM Principles and Applications”. McGraw-Hill Education Pvt.Ltd., New Delhi.

REFERENCE BOOK:

1. Sareen Kuldeep and Chandan Deep Grewal. 2010, “CAD/CAM Theory and Practice”. S. Chand & Company Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - I Semester		L	T	P	C
		2	0	0	0
CONSTITUTION OF INDIA					

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative

Course Outcomes:

At the end of the course, the student will be able to have a clear knowledge on the following:

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government.
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
  1. Know the sources, features and principles of Indian Constitution.
  2. Learn about Union Government, State government and its administration.
  3. Get acquainted with Local administration and Pachayati Raj.
  4. Be aware of basic concepts and developments of Human Rights.
  5. Gain knowledge on roles and functioning of Election Commission

UNIT I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Learning outcomes:After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties

UNIT II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;

Learning outcomes: After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

UNIT III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Learning outcomes: After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secretariat

UNIT IV

A.Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Learning outcomes:-After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Myer and elected representatives of Municipalities
- Evaluate Zillapanchayat block level organisation

UNIT V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women

Learning outcomes: After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election commissioner and Commissiononerate
- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

References:

1) Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India Pvt. Ltd.
2) SubashKashyap, Indian Constitution, National Book Trust
3) J.A. Siwach, Dynamics of Indian Government & Politics
4) D.C. Gupta, Indian Government and Politics
5) H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6) J.C. Johari, Indian Government andPolitics Hans
7) J. Raj IndianGovernment and Politics
8) M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9) Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

e-Resources:

1) nptel.ac.in/courses/109104074/8
2) nptel.ac.in/courses/109104045/
3) nptel.ac.in/courses/101104065/
4) www.hss.iitb.ac.in/en/lecture-details
5) www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
HEAT AND MASS TRANSFER					

Objective: To enable the students to know about the transport phenomenon in materials through heat and mass transfer for applications in unit operations of dairy and food engineering.

Outcomes:

Skill development on principles of heat and mass transfer, steady state heat transfer & its analysis, measurement of thermal conducting of pleasure & composite walls, tubes and spheres, multilayer tubes.

Skill development on conduction principles of different materials in parallel, combined convection and conduction, concept of insulation.

Skill development on conduction, convection and radiation analysis of heat and mass transfer, different laws on radiation theory.

Imparting skills on unsteady state analysis of heat transfer in fins, free & force convection, cooling theories and principles.

Skill development on theory and principles of heat exchanges, their analysis, frick's law of mass transfer coefficients, Reynolds analogy.

Unit – I:

Introductory concepts, application of heat and mass transfer, modes of heat transfer examples, Fourier's law of heat transport. Introduction to steady state heat transfer - One dimensional steady state heat conduction equation. Thermal conductivity of different materials – Measurement - insulation Materials, one dimensional steady state conduction through plane and composite walls, conduction through tubes and spheres with and without heat generation, conduction through multilayer tubes.

Unit – II:

Electrical analogy - Conduction through materials in parallel, combined convection and conduction and overall heat transfer coefficients, problem solving, Concept of critical thickness of insulation for a cylinder, problem solving,

Unit III:

Radiation heat transfer - Introduction, absorptivity, reflectivity and transmissivity. Black body and monochromatic radiation, Plank's law, Stefan-Boltzman law, Krichhoff's law, grey bodies and emissive power, solid angle intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection and radiation by networks.

Unit IV:

Unsteady state heat transfer - Unsteady state system with negligible internal thermal resistance- equation for different geometries, Fins - Heat transfer from extended surfaces, types of fins, numerical, free and force & convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced

convection. Useful non - dimensional numbers and empirical relationships for free and forced convection.

Unit V:

Equation of laminar boundary layer on flat plate and a tube, laminar forced convection on a flat plate and in a tube, combined free and forced convection, types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units, heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow - Fick's law mass transfer coefficients, Reynold's analogy.

REFERENCES:

1. Transport processes and Unit Operations, Geankoplis C.J. 1992. Allyn and Bacon Inc., Newton, Massachusetts.
2. Heat Transfer, Holman JP 1989. McGraw Hill Book Co., New Delhi.
3. Fundamentals of Heat and Mass Transfer, Incropera F P and De Witt D P 1980John Wiley and Sons. New York.
4. Engineering Heat Transfer, Gupta CP and Prakash R 1994. Nem Chand and Bros., Roorkee.
5. Heat transfer, Rajput S. Chand & Co, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
GROUND WATER HYDROLOGY, WELL AND PUMPS					

Objective: To enable the students to acquire knowledge on aquifers and estimation of their different properties like hydraulic conductivity, transmissibility, storage coefficient, specific yield, leakage factor, hydraulic resistance under steady and unsteady state conditions in wells dug under different aquifers, well drilling and development methods and equipment design of gravel pack in bore well. Further to make the students to acquire knowledge on various pumps available commercially, their selection, operation and maintenance with due importance to find out the cost of operation.

Outcomes:

Skill development on principles of ground water resources development, different acquaintance and their principles.

Imparting knowledge on theory of open well hydraulics and drilling methods.

Skill development on aquifers characteristics under steady and unsteady state conditions, multiples well systems for coastal areas.

Knowledge development to students on artificial ground water recharge classification of indigenous pumps, solar pumps, wind mill pumps etc.,

Skill development on principles of Centrifugal pumps, principles & characteristics, High lift pumps, mixed flow pumps and vertical turbine pump sets.

Unit – I: Water resources status of India-Occurrence and Movement of ground water and aquifers – Types of water bearing formations – Unconfined, confined, semi confined aquifers – Perched water table condition – diagramatic representation.

Unit – II: Classification of wells – Design of open wells – Ground water replenishment – Ground water exploration – Methods of drilling of wells – Common well drilling difficulties – Gravel packing – well screens – Development of well.

Unit – III: Aquifer characteristics - Influencing yield of wells - Determination of aquifer parameters – Steady state and unsteady state conditions – Well interference and multiple well point systems in coastal areas.

Unit – IV: Surface and subsurface exploitation and estimation of ground water potential – Artificial ground water recharge – Ground water project formulation – Classification of indigenous pumps – Wind powered water lifts – Solar powered and biogas operated water lifts – Reciprocating pumps.

Unit – V: Centrifugal pumps – Terminology on horse power – Selection of pump installation and troubleshooting of pumps – Performance characteristic curves – Effect of change of impeller dimensions on performance characteristics. Hydraulic ram – Propeller pumps - Mixed flow pumps - Air lift pumps – Priming – Vertical turbine pumps – Submersible pumps – Cost economics

REFERENCES:

1. Ground water and tube wells - Garg S P 1985. Oxford and IBH publish in companylimited, New Delhi.
2. Water Well land Pump Engineering – Michael A M and Khepar S T 1989 Tata McGraw-Hill Publishing company limited, New Delhi.
3. Irrigation Theory and Practice – Michael A M 2008 Vikas Publishing House Pvt. Ltd,New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
THEORY OF STRUCTURES					

Objective: The Students will have acquired knowledge on the design principles of beams, slabs,columns, foundations and RCC structures.

Outcomes:

Skill development on RCC theory and practice of principles, stress – Strain analysis.

Skill development on single, double reinforced sections, their theory & principles, shear stressanalysis.

Acquaintance of knowledge on design principles of shear reinforcement, anchorage of bars &analysis.

Skill development on theory and principles of design of one – way reinforced beams/slabs, twoway slabs and columns.

Skill development on principles of auxiliary loaded columns, foundations retaining walls, stability analysis.

Unit-I:

Introduction to loads and BIS codes – Analysis and designing of single reinforced sections – Properties of reinforced concrete, advantages, assumptions, modular ratio, equivalent area of R.C.C., stress and strain diagram, neutral axis, moment of resistance, design of rectangular section.

Unit-II:

Analysis of balanced over reinforced and under reinforced sections – Under reinforced sections, over reinforced sections, problems. Analysis and designing of double reinforced sections – Modular ratio for compression shell equivalent area of steel in compression, neutral axis, moment of resistance, steel beam theory, problems. Shear stresses in beams – Shear stress induced in homogeneous and R.C. beams, nominal shear stress, varying depth, effect of shear in R.C. beams, failures, shear resistance of concrete without shear reinforcement.

Unit- III:

Design of shear reinforcement, problems. Vertical stirrups and inclined bars – Development of length, development of stress in R.C.C. anchorage for reinforced bars Anchorage for reinforced bars, anchorage bars in tension, anchorage bars in compression. Curtailment of bars – Decision on the curtailment of bars, design considerations for bond, general concept of bond. Design of flanges beams (CT and I beams).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Unit- IV:

Design of one - way slabs – Loading on slabs, arrangement of reinforcement, Problems on design of one - way slabs. Design of reinforced brick slabs, Design of one - way slabs – Rankine theory, Grashoff theory, shear force on the edges, design, problems, Merco's method. Design of two way slabs – Torsion reinforcement, load and bending moment, problems, slabs with edges fixed. Design of two - way slabs – Provision of torsion reinforcement, Marcor's method, problems. Axially loaded columns – Types of columns, effective length of columns, long and short columns, composite columns.

Unit- V:

Axially loaded columns – Basic rules for design of columns, arrangement of transverse reinforcement, problems. Foundations – Types of foundations, design criteria. Foundations – Problems on design criteria. Retaining walls – Earth pressure on a retaining wall, active earth pressure, passive earth pressure. Stability of walls – Conditions for stability of retaining walls, problems.

TEXT BOOKS:

1. Mechanics of Structures Vol. I, Junarkar,S.B. 2001 – Charotar Publishing Home, Anand.
2. Mechanics of Materials, Dr. B.C. Punmia, Laxmi Publications.

REFERENCES:

1. Strength of materials, R.S. Khumi 2001 – S. Chand & Company Ltd., 7361, Ram Nagar, NewDelhi – 110055.
2. Treasure of R.C.C. Design, Sushil Kumar 2003 – R.K.Jain – 1705-A, Nai Sarak, Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
SOIL MECHANICS					

Objective: Students will be trained on concepts and analysis of soil properties, stress conditions of loaded soil, consolidation and soil failure theories. The knowledge imparted will be used in higher level design considerations for construction of soil and water conservation structures, irrigation and drainage structures.

Outcomes:

Skill development on principles of soil mechanics soil classification, stresses insoils.
Skill development on Bousinesq's analysis for vertical pressure applications & westerguard's analysis for point load applications.
Acquaintance of knowledge on shear stress analysis, mohr's stress circle, measurement of shear strength.
Skill development on soil consolidations theory and principles.
Skill development on earth pressure and its effects on soil stability of slopes.

Unit–I:

Introduction of soil mechanics – Field of soil mechanics. Soil on three phase systems – Physical and index properties of soil. Classification of soils - General, particle size classification. Classification of soils - Textural classification, I.S. classification. Stress condition in soils – Effective and neutral stress.

Unit-II:

Concept on Bousinesq's analysis – Vertical pressure distribution on vertical line, vertical pressure under a uniformly loaded circular area, vertical pressure due to a line load. Concept on Bousinesq's analysis – Vertical pressure under strip load, vertical pressure under a uniformly loaded rectangular area, equivalent point load method. Concept on Westerguard's analysis – Point load pressure distribution, uniformly loaded circular area. Westerguard's analysis – Uniformly loaded rectangular area, comparisons between Bousinesq's and Westerguard's solutions. Newmark's influence chart – Preparation, problems.

Unit-III:

Shear strength – Introduction, Mohr's stress circle, stress systems with principal planes parallel to the coordinate axes. Shear strength – Introduction, Mohr's stress circle, stress systems with principal planes parallel to the coordinate axes. Shear strength – Mohr – Coulomb failure theory, effective stress principle. Measurement of shear strength – Introduction, direct shear test, tri-axial compression test, stress conditions in soil specimen during tri-axial testing. Measurement of shear strength – Advantages of tri-axial test, graphical solutions, unconfined compression test, vane shear test. Problems on shear strength. Compaction of soils – Standard test and modified Proctor test. Abbot compaction test. Jodhpur mini compaction test. Field compaction method and control.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Unit – IV:

Consolidation of soil – One - dimensional analysis spring analogy – Terzaghi's theory. Laboratory consolidation test. Calculation of coefficient of volume change – Coefficient of consolidation.

Unit-V:

Earth pressure – Plastic equilibrium in soils. Active and passive states of earth pressure. Rankine's theory of earth pressure. Earth pressure for cohesive soils. Simple numerical exercises on earth pressure. Stability of slopes – infinite and finite slopes. Friction circle method. Taylor's stability number.

TEXT BOOK:

1. Soil Mechanics and Foundations, Punmia B C, Jain A K and Jain A K, 2005. Laxmi Publications (p) LTD. New Delhi

REFERENCES:

1. Basic and Applied Soil Mechanics, Gopal Ranjan and Rao A S R 1993.Willey Eastern Ltd., New Delhi.
2. Soil Engineering Vol.1, Alam Singh 1994. CBS Publishers, and Distributions, Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS					

Course Objectives:

- The Learning objectives of this paper are to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting.
- To familiarize about the Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis.
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.
- Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Unit-I

Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

Unit – II:

Theories of Production and Cost Analyses:

Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

Unit – III:

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles : Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

Unit – IV:

Introduction to Accounting & Financing Analysis:

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Unit – V:

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Course Outcomes:

- The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product.
- The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
- The pupil is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
- The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis.
- The Learner can able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

TEXT BOOKS:

A R Aryasri, Managerial Economics and Financial Analysis, The McGraw – Hill companies.

REFERENCES:

1. Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd,
2. JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition
3. N.P Srinivasn and M. SakthivelMurugan, Accounting for Management, S. Chand & Company Ltd,
4. MaheswariS.N,AnIntroduction to Accountancy, Vikas Publishing House Pvt Ltd
5. I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd
6. V. Maheswari, Managerial Economics, S. Chand & Company Ltd,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		0	0	3	1.5
HEAT AND MASS TRANSFER LAB					

1. COP of VCR System with Capillary and thermal expansion valve.
2. Determination of overall heat transfer co-efficient of a composite slab
3. Determination of heat transfer rate through a lagged pipe.
4. Determination of heat transfer rate through a concentric sphere
5. Determination of thermal conductivity of a metal rod.
6. Determination of efficiency of a pin-fin
7. Determination of heat transfer coefficient in natural and forced convection
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzman constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.
13. Determination of Thermal conductivity of liquids and gases.
14. Investigation of Lambert's cosine law.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		0	0	3	1.5
THEORY OF STRUCTURES LAB					

1. Verify moment area theorem regarding the slope and deflection of the beam.
2. Verify strain in an externally loaded beam with the help of a strain gauge indicator and to verify theoretically
3. Study behavior of different types of columns and find Euler's buckling load for each case.
4. Study two hinged arch for the horizontal displacement of the roller end for a given system of loading and to compare the same with those obtained analytically.
5. Study the behavior of a portal frame under different end conditions.
6. Find the value of flexural rigidity (EI) for a given beam and compare it with theoretical value.
7. Determine the deflection of a pin connected truss analytically & graphically and verify the same experimentally.
8. Verify the Muller Breslau theorem by using Begg's deformator set.
9. Verify clerk Maxwell's reciprocal theorem
10. Determine material fringe value by using diffused light research polariscope.
11. Verify the moment area theorem regarding the slopes and deflections of the beam.
12. Determine the moment required to produce a given rotation (rotational stiffness) at one end of the beam when the other end is pinned.

TEXT BOOKS:

1. Mechanics of Structures Vol. I, Junarkar,S.B. 2001 – Charotar Publishing Home, Anand.
2. Mechanics of Materials, Dr. B.C. Punmia, Laxmi Publications.

REFERENCES:

1. Strength of materials, R.S. Khumi 2001 – S. Chand & Company Ltd., 7361, Ram Nagar, NewDelhi – 110055.
2. Treasure of R.C.C. Design, Sushil Kumar 2003 – R.K.Jain – 1705-A, Nai Sarak, Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		0	0	3	1.5
SOIL MECHANICS LAB					

1. Determination of water content of soil.
2. Determination of specific gravity of soil.
3. Determination of field density of soil by core cutter method.
4. Determination of field density by sand replacement method.
5. Grain size analysis by sieving (Dry sieve analysis).
6. Grain size analysis by hydrometer method.
7. Determination of liquid limit by Casagrande's method.
8. Determination of liquid limit by cone penetrometer and plastic limit.
9. Determination of shrinkage limit.
10. Determination of permeability by constant head method.
11. Determination of permeability by variable head method.
12. Determination of compaction properties by standard proctor test.
13. Determination of shear parameters by direct shear test.
14. Determination of unconfined compressive strength of soil.
15. Determination of shear parameters by Tri-axial test.
16. Determination of consolidation properties of soils.

TEXT BOOKS:

1. B. C. Punmia and A. K. Jain,2005, Soil Mechanics and Foundations, 16th edition, Laxmi Publishing, NewDelhi.
2. N. C. Brady,2008, The Nature and Properties of Soil, 10th edition, Macmillan Publishing Company,New York.

REFERENCES BOOKS:

1. B. M. Das and G. V. Ramana, 2010,Principles of Soil Dynamics, 2nd edition, Cengage Learning.
2. V. N. S. Murthy,2008, Soil Mechanics and Foundation Engineering, 1st edition, CBS Publishers,NewDelhi.
3. B. Singh and S. Prakash,2010, A Text Book of Soil Mechanics, New Chand and Bros., Roorkee.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

II Year - II Semester		L	T	P	C
		1	0	2	2
ANALYSIS/SIMULATION USING MATLAB					

1. Development of soil monitoring systems
2. Analysis of harvesting equipment design parameters and performance
3. Assessment of disease management
4. development and optimisation of smarter irrigation system
5. Analysis of safety storage of harvested crops
6. Analysis of effective usage of water resources
7. Tractor position tracking using MatLab
8. Air and water quality monitoring system for healthy crop environment.
9. Development of real–time monitoring system of agricultural fields
10. Using wireless sensor network in an agricultural field also to develop a smart farming environment.
11. Monitoring the critical factor as water quality to enhance the growth of crops is develop using sensors
12. Stock management system at agricultural storages.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
FARM MACHINERY AND EQUIPMENT - I					

Objective: To understand primary and secondary tillage implements along with earth moving machinery, seeding and plant protection equipment will be discussed to get awareness on the mechanical area of the agricultural engineering.

UNIT-I

Objectives of Farm Mechanization, sources of farm power, classification of farm machines. Materials of construction and heat treatment. Principles of operation and selection of machines used for production of crops -Field capacities of different implements and their economics. Problems on field capacities and cost of cultivation.

UNIT-II

Classification and types of tillage, Primary tillage implements - Mold board plough and its parts, Disc plough, and other ploughs, Secondary tillage equipment - Disc harrows, implements- Cultivators, and intercultural implements. Forces acting on tillage tools, Problems on forces analysis, Draft measurement of tillage equipment, Draft and unit draft related problems.

UNIT-III

Earth moving equipment-terminology, Earth moving equipment, construction and their working principles, Earth moving equipment-shovels, Bulldozers, Earth moving equipment - Trenches and elevators.

UNIT-IV

Seeding methods, Different types of seed metering mechanism, different types of furrow openers. Calibration of Seed drills. Adjustment of Seed Drills -Objectives and uses of plant protection equipment. Types of sprayers and dusters. Sprayers calibration and selection. Constructional features of different components of sprayers and dusters and their adjustments.

UNIT-V

Transplanting methods, different types of Transplanting machinery and their working principle, adjustments in Transplanting equipment. Fertilizer application equipment – fertilizer meeting mechanism calibration of fertilizer equipment.

TEXT BOOKS:

1. Farm Machinery, Stone A A 1958. John Wiley and sons, New York.
2. Farm Machinery and Equipment, Smith H P 1971. Tata McGraw Hill Publishing Co. Ltd., NewDelhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCE BOOKS:

1. Principals of Agricultural Engineering, Michael A M and OJha T P 1985 Vol. I, Jain Brothers, New Delhi.
2. Principals of Farm Machinery, Kepner R A, Bainer R and Barger E L 1987. CBS Publishers and Distributors, Delhi.
3. Elements of Agricultural Engineering, Jagadeshwar Sahay 1992. Agro Book Agency, Patna.
4. Land Reclamation Machinery, Borshahov Mansurov Sergecv 1988. Mir Publishers, Moscow.

Course Outcome:

CO1: Apply Principles of Farm Mechanization to calculate field capacities and cost of cultivation.
CO2: Calculate the forces acting on tillage tools, Draft and Unit draft.
CO3: Explain Earth moving Equipment.
CO4: Analyze Seeding methods, Plant protection Equipment
CO5: Discuss the features of Transplanting machinery and Fertilizer application equipment.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
SURFACE WATER HYDROLOGY					

Objective: To enable the students to acquire knowledge and skills on hydrological (rainfall and runoff) measurements in watersheds, hydrological design of structures, prediction of volume and rates of runoff with tools like hydrographs and unit hydrographs, reservoir planning with flood routing techniques for application in natural resources management.

UNIT-I:

Hydrology - Definition, hydrology cycle and its components. Forms of precipitation rainfall, characteristics of rainfall in India (types of monsoon). Measurement of rainfall – Recording and non-recording rain gauges - Rain gauge network density for different topographic conditions – Point rainfall analysis. Presentation of rainfall data mass curve and hyetograph, Mean precipitation over an area – Arithmetic mean, Thiessen polygon, Isohyetal methods, DAD relationships and curves. Probability analysis of rainfall – Return period, plotting position by Weibull's method, Rainfall events at different probability levels (20%, 40%, 60%, 80%)

UNIT-II:

Intensity-Duration-Frequency relationship, determination of net effective rainfall- infiltration indices - Phi index. Runoff-definition-components of runoff-direct runoff and base flow, overload flow and interflows, pictorial representation of different routes of runoff. Runoff characteristics of streams – Perennial, intermittent and ephemeral streams, measurement of stream flows. Measurement of stage and velocities, staff gauge, wire gauge, automatic stage recorders, current meters (horizontal and vertical axis meters), calibration (V= a Ns + b). Rainfall-Runoff relations (R=a P + b), curve fitting and determination of 'a' and 'b' and (correlation coefficient), factors affecting runoff. Definition and estimation of peak runoff and design peak runoff rate, rational method and curve number techniques.

UNIT-III:

Hydrographs - Definitions and components, factors affecting flood hydrographs, hydrograph separation for simple and complex storms – Method I (straight line method, N=b A0.2), other Methods II and III. Unit hydrographs - Concept and the three implications of the definitions and the two basic assumptions (linear response and time invariance). Effects of the characteristics of storms (duration of rain, time-intensity pattern, areal distribution of runoff and amount of runoff) on the shape of the resulting hydrographs. Derivation of unit hydrographs, average unit hydrographs from several storms of the same duration (proper procedure of computing average perk flow and time to peak). Derivation of unit hydrographs for complex storms.

UNIT-IV:

Conversion of unit hydrograph duration, methods for unit hydrographs of different durations – Method of superposition and S-curve. S-curve method, explanation of concept and application.conversion of unit graph duration by S-curve method, determination of lower duration graph from the given higher duration graph and vice-versa. Synthetic unit hydrograph, concept, Snyder' synthetic unit hydrograph, formulas relating hydrograph features (basin lag, peak flow and time base of the unit hydrograph).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Instantaneous unit hydrograph, concept and application, SCS triangular hydrograph - Application of hydrology - Flood control and regulation, flood mitigation, floodplain mapping, retards.

UNIT V:

Flood routing - Introduction, two broad categories of flood routing and channel routing, hydrologic routing and hydraulic routing, basic equations. Hydrologic storage routing, Schematic representation of storage routing, modified Pul's method (semi-graphical method). Explanation of the features of the modified Pul's method. Flood routing through a reservoir by modified Pul's method. Applications of hydrology in land and water management, watershed management.

TEXT BOOKS:

1. Engineering Hydrology. Raghunath H.M. 1986. Willey Eastern Limited, New Delhi.
2. Watershed Hydrology, Suresh R. 1997. Standard Publisher and Distributors, New Delhi.

REFERENCE BOOKS:

1. Engineering Hydrology. Subramanyam K. 1984. Tata Mc. Graw – Hill Publishing Co., Limited, New Delhi.
2. Hydrology for Engineers Linsley R.K. Kholer A. & Paul Hus J.L.H. 1988, Mc-Graw Hill Book Co. New Delhi.
3. Watershed Management. Dhruvanarayana, VV. 1990. ICAR Publication, New Delhi.

Course Outcome:

CO1: Analyze probability of rainfall, Return Period, Plotting position.
CO2: Determine net effective rainfall, Peak runoff and Peak runoff rate
CO3: Discuss the factors affecting flood hydrographs, hydrograph Separation for simple and complex storms.
CO4: Describe method of superposition, S-Curve and determine duration graphs.
CO5: Use the Concepts of Flood raining.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
POST HARVEST ENGINEERING OF CEREALS, PULSES AND OILSEEDS					

Objective: To enable the students to acquire knowledge and skills on Cleaning and grading, aspiration, scalping; size separators, screens, sieve analysis, capacity and effectiveness of screens, Drying, Different methods of drying, batch-continuous; mixing-non-mixing, sun, mechanical, conduction, convection, radiation, superheated steam, tempering during drying, Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray. Milling of rice, Milling of wheat, unit operations and equipment. Milling of pulses: traditional milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods: CFTRI and Pantnagar methods.

UNIT-I

Cleaning and grading, aspiration, scalping; size separators, screens, sieve analysis, capacity and effectiveness of screens. Various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone, shape graders. Size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing), Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill.

UNIT-II

Material handling equipment, Types of conveyors: Belt, roller, chain and screw. Elevators: bucket, Cranes & hoists. Trucks (refrigerated/ unrefrigerated), Pneumatic conveying.

UNIT-III

Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination, Psychrometric chart and its use in drying, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Mass and energy balance, Shedd's equation, Dryer performance, Different methods of drying, batch-continuous; mixing-non-mixing, sun, mechanical, conduction, convection, radiation, superheated steam, tempering during drying, Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray.

UNIT-IV

Mixing:- Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes. Milling of rice: Conditioning and parboiling, advantages and disadvantages, traditional methods, CFTRI and Jadavpur methods, Pressure parboiling method, Types of rice mills, Modern rice milling, different unit operations and equipment.

UNIT-V

Milling of wheat, unit operations and equipment. Milling of pulses: traditional milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods: CFTRI and Pantnagar methods. Pulse milling machines, Milling of corn and its products. Dry and wet milling. Milling of oilseeds: mechanical expression, screw press, hydraulic press, solventextraction methods, preconditioning of oilseeds, refining of oil, stabilization of rice bran., Extrusion cooking: principle, factors affecting, single and twin-screw extruders. By-products utilization.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

TEXTBOOKS:

1. Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
2. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.

REFERENCE BOOKS:

1. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman and hall, London
2. McCabe, W.L., Smith J.C. and Harriott, P. Unit operations of Chemical Engineering. McGraw Hill.
3. Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.

Course Outcome:

CO1: Apply principles of Bond's law, Kick's law, Rittinger's law for size rduction
CO2: Explain the features and application of Material Handling equipment
CO3: Explain the concepts of Dryers
CO4: Use CFTRI and Jadavpur methods for Mixing and Milling Practices
CO5: Apply the principles of milling wheat and Oil seeds.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
Open Elective (*Offered by other department)*					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
SEED PROCESSING AND STORAGE ENGINEERING (Professional Elective - I)					

Objective: To enable the students to understand the principles and acquire the knowledge on moisture content determination methods, EMC models, principles and methods of drying and their analysis, study of different driers, dehydration and functional requirements, storage of grains, CAP storage, MAP storage, and to study the conveying equipment.

UNIT-I:
Moisture contents and methods for determination: representation, wet basis, dry basis, direct and indirect methods of moisture content determination, problems. Importance of EMC and methods of its determination: static method, dynamic methods: desortation method and isotenoscopic method. EMC curve and EMC model: Henderson equation, hysteresis effect, bound moisture, unbound moisture, free moisture. Deep bed drying and their analysis, time of advance of drying front, decreasing rate period – remarks on the deep bed, problems on drying.Critical moisture content, drying models, rate of drying curves for constant drying conditions, calculation methods for falling rate drying period.

UNIT-II:
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: convective drying, radiation drying, dielectric drying, chemical drying, sack drying, puff drying, foam mat drying, freeze drying etc. Study of different types of dryers: unheated air driers: air distribution systems, heated air driers: flatbed type batch dryers, reciprocating batch drier. Study of LSU dryer, baffle dryer, rotary dryer, performance, energy utilization pattern and efficiency.

UNIT–III:
Types and causes of spoilage in storage. Functional requirements of seed storage, control of temperature and relative humidity inside storage. Calculation of refrigeration load, control of itsenvironment, 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. Conditioning of environment inside storage through mechanical ventilation, artificial drying.

UNIT-IV:
Grain storage structures: Storage of cereal grains and their products. Storage of seeds – terminology and treatments. Principles of grain storage – parameters – effecting the grain storage. Changes occurring during storage, nutritive changes, minerals, carbohydrates, proteins and vitamins. Moisture migration, storage insects, pests and their control. bag storage of grains: different types of storage, classification planning for a bag storage complex, constructional features and basic specifications of typical bag storage structures, design aspects of bag storage structures. Bulk storage of grains: advantages of bulk handling system, types of bulk storage traditional storage structures, moral, Bhukari, Kothari type storage structures. Bulk storage of grains, Pusa bin, brick and cement bin, bunker storage, vertical silos.

UNIT-V:
Grain handling equipment-bucket elevator: types of bucket elevators, components of bucket elevators, head section, boot section, elevator legs, elevator belt, buckets, drive mechanism and power requirement problems. Belt conveyors: salient features, design considerations, belt tension, power, design problems. Screw conveyors: Salient features, Conveyor elements, selection of screw conveyors

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

and power requirements–problems. pneumatic conveyor, essential components, description of typical plant, limitations of pneumatic conveyor. Hermetically sealed and air cooled storage. Controlled Atmosphere storage of grains. Modified Atmosphere storage of grains. Tutorial problems on drying.

TEXT BOOKS:

1. Unit Operations of Agricultural Processing Sahay K M and Singh K K 1994 Vikas Publishing House Pvt. Ltd., New Delhi.
2. Grain Storage Engineering and Technology, Vijaya Raghavan, S. 1993. Batre Bale Service New Delhi.
3. Drying and Storage of Grains and Oilseeds CBS Publishers & distributions, New Delhi.

REFERENCEBOOKS:

1. Transport Processes and Unit Operations, Geankoplis C J 1978. Aliyn and Bacon Inc., Newton, Massachusetts.
2. Unit operations in Food Processing, Earle R L 1983. Pergamon Press, New York.
3. Post Harvest Technology of Cereals, Pulses and Oil seeds, Chakravarthy A. 1988 Oxford and IBH Publishing Co. Ltd., Calcutta.
4. Unit Operations of Chemical Engineering, McCabe W L and Smith J C 1993 McGraw Hill Book Co., New Delhi.

Course Outcomes: Atthe end of the course, student will be able to

CO1: Estimate the moisture content by using different methods.

CO2: Calculate drying air temperature and air flow rate, air pressure within the grain bed.

CO3: Explain the causes for the spoilage in storage and calculate the parameters associated.

CO4: Design grain storage structures

CO5: Analyze Grain handling equipment.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
GREENHOUSE TECHNOLOGY (Professional Elective - I)					

Objective: Constructional and operational details of greenhouses will lead the students to grow crops with profits and also to use the greenhouses for offseason usage and also to manage them commercially.

UNIT-I:
Greenhouses – Introduction, history, definition, greenhouse effect, advantages of greenhouses. Classification of greenhouses – Greenhouse types based on shape, utility, construction and covering material. Plant response to greenhouse environment – light, temperature, relative humidity, ventilation and carbon dioxide.

UNIT-II:
Environmental requirement for crops – Temperature requirement of horticultural crops, light requirement of crops and lighting control methods, Greenhouse shading methods, Greenhouse supplemental lighting systems. Environmental control inside greenhouse – Manual controlling, thermostats, microprocessors and computerized control systems.

UNIT-III:
Natural and forced ventilation summer and winter cooling systems, carbon dioxide enrichment method. Planning of greenhouse facility – Site selection and orientation, structural design, Materials used for construction of greenhouses – Wood, Galvanized iron pipe and glass. Greenhouse covering materials – Polyethylene film, PVC, Polyester, Tefzel T2 film, Polyvinyl chloride rigid panel, fiber glass reinforced plastic rigid panel, Acrylic and polycarbonate rigid panel. Design criteria and construction details of glass and pipe framed greenhouses – Material
requirement and procedure for erection.

UNIT-IV:
Greenhouse heating and energy storage – Type of heat loss, heating systems, heat distribution systems, water and rock storage, heat conservation practice. Greenhouse irrigation systems – Rules of watering, Hand Watering, perimeter watering, overhead sprinklers, Boom watering, Drip irrigation.

UNIT-V:
Greenhouse utilization in off season – Drying of agricultural produce. Protected Agriculture Techniques – row covers. Economics of greenhouse production – Capital requirements. Economics of production and conditions influencing returns.

TEXT BOOKS:

1. Greenhouse technology and Application, Vilas M. Salone and Ajay K. Sharma Agrotech Publishers, New Delhi, 2012
2. Greenhouse Technology for controlled Environment, Tiwari, G.N. Narsoa Publishing house Pvt. Ltd.
3. Greenhouse Technology- Management, Operation and Maintenance, N.N Patil, Universal Prakashan Publisher.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCEBOOKS:

1. Greenhouse technology and management, Radha Manohar, K and Igathinathane. C. 2nd Edition, BS Publication.
2. Advances in protected cultivation, Singh Brahma and Balraj Singh, New India Publishing Company, 2014.
3. Greenhouse Management of Horticulture crops, S. Prasad and U. Kumar, second edition, Agrobios New Delhi, 2012.
4. Greenhouse: Advanced Technology for Protected Horticulture, J. Hanan, CRC Press, LLC, Florida, 1998.

Course Outcomes: At the end of the course, student will be able to

CO1: Classify the greenhouses based on different parameters

CO2: Identify the required environmental factors for crop growth

CO3: Analyze the Natural and forced ventilation, summer and winter cooling systems

CO4: Explain Greenhouse irrigation systems.

CO5: Describe protected Agricultural techniques.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
TRACTOR DESIGN AND TESTING (Professional Elective - I)					

Objects: To enable the students to know the development of agricultural tractors and different operations performed by the tractors. To know the different trouble shootings and remedies, design of different parts. To get knowledge on different tests performed on tractors.

UNIT–I

Procedure for design and development of agricultural tractor, classification, selection. Study of parameters for balanced design of tractor for stability & weight distribution, traction theory, hydraulic lift and hitch systems design.

UNIT-II

Complete drive train, transmission. Design of mechanical power transmission in agricultural tractors: single disc, multi disc and cone clutches. Rolling friction and anti-friction bearings.

UNIT-III

Design of Ackerman Steering and tractor hydraulic steering. Study of special design features oftractor engines and their selection viz. cylinder, piston, piston pin, crankshaft, etc. Design of seat and controls of an agricultural tractor. Tractor Testing.

UNIT-IV

Design problem of tractor clutch – (Single/Multiple disc clutch). Design of gear box (synchromesh/constant mesh), variable speed constant mesh drive; Selection of tractor tyres –Problem solving. Problem on design of governor. Design and selection of hydraulic pump. Engine testing as per BIS code.

UNIT-V

Drawbar performance in the lab; PTO test and measure the tractor power in the lab/field. Determining the turning space, turning radius and brake test, hydraulic pump performance test and air cleaner and noise measurement test; Visit to tractor testing centre//industry

TEXTBOOKS:

1. Maleev V.L., 1964. Internal Combustion Engines, Tata McGraw-Hill, USA
2. Richey C.B. 1991. Agricultural Engineering Handbook. McGraw-Hill, USA

REFERENCE BOOKS:

1. Liljedahl J.B., Carleton W.M., Turnquist P.K. and Smith D.W. 1984. Tractors and their Power Units. AVI Publishing Co. Inc., Westport, Connecticut.
2. Raymond N, Yong E.A. and Nicolas S.1984. Vehicle Traction Mechanics, Elsevier Scitific Publications, USA.
3. Kirpal Singh. 2012. Automobile Engineering –n Vol I and Vol II. Standard Publishers Delhi.
4. Mehta M.L., Verma, S.R., Mishra, S.K., Sharma V.K. 2005. Testing & Evaluation of Agricultural Machinery, Daya Publishing House, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course Outcomes: At the end of the course, student will be able to

CO1: Analyze parameters for balanced design of a tractor
CO2: Explain the Elements of mechanical power transmission in Agricultural tractor
CO3: Design seat controls of an agricultural tractor
CO4: Design gear box
CO5: Determine turning space, turning radius and other parameters associated.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		0	0	3	1.5
THEORY OF MACHINES LAB (*Offered by Mechanical Department*)					

1. To determine whirling speed of shaft theoretically andexperimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnellgovernorand to plot the characteristic curve of radius ofrotation.
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spinaxis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of aflywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slidercrank mechanism/Four bar mechanism
10. To find coefficient of friction between belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage , velocityratio and efficiency
12. To study various types of gears- Spur, Helical, Worm and BevelGears

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		0	0	3	1.5
ELECTRICAL CIRCUITS LAB (*Offered by EEE Department)*					

Preamble:
To verify and demonstrate various theorems, locus diagrams, resonance and two port networks. To determine self and mutual inductance of a magnetic circuit, parameters of a given coil and measurement of 3- phase power.

Course Objectives:

- To verify and demonstrate various theorems and resonance.
- To draw the locus diagram of series circuits
- To determine the various parameters of a two port networks
- To determine self and mutual inductance of a magnetic circuit, parameters of a given coil.
- To measure the power of three phase unbalanced circuit.

(Any 10 of the following experiments are to be conducted)

1. Verification of Kirchhoff's circuit laws.
2. Verification of Superposition theorem
3. Verification of Thevenin's and Norton's Theorems
4. Verification of Maximum power transfer theorem
5. Verification of Compensation theorem
6. Verification of Reciprocity and Millman's Theorems
7. Locus diagrams of R-L(L Variable) and R-C (C Variable) series circuits
8. Series and parallel resonance
9. Determination of self, mutual inductances and coefficient of coupling
10. Determination of Impedance (Z) and Admittance (Y) Parameters for a two port network
11. Determination of Transmission and Hybrid parameters
12. Determination of Parameters of a choke coil.
13. Determination of cold and hot resistance of an electric lamp.
14. Measurement of 3-phase power by two wattmeter method for unbalanced loads

Course Outcomes:
At the end of the course, student will be able to

- Apply various theorems
- Determination of self and mutual inductances
- Two port parameters of a given electric circuits
- Draw locus diagrams
- Draw Waveforms and phasor diagrams for lagging and leading networks

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		1	0	2	2
ADVANCED COMMUNICATION SKILLS LAB (Skill Oriented Course)					

Introduction

A course on *Advanced English Communication Skills (AECS) Lab* is considered essential at the third year level of B.Tech. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

Course Objectives: This Lab focuses on using multi-media instruction for languagedevelopment to meet the following targets:

- To improve students' fluency in spoken English
- To enable them to listen to English spoken at normal conversational speed
- To help students develop their vocabulary
- To read and comprehend texts in different contexts
- To communicate their ideas relevantly and coherently in writing
- To make students industry-ready
- To help students acquire behavioural skills for their personal and professional life
- To respond appropriately in different socio-cultural and professional contexts

Learning Outcomes: Students will be able to:

- Acquire vocabulary and use it contextually
- Listen and speak effectively
- Develop proficiency in academic reading and writing
- Increase possibilities of job prospects

Communicate confidently in formal and informal contexts

Syllabus

The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

1. **Inter-personal Communication and Vocabulary Building** - Starting a Conversation – Responding Appropriately and Relevantly – Role Play in Different Situations - Synonyms and Antonyms, One- word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.
2. **Reading Comprehension and Listening Skills** –General Vs Local Comprehension, Techniques- Reading for Facts, Guessing Meanings from Context, Skimming, Scanning, Inferring Meaning- Listening Comprehension(Video/Audio talks)
3. **Technical Writing Skills** – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing- Circular writing/ Meeting agenda/ Minutes of Meeting.
4. **Presentation Skills** – Public speaking-Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ e-mails/Assignments… etc.,- Stage dynamics- Body Language- Para Language.
5. **Getting Ready for the Job:**
   a. **Group Discussion and Interview Skills** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process, Pre-interview Planning, Opening

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

b. Soft Skills: Inter and Intra Personal Skills.

Minimum Hardware Requirement:
Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 30 students in the lab:

- **Spacious room with appropriate acoustics**
- **Eight round tables with five movable chairs for each table.**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **Computer with suitable configuration**

Suggested Software: The software consisting of the prescribed topics elaborated aboveshould be procured and used.

- **Oxford Advanced Learner's Compass**, 10th Edition.
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **TOEFL & GRE(KAPLAN, AARCO & BARRONS, USA, CRACKING GRE by CLIFFS)**
- **TRAIN2SUCCESS.COM**

Suggested Reading:

1. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press2009.
2. Technical Communication by Paul V.Anderson.2007. Cengage Learning pvt. Ltd. NewDelhi.
3. Business and Professional Communication: Keys for Workplace Excellence .Kelly M. Quintanilla& ShawnT.Wahl. SageSouth AsiaEdition. SagePublications.2011.
4. The Basics of Communication: A Relational Perspective. Steve Duck & David T.McMahan. Sage South AsiaEdition.SagePublications.2012.
5. English Vocabulary in Use series, CambridgeUniversityPress2008.
6. Management Shapers Series by Universities Press (lndia) Pvt Ltd., Himayatnagar, Hyderabad2008.
7. Handbook for Technical Communication by David A.McMurrey & Joanne Buckley.2012.
8. Handbook for Technical Writing by David A McMurrey & JoanneBuckely CENGAGE Learning 2008.
9. Job Hunting by Colm Downes, Cambridge University Press2008.
10. Master Public Speaking by Anne Nicholls, JAICOPublishingHouse,2006.
11. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hil 2009.
12. Books on TOEFL/GRE/GMAT/CAT/IELTS/SAT by Barron's/DELTA/Cambridge University Press.
13. The Definitive Book of body Language – by Allan Pease, Barbara Pease.

Sample Web references:

Listening

- https://learningenglish.voanews.com/z/3613
- http://www.englishmedialab.com/listening.html

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Speaking

- https://www.talkenglish.com/
- BBC Learning English – Pronunciation tips
- Merriam-Webster – Perfect pronunciation Exercises

All Skills

- https://www.englishclub.com/
- http://www.world-english.org/
- http://learnenglish.britishcouncil.org/

Online Dictionaries

- Cambridge dictionary online
- MacMillan dictionary
- Oxford learner's dictionaries

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		2	0	0	0
PROFESSIONAL ETHICS AND HUMAN VALUES (Mandatory Course)					

Objective: To enable the students to understand the concepts of human values, gain knowledge about the principles of engineering ethics, interpret engineering as social experimentation, engineers' responsibility for safety and risk, gain knowledge about the engineers' rights and responsibilities.

UNIT-I

Human values**:** Morals, Values and Ethics – Integrity – Work Ethics – Service Learning –Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing –Honesty –Courage – Value time – Co-operation – Commitment – Empathy –Self-confidence – Spirituality- Character.

UNIT-II

Engineering ethics**:** The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

UNIT-III

Engineering as social experimentation**:** Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT-IV

Engineers' responsibility for safety and risk:Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability-Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis- Accidents.

UNIT-V

Engineers' responsibilities and rights:Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty-obligations of Loyalty misguided Loyalty – professionalism and Loyalty-Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self-interest, Customs and Religion- Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage-price fixing-endangering lives-Whistle Blowing types of whistle blowing-when should it be attempted-preventing whistle blowing.

TEXTBOOKS:

1. Engineering Ethics and Human Values by M. Govindarajan, S. Natarajan and V.S. Senthil Kumar-PHI Learning Pvt. Ltd-2009.
2. Professional Ethics and Morals by Prof. A.R. Aryasri, Dharanikota, Suyodhana-Maruthi Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCE BOOKS:

1. Professional Ethics and Human Values by A. Alavudeen, R. Kalil Rahman and M. Jayakumaran-Laxmi Publications.
2. Professional Ethics and Human Values by Prof. D. R. Kiran, TMH.
3. Indian Culture, Values and Professional Ethics by P.S.R. Murthy-BS Publication.
4. Ethics in Engineering by Mike W. Martin and Roland Schinzinger– Tata McGraw-Hill – 2003.
5. Engineering Ethics by Harris, Pritchard and Robins, CENGAGE Learning, Indian Edition, 2009.

Course outcomes: At the end of the course, student will be able to

CO1: Judge the concepts of human values.

CO2: Justify knowledge about the principles of engineering ethics.

CO3: Interpret engineering as social experimentation.

CO4: Realize engineers' responsibility for safety and risk.

CO5: Discuss about the engineers' rights and responsibilities.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - I Semester		L	T	P	C
		0	0	3	1.5
Summer Internship 2 Months (Mandatory) after Second Year (to be evaluated during V Semester					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
SOIL AND WATER CONSERVATION ENGINEERING					

Objective: To enable the students to acquire knowledge on different soil laws estimationmodels, run off estimation by rational, curve number, cook's etc. Land use, capabilityclassification, soil conservation measures like contour bunding, terracing, bench terraces,contour trenches and their types and complete design calculations. Also, to enrich the studentsand familiarize the students in the design of various gully control structures, temporary andpermanent, their designs with a due importance to hydrologic, hydraulic and structural phasesof design.

UNIT–I

Runoff – Factors affecting runoff – Peak Runoff and design peak runoff – its estimation -Rational method – Time of concentration & its estimation – Curve number method – Cook'smethod. Land use capability classification based on different criteria with a special referenceto slope.

UNIT-II:

Introduction – Soil and water conservation research in India–Its sub-centers–Soil erosion–Geologic, Types & erosion procedures Accelerated types. Causes and agents of erosion –Factors affecting erosion – Water Erosion–Forms of water erosion – Mechanics of Erosion -Different stages of erosion – Rill – Sheet – Gully and Ravines—Gully erosion ofclassification, stages of gully development. Soil Loss estimation–Universal Soil Loss equationand modified soil loss equation, Explanation of various terms – Estimation of their variousparameters. Erosion control measures – Agronomic and mechanical or engineering measures.

UNIT–III:

Wind Erosion – Factors affecting wind erosion, mechanics of wind erosion, Wind erosioncontrol measures – Vegetative, mechanical measures, wind blades and shelter belts, sanddunes stabilization – Wind erosion and its control.

UNIT-IV:

Contour bunds – Design of contour bunds – Horizontal interval – Vertical interval – Crosssection of the contour bunds – Seepage line consideration. Determination height of bund –Loss of area due to bunding. Design of waste weir – Construction of contour bunds in fields.Graded bunds – Design of graded bunds. Introduction to Conservation Ditching. Contour trenching – Staggeredand continuous trenches – Adaptability and types. Terraces – Classification of terraces - Design ofnarrow based and broad-based terraces. Bench Terraces – Types of bench terraces – Derivation ofan equation for finding of vertical interval – Design of bench terraces.

UNIT-V: Vegetated water ways – Types of water ways based on shapes – Expression for wetted perimeter – C/S areas – Hydraulic radii – types of vegetation – roughness of different grasses –Design of vegetated water ways. Sedimentation – Sedimentation in reservoirs in streams,estimation and measurement, sediment delivery ratio, trap efficiency – Estimation of useful life ofreservoir based on sedimentation. Characteristics of contours and preparation of contour maps forwater area estimation, Volume calculation – Stage –Volume relationship structures for waterharvest, Analysis of toposheets. Introduction to water harvesting techniques – Earthen dams etc.Design of WH Structures, - Farm Pond, Percolation tanks, Check dams, Earthen dams etc. –Introduction to Stream water quality and pollution. Temporary gully control structures – Design – Types like Brush wood dams – Wire Mesh – Dams etc. – Introduction to permanent gully controlstructures – Design phases – Components of permanent

structures. Machining used in earthwork – Estimate preparation for all structures. Goud Schemes or NRM activities and their objectives.

TEXTBOOKS:

1. Soil and Water Conservation Engineering. Scwab G.O. Frevert R.K. Edminster T.W. and Barnes K.K. 1981 John Wiley and Sons New York.
2. Manual of Soil and Water Conservation Practical. Gurmel Singh. Venkataramanam C. Sastry G and Joshi BP. 1994.Oxford and IBH Publishing Co. Ltd., New Delhi.

REFERENCEBOOKS:

1. Land and Water Management Engineering. Murthy VVN 2004. Kalyani Publishers, New Delhi.
2. Introduction to Soil and Water Conservation Engineering. Mal B.S. 1995 Kalyani Publishers, Rajinder Nagar, Ludhiana.
3. Reddy, K.S. Manual on "Farm Ponds: A climate resilient technology in Rainfed Agriculture:
4. Design Planning and construction. ICAR, CRIDA Publications; www.crida.in.

Course outcomes:

Upon successful completion of this course, learner will be able to:
CO1: Calculate Peak run off, time ofconservation
CO2: Estimate soil loss by using Universal Soil Loss equation and modified soil loss equation,
CO3: Discuss factors affecting wind erosion, mechanics of wind
CO4: Design contour bunds, graded bunds and bench terraces
CO5: Design vegetated water ways, WH Structures

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
FARM MACHINERY AND EQUIPEMNT - II					

Objective: To enable the students to understand the basic principles of cutting mechanisms and toknow the various available harvesting machines. To know the working principle and functions ofvarious machine parts of mowers, reapers, windrowers, forage harvesters, threshers, combineharvesters, cotton strippers, cotton pickers, groundnut and potato and sugarcane harvesters.Students can also understand the importance of testing and evaluation of agricultural machines and
different standard codes (BIS Codes) available in India for testing of machinery.

UNIT–I:
Harvesting – Crop harvesting machinery, history of development, manual harvesting and itsclassification. Principles and types of cutting mechanisms – principle of cutting mechanism,impact cutting, types of impact cutting, shear cutting Construction and adjustments of shear andimpact type cutting mechanisms. Mowers – history and development, tractor mounted mowers,Trail behind tractor mower, integral Rear mounted mowers, side or central mounted tractormower, semi-mounted mowers, safety precautions in operation and adjustments of mowers, Knifedrives, cutter bar and its parts – inside and outside shoes. Cutter Bar – Guards, Ledger plates,wearing plates, knife clips, grass board and various parts of cutter bar assembly, alignment andregistration of cutter bar. Windrowing – Methods of windrowing, Self-propelled windrows, effectson yields and quality of Reapers, Animal drawn reaper, Tractor mounted Vertical conveyer reaperRepairs & maintenance of Harvesting equipment.

UNIT-II:
Power operated vertical conveyer reapers – Reaper binders – Care and maintenance, types Forageharvesting equipment – row forage harvesting equipment, field forage harvesters, types of fieldforage harvesters. Field chopper harvesters, forage wagons and boxes, field flail forage harvesters,the self-propelled forage harvester, silo forage blowers, silo unloaders.

UNIT–III:
Threshing – Principal of threshing, threshing methods, threshing by manual, threshing by animals, threshing by machines, Olpad threshers, Power thresher – types of power threshers, hammer milltype, rasp bar, spike tooth, syndicator, Classification threshers based on feeding type, components
of power thresher. Cleaning unit- Aspirator, blower, winnower, winnowing fan, cylinderadjustment, wheat thresher, groundnut thresher, and terminology connected with power thresher.Development of the binder and development of the combine.

UNIT–IV:
Harvester, advantages and disadvantages of combines, types of combines – Tractor drawn andself-propelled combines. Functions performed by a combine, cutting mechanism, threshing harvesting equipment- types of corn pickers, snappers, picker husker, Picker Sheller, powertransmission, gathering and snapping mechanism, conveying and elevating mechanism. Huskingmechanism, shelling mechanism, factors affecting performance of corn pickers, safety rules foroperating corn pickers - Root crop harvesting equipment – groundnut harvester, groundnutdiggers, digger operation and adjustments – groundnut shakers, groundnut threshers and pickers,groundnut combines different units and its operation. Potato harvesters – harvesting methods andequipment, one-row harvester, two-row harvester, digging and soil separation, vine removal byharvesters, separation of stones and clods.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT-V:

Cotton harvesting equipment – cotton stripper, types of cotton strippers, factors affecting theperformance of the cotton strippers, plant characteristics – thickness of plants – conveying system.Cotton pickers – types of pickers, drum type and chain belt spindle arrangements in cotton pickers,methods of mounting spindles, doffing of the cotton, conveying systems, working, factorsaffecting performance of cotton pickers. Sugar cane harvesters – self-propelled sugar caneharvester, cleaning and special sugar cane wagon. Sugar cane harvesters – Self-propelled sugarcane harvester, conveying and special sugar cane wagon. Principles of fruit harvesting tools andmachines – Harvesting methods – manual harvesters – hold on and twist type – Horticultural tools and gadgets. Testing of farm machine- Introduction, Standardization efforts, Testing programmeand Procedure, Type of testing systems, national testing, prototype testing, testing for qualitymarketing.

TEXT BOOKS:

1. Principals of Farm Machinery. Kepner R.A., Bainer R and Barger E.L, 1987. CBS Publishersand Distributors, Delhi.
2. Engineering principles of Agricultural machines, Ajith k Srivatsava, Carrol E. Goering, RogerP. Rohrbach, 1993, ASAE Publishers.

REFERENCE BOOKS:

1. Pesticide Application Equipment. Bindra O S and Hari Charansingh 1971. Oxford and IBH Publishing Co. Ltd., New Delhi.
2. Farm Machinery and Equipment. Smith H.P. 1971. Tata McGraw-Hills Publishing Co., Ltd., New Delhi.
3. Testing and Evaluation of Agricultural Machinery. Mehta M.L., Verma S.R. Misra S.K. and Sharma V.K. Daya Publishing House, New Delhi.

Course outcomes:

Upon successful completion of this course, learner will be able to:

CO1: Describe Crop harvesting machinery
CO2: Analyze the Power operated vertical conveyer reapers
CO3: Apply the threshing principles for all types of threshers
CO4: Analyze the factors affecting the harvesters.
CO5: Explain the features of cotton harvesting equipment.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
AGRICULTURAL PROCESS ENGINEERING					

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

UNIT-I:
Scope and importance of material handling devices, study of different material handling systems– Classification, principles of operation, conveyor systems selection/design. Belt Conveyor–Inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper Chain conveyor–Principle of operation, advantages, disadvantages, capacity and speed, conveying chain, Screw conveyor – Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors. Bucket elevator–Principle, classification, operation, advantages, disadvantages, capacity, speed, Bucket discharge, relationship between belt speed, pickup and bucket discharge, bucket types, Pneumatic conveying system- capacity and power requirement, types, selection of pneumatic conveying system, Gravity conveyor design considerations – capacity and power requirement. Scope and importance crop processing – principles and methods of food processing cleaning and grading of cereals. pulses & oilseeds – Principles. Size reduction –principle of comminution/ size reduction, mechanisms of comminution of food, particle shape, average particle size, haracteristics of comminuted products, crushing efficiency. determination and designation of the fineness of ground material, screen analysis, empirical relationships (Rittinger's, Kick's and Bond's equations), work index, energy utilization, methods of operating crushers, classification based on particle size, nature of the material to be crushed. Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, burr mill, tumbling mills, action in tumbling mills, Size reduction equipment –Ultra fine grinders (classification hammer mills, colloid mill), cutting machines (slicing, dicing, shredding, pulping), energy requirement of size deduction.

UNIT–II:
Mixing –introduction, theory of solids mixing, criteria of mixer effectiveness and mixing index for granular solids, mixing indices, criteria of mixer effectiveness and mixing index for pastes and semi solid masses, mixing index at zero-time, rate of mixing, theory of liquid mixing, power requirement for liquids mixing. Mixing equipment – Mixers for low or medium viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices), mixers for high viscosity liquids and pastes, mixers for dry powders and particulates solids.

UNIT-III:
Aerodynamics of agricultural products – drag coefficient – frictional drag and profile drag or pressure drag – and terminal velocity. Theory of separation, types of separators, cyclone separators, size of screens applications, separator based on length, width, and shape of the grains, specific gravity, density. Air-screen grain cleaner: principle and types, design considerations of air-screen grain cleaners, sieve analysis-particle size determination, ideal screen and actual screen– effectiveness of separation and related problems, pneumatic separator, threshing, winnowing, cleaning and separation equipment.

UNIT–IV:
Moisture content and methods for determination in grains, moisture content representation, wet basis, dry basis, direct and indirect methods of moisture content determination, problems, Importance of EMC and method of determination, static-dynamic methods, EMC curve and EMC models, hysteresis effect, bound, unbound and free moisture. Principles of drying, theory of diffusion, mechanism of drying,

falling rate, constant rate period, Thin layer, deep bed dying methods, Effect of different factors on the drying process, different types of dryers, LSU dryer, flat bed batch dryer, fluidized bed dryer, rotary dryer, solar dryer.

UNIT–V:

Rice milling, principles and equipment, paddy parboiling methods and equipment, wheat milling, milling of pulses and oilseeds. Theory of filtration, rate of filtration, pressure drop during filtration, applications, Constant-rate filtration and constant–pressure filtration derivation of equation, Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters.

TEXTBOOKS:

1. Transport Processes and separation Process Principle, Geankoplis C J 2003 Prentice-Hall Inc., New Jersey.
2. Unit operations in Food processing, Earle R L 1983. Pergamon Press, New York

REFERENCEBOOKS:

1. Post Harvest Technology of Cereals, Pulses and oil seeds, Chakraverty A 1988. Oxford and IBH Publishing Co. Ltd., Calcutta.
2. Unit Operations of Chemical Engineering, McCabe WL, Smith JC and Harriott P 1993 Mc Graw-Hill Book Co., Boston.

Course outcomes:

Upon successful completion of this course, learner will be able to:

CO1: Discuss different types of Material handling devices.
CO2: Analyze the effectiveness and mixing index for granular solids, mixing indices
CO3: Explain Aerodynamics of Agricultural product .
CO4: Estimate moisture content in wet basis and dry basis for different types of grains
CO5: Apply milling principles for wheat, pulses and oil seeds.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
FOOD PACKAGING TECHNOLOGY (Professional Elective - II)					

Objective: To provide knowledge on factors influencing spoilage of foods, packaging systems, different packaging materials, packaging equipment and packaging technology.

UNIT-I

Introduction to food packaging – packaging situation in world and in India – Definition of packaging - package, packaging, packing - need of packaging food – logistics –merchandising outlets – handling – transportation – packaging machinery – technology upgradation – public distribution – cost effective packaging - levels of packaging –functions of packaging –packaging environments – functions/ environment grid.

UNIT-II

Shelf life of processed foods: Factors influencing shelf life of food products – package – Environment, hazards of distribution – mechanical, climatic and other hazards and general principles of control of spoilage agents, packaging laws and regulations – FSSAI packaging and labeling regulations.

UNIT-III

Packaging materials – classification of packages – paper as packaging material –types of paper - kraft paper - bleached paper - grease proof paper – glassine - paper – vegetable parchment waxedpaper - paper boards - paper board grades - folding cartons - kinds of carton boxes – beverage cartons - molded pulp containers - printing and varnishing – die cutting and creasing - gluing and sealing. Glass as package material - Composition of Glass - Parts of Glass container - Closures - Parts of Closures - Types of Closures -Properties of glass – Internal pressure resistance – Vertical load Strength- Resistance to impact - Resistance to Scratches and Abrasions Glass manufacture - Press and Blow(P&B) - Narrow Neck Press and Blow (NNPB) - Shape of glass ContainerImprovements in glass manufacturing - Hot and Cold end treatment of surface – Inspection of Glass Bottles - Advantages and Disadvantages Metal as Packaging material - Introduction - Manufacture of Tin Plate - Tin plating Manufacture of ECCS Manufacture of Aluminium - Advantages and Disadvantages.

UNIT-IV

Packaging of milk and milk products - Packaging of fruits and vegetables – Meat, fish and poultry – Bakery and confectionary products – Protein rich foods - Packaging of Edible starches and starch products – Oils and Fats – Food grains - and food grain products – Sugar and Honey - stimulant foods – Alcoholic drinks and carbonated beverages – Spices and Condiments Condiments.Packaging of biscuits, , milk powder, coffee - carbonated soft drink- fried snack foods package testing - thickness – paper density - basis weight – grammage - burst strength –tear resistance - tensile strength - grease resistance – gas transmission rate (GTR) – water vapour transmission rate (WVTR).

UNIT-V

Container Making Processes - End Manufacture - Three Piece Can Manufacture -Welded Side seams - Soldered Side seams - Double Seaming - Two Piece Can Manufacture D&I Cans – DRD Cans - Protective and Decorative coatings – Aluminium foils and Containers - Tube – Retort Pouch Plastic Consumption in India and World -Plastic packaging material - Classification of Plastics – Advantages and disadvantages Polyethylene - Low Density Polyethylene - Linear Low density Polyethylene – High Density Polyethylene - Polypropylene - Polystyrene – Polycarbonate – Polyvinyl Chloride –

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Polyvinylidene Chloride – Ethylene vinyl Alcohol- Polyethylene terephthalate Coating - Laminating - Coating process – Laminating Processes.

TEXT BOOKS:

1. Food Packing Technology by Richard Coles and Mark J. Kirwan, Wiley Blackwell Publishing. 2nd Edition. 2011
2. In – Pack Processed Food by P. Richardson, Woolhead Publishing, 1st Edition, 2008.

REFERENCEBOOKS:

1. Food Packaging Principles and Practices by Gordon L. Robertson, CRC Press, 3rd Edition, 2013.
2. Recent Innovation in Barrier Technology for Plastic packaging, A review by Jacob L. Packaging Technology and Sciences, 2003.
3. New Concept in Dairy Packaging by Varghes S. and Goyal G.K, Beverages

Course outcomes:

Upon successful completion of this course, learner will be able to:

CO1: Apply principles of packaging for cost effective packaging

CO2: Estimate the Shelf life of processed foods

CO3: Describe different types of packaging materials.

CO4: Analyze the different techniques used for packaging of milk, fruits and meat.

CO5: Explain various container making processes

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
WATERSHED MANAGEMENT (Professional Elective - II)					

Objectives: To train the students in the multi-disciplinary subject of watershed management for effective conservation of land, using engineering and agronomic practices, control of soil loss in watershed participatory management teams in small as well as large watersheds for increasing the productivity and preparation of necessary proposals.

UNIT–I

Watershed – introduction and characteristics. Watershed development – problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors.

UNIT–II

Watershed management – concept, objectives, factors affecting, watershed planning based on land capability classes, hydrologic data for watershed planning, watershed codification, delineation and prioritization of watersheds, sediment yield index. Water budgeting in a watershed.

UNIT–III

Management measures – rainwater conservation technologies – in-situ and ec-situ storage, water harvesting and recycling. Dry farming techniques – inter-terrace and inter-bund land management. Integrated watershed management – concept, components, arable lands – agriculture and horticulture, non-arable lands – forestry, fishery and animal husbandry.

UNIT–IV

Effect of cropping systems, land management and cultural practices on watershed hydrology. Watershed programme – execution, follow-up practices, maintenance, monitoring and evaluation.

UNIT–V

Participatory watershed management – role of watershed associations, user groups and self-help groups. Planning and formulation of project proposal for watershed management programme including cost-benefit analysis.

TEXTBOOKS:

1. Ghanshyam Das. 2008. Hydrology and Soil Conservation Engineering: Including Watershed
2. Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
3. Katyal, J.C., R.P. Singh, Shriniwas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra. 1995. Field

REFERENCEBOOKS:

1. Singh, G.D. and T.C. Poonia. 2003. Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.
2. Singh, P.K. 2000. Watershed Management: Design and Practices. E-media Publications, Udaipur.
3. Singh, R.V. 2000. Watershed Planning and Management. Yash Publishing House, Bikaner.
4. Tideman, E.M. 1999. Watershed Management: Guidelines for Indian Conditions. Omega Scientific Publishers, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes:

Upon successful completion of this course, learner will be able to:

CO1: Plan for watershed development

CO2: Analyze the factors affecting the watershed management.

CO3: Explain rainwater conservation technologies.

CO4: Estimate the Effect of cropping systems, land management and cultural practices on watershed hydrology.

CO5: Prepare project proposal for watershed management programme including cost-benefit analysis.

.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
HUMAN ENGINEERING AND SAFETY (Professional Elective - II)					

Objective: To enable the students to study of human relation with environmental factors, study of anthropometry study of safety gadgets for spraying, chaff cutting and tractor & trailer operator.

UNIT-I

Introduction to Human Engineering and Safety: Human factors, machine factors, environmental factors, relationship between the three; study of human machine model, human performance, effectors and senses, importance of FMJ (Fitting Man Job) and FJM (Fitting Job Man). Study of Anthropometrics in designs: Workspace design for standing and seated workers, Tasks requirements – visual requirements and postural requirements.

UNIT-II

Functions of the skeletal and muscular systems: Conditions for the static equilibrium for the human body, the muscle function and types of muscle fatigue and discomfort; Factors influencing the work posture.

UNIT-III

Design of Hand Tools:Biometrics and energy for muscle contraction, oxygen dependent and oxygen independent system. CO2 consumption, importance of cardio muscular system and respiratory system in physical work handling; difference between static and dynamic works.

UNIT-IV

Physical work capacity: Factors affecting the work capacity - introduction, work capacity personal factors- age and sex. Environmental factors: light and climate. Indirect measures of energy expenditure, calculation of rest periods in manual work. Safety: Different machines and measures taken for the protection, vision- importance of vision, measures taken for the protection of the vision, guidelines for using colour combinations.

UNIT-V

Noise and Vibration- Measurement of sound, the nature of sound, damages due to noise, preventive measures, Displacer, types of displace, visual displace, audio signals, communication, noise communication, audio warning cues. Advance Effects of Air Pollution**:** Safety regulation acts during field operations, safety measures. rehabilitation and compensation to accident victims, human information processing, skill and performance, general model of human information processing, memory storage, short term and long-term storages, feedback information, design of hand tools for agricultural operations.

TEXT BOOKS:

1. Work study and Ergonomics, Dalela S and Saurabh 1995, Standard Publishers and Distributors, New Delhi.
2. New Horizons I Human Factor Design, Huckingson 1992. McGraw-Hill Book Co., New Delhi.
3. Human Factors Engineering, McCormick E J 1992. McGraw-Hill Book Co., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCEBOOKS:

1. Human Factors in Engineering and Design, Sanders M S and McCormick E J 1992. McGraw-Hill Book Co., New Delhi.
2. Anthropometric Methods: Designing to Fit the Human Body by John A. Roebuck Jr. 1996. HFES Publications.
3. Anthropometric Sourcebook (1978). NASA Reference Publication No. 1024, Houston TX:
4. NASA (NTIS, Springfield, VA 22161, Order No. 79 11734).

Course outcomes:

Upon successful completion of this course, learner will be able to:
CO1: Design workspace for standing and seated workers.
CO2: Interpret the functions of the skeletal and muscular systems
CO3: Apply Biometrics and energy for muscle contraction for the design of Hand tools.
CO4: Estimate the Physical work capacity
CO5: Calculate sound, the nature of sound, damages due to noise

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
Open Elective - II (*Offered by other department*)					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		0	0	3	1.5
SOIL AND WATER CONSERVATION ENGINEERING LAB					

Objective: To enable the student to underrated the procedure for estimation of soil loss, discharge, evaporation, sediment, accumulation, water movement through layers.

Practical

1. Estimate the soil losses and sediment concentration.
2. Describes the procedure for planning and construction of soil conservation measures.
3. Estimate the water discharge rate and evaporation and separation rate.
4. Design the soil conversion measures and structures.

1. Estimation of Soil Loss from using Cushocton Silt sampler and multi slot divisor.
2. Determination of sediment concentration through Oven Dry method.
3. Soil loss estimation using erosivity index and erodibility index.
4. Determination of rate of sedimentation and storage loss in reservoir.
5. Field planning for implantation of soil conservation measures.
6. Field visit to study different soil conservation structures
7. Field visit to study different gully control structures
8. Determination in filtration characteristics of soils.
9. Measurement of irrigation water with H-Flume.
10. Measurement of evapo-transpiration.
11. Visit to nearby irrigation projects
12. Use of current meter and water meter.

TEXTBOOKS:

1. Soil and Water Conservation Engineering. Scwab G.O. Frevert R.K. Edminster T.W. and Barnes K.K. 1981 John Wiley and Sons New York.
2. Manual of Soil and Water Conservation Practical. Gurmel Singh. Venkataramanam C. Sastry G and Joshi BP. 1994.Oxford and IBH Publishing Co. Ltd., New Delhi.

REFERENCEBOOKS:

1. Land and Water Management Engineering. Murthy VVN 2004. Kalyani Publishers, New Delhi.
2. Introduction to Soil and Water Conservation Engineering. Mal B.S. 1995 Kalyani Publishers, Rajinder Nagar, Ludhiana.
3. Reddy, K.S. Manual on “Farm Ponds: A climate resilient technology in Rainfed Agriculture:
4. Design Planning and construction. ICAR, CRIDA Publications; www.crida.in.

Course Outcomes:

1. Estimate soil and water conservation practices.
2. Estimate erosivity index and erodibility index.
3. Measure irrigation water with H-Flume.
4. Estimate the discharge rate of water by using current meter and water meter.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		0	0	3	1.5
FARM MACHINERY AND EQUIPMENT LAB					

Objective:
To enable the student to get the practical knowledge on various operation in agricultural field for cropproduction.

Practical

1. Study of various Farm Machinery and equipment.
2. Visit to machinery Production industry and ICAR, SAU'S research station.
3. Determination of Fieldcapacity and Field efficiency of primary tillage implements.
4. Draft and Fuel consumption measurement for different implements
5. Study of different types of plough bottoms and shares of M.B. Plough
6. Determination of disc angle, tilt angle, concavity of a disc plough
7. Calculation of draft and horse power
8. Study of seed-cum-ferti drill and seed metering mechanisms
9. Calibration of seed drill and problems
10. Study of sprayers, dusters and measurement of nozzle discharge and field capacity
11. Study of earth moving equipment through exposure Visit
12. Construction and working of rotovators and weeding equipment

TEXT BOOKS:

1. Principles of Farm Machinery. Kepner R.A., Bainer, R and Barger E.L., 1987. CBS Publishers and Distributors, Delhi.
2. Elements of Agricultural Engineering. Jagadeshwar Sahay. 1992. Agro Book Agency, Patna.

REFERENCE BOOKS:

1. Farm Machinery. Stone A.A. 1958. John Wiley and Sons. New York.
2. Farm Machinery and Equipment. Smith H.P. 1971. Tata Mc Graw-Hills. Publishing Co. Ltd., New Delhi.
3. Principals of Agricultural Engineering, Vol. I. Michael A.M. and Ohja T.P. 1985. Jain Brothers, New Delhi.
4. Land Reclamation Machinery. Borshahov Mansurov Sergecv 1988 Mir Publishers, Moscow.

Course Outcomes:

1. Study various implements and functional element.
2. Evaluate field efficiencies and fuel efficiencies.
3. Evaluate performance of various agricultural implements and machines.
4. Design and calibrate seed drills and matching mechanism.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		0	0	3	1.5
AGRICULTURAL PROCESS ENGINEERING LAB					

Objective:
To train the students on how to conduct experiments and evaluate performance of various agricultural food process.

Practical:
1. Preparation of flow charts and layout of a food processing plant
2. Determination of fineness modulus and uniformity index
3. Determination of mixing index of a feed mixer
4. Determination of the efficiency of cyclone separator
5. Tutorial on extraction by McCabe and Thiele plot
6. Tutorial on use of psychrometry chart
7. Tutorial Problems on distillation
8. Tutorial on power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law
9. Performance evaluation of hammer mill and attribution mill
10. Separation behavior in pneumatic separation
11. Evaluation of performance of indented cylinder and screen pre cleaner
12. Mixing index and study of mixers

TEXTBOOKS:
1. Transport Processes and separation Process Principle, Geankoplis C J 2003 Prentice-Hall Inc., New Jersey.
2. Unit operations in Food processing, Earle R L 1983. Pergamon Press, New York

REFERENCEBOOKS:
1. Post Harvest Technology of Cereals, Pulses and oil seeds, Chakraverty A 1988. Oxford and IBH Publishing Co. Ltd., Calcutta.
2. Unit Operations of Chemical Engineering, McCabe WL, Smith JC and Harriott P 1993 Mc Graw-Hill Book Co., Boston.

Course Outcomes:
1. Calculate uniformity and milling index.
2. Design the procedural calculation of cyclone and pneumatic separation.
3. Solve the problems on psychometric chart on site reduction.
4. Conduct the performance evaluation of hammer and attribution mills.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		1	0	2	2
STRUCTURAL DESIGN WITH ANSYS (Skill Oriented Course)					

Objective: To enable the students to understand the concepts of Loads and use of BIS Codes, design of singly and doubly reinforced sections, Reinforced concrete Cantilever and Counter fort Retaining Walls, RC Solid Slab Bridge, Design of Eccentric Shear and Moment Resisting connections, Method of IS code and Structural steel Framing

UNIT-I
Loads and use of BIS Codes. Design of connections. Design of structural steel members in tension, compression and bending. Design of steel roof truss.

UNIT-II
Analysis and design of singly and doubly reinforced sections, Shear, Bond and Torsion. Design of FlangedBeams, Slabs, Columns, Foundations, Retaining walls and Silos.

UNIT-III
Retaining Walls: Reinforced concrete Cantilever and Counter fort Retaining Walls–Horizontal Backfill with Surcharge–Design of Shear Key-Design and Drawing.

UNIT-IV
Flat slab and bridges: Design of Flat Slabs with and without drops by Direct DesignMethod of IS code-Design and Drawing - IRC Specifications and Loading – RC Solid Slab Bridge– Steel Foot-over Bridge- Design and Drawing. liquid storage structures: RCC WaterTanks - On ground, Elevated Circular, underground Rectangular Tanks– Hemispherical BottomedSteel Water Tank –-Design and Drawing

UNIT-V
Industrial structures: Structural steel Framing - Steel Roof Trusses – Roofing Elements– Beam columns – Codal provisions - Design and Drawing. Girders and connections:Plate Girders – Behaviour of Components-Design of Welded Plate Girder-Design of IndustrialGantry Girders – Design of Eccentric Shear and Moment Resisting connections.

Practical
Design and drawing of single reinforced beam, double reinforced beam, Design and drawingof teel roof truss; Design and drawing of one-way, two-way slabs, Design and drawing of RCCbuilding; Design and drawing of Retaining wall. To measure workability of cement by slump test

TEXT BOOKS:

1. Junarkar, S.B. 2001. Mechanics of Structures Vol. I Charotar Publishing Home, Anand.

REFERENCEBOOKS:

1. Kumar Sushil 2003. Treasure of R.C.C. Design. R.K. Jain. 1705-A, Nai Sarak, Delhi-110006, P.B.1074.
2. Khurmi R. S. 2001. Strength of materials. S. Chand & Company Ltd., 7361, Ram Nagar, New Delhi – 110055.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes:

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

CO1: Design of connections, structural steel members in tension, and compression and bending.
CO2: Analyze singly and doubly reinforced sections, Shear, Bond and Torsion.
CO3: Design of Reinforced concrete Cantilever and Counter fort Retaining Walls
CO4: Design of Flat Slabs with and without drops by Direct Design Method of IS code.
CO5: Design of Eccentric Shear and Moment Resisting connections.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		2	0	0	0
EMPLOYABILITY SKILLS (Mandatory Course)					

Preamble: The aim of this course is to enhance learner's knowledge of both soft skills and IT related skills so as to develop attributes that enhances interpersonal communication, earning power and job performance.

Course objectives:

- To enhance the Numerical ability skills such as addition, subtraction, multiplication, division, calculation of percentages, average etc.
- To develop the problem solving skills on time, distance and speed calculations, to improve the basic mathematical skills on arithmetic ability.
- To analyze a candidate's ability to relate a certain given group of items and illustrate it diagrammatically.
- To develop interpersonal skills and adopt good leadership behavior for empowerment of self and others by managing stress and time effectively.
- To prepare good resume, prepare for interviews and group discussions, and to explore desired career opportunities.

UNIT - I
Numerical ability
Number system, HCF & LCM, Average, Simplification, Problems on numbers Ratio & Proportion, Partnership, Percentages, Profit & Loss

UNIT - II
Arithmetical ability
Problems on ages, Time & Distance, Problems on boats &Steams, Problems on Trains, Time & Work, Pipes & Cistern, Chain Rule.
Allegation, Simple interest and compound interest, Races & Games of skills, Calendar and Clock.

UNIT - III
Logical ability: Permutations and Combination and Probability.
Mensuration: Geometry, Areas, Volumes,
Data interpretation: Tabulation, Bar graphs, Pie charts, line graphs

UNIT - IV
Self-Management Skills
Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities
Etiquette
Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT - V
Job-Oriented Skills
Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes:

After the completion of the course the student should be able to:

- Follow strategies in minimizing time consumption in problem solving Apply shortcut methods to solve problems
- Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.
- Analyze, summarize and present information in quantitative forms including table, graphs and formulas
- Understand the core competencies to succeed in professional and personal life
- Learn and demonstrate a set of practical skills such as time management, self-management, handling conflicts, team leadership, etc.

Text Books:

1. R. S. Aggarwal "Quantitative Aptitude", Revised ed., S Chand publication, 2017 ISBN:8121924987
2. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
3. Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

Reference Books:

1. S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.

E-resources and other digital material:

1. https://blog.feedspot.com/aptitude_youtube_channels/
2. https://www.tutorialspoint.com/quantitative_aptitude/
3. https://www.careerbless.com/aptitude/qa/home.php
4. https://www.Indiabix.com
5. https://www.freshersworld.com

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

III Year - II Semester		L	T	P	C
		0	0	0	0
Industrial/Research (Mandatory) 2 Months… to be evaluated in IV year I semester					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
IRRIGATION AND DRAINAGE ENGINEERING (Professional Elective - III)					

Objective: To impose skills to students on surface and sub – surface drainage system, their concepts of design & keynotes for problem soils in irrigated agriculture.

UNIT-I:
Introduction irrigation Engineering, advantages of irrigation, necessity and development of irrigation in India and AP and classification of irrigation projects, Irrigation terminology- GCA,CCA, Base period, crop period, Delta, Duty, Relationship between Duty and Delta,Introduction to soil-water plant relationships, soil physical properties such as soil texture, soilstructure, capillary conductivity, soil consistency-volume-mass relationships of soil constituents, Water relations with soil - kinds of soil water-hygroscopic, capillary and gravitational movement of water into soils, Infiltration, factors affecting infiltration, procedure for measurement of infiltration rate and development of infiltration equations (Kostia-Kov equations Huston equations -curve fitting), Soil moisture characteristic curves, difference between soil moisture stress and soil moisture tension, soil moisture constants such as saturation capacity, field capacity moisture equivalent and permanent wilting point. Terminology related with movement of water within soils-water intake, percolation, interflow, seepage, permeability, hydraulic conductivity and hydraulic gradient- Measurement of soil moisture by different methods, evaporation, transpiration and evapo-transpiration-Estimation by Blaney-Criddle, Thornthwaite, Penman and modified Penman equations only-Potential ET. Water requirements of crops importance of water in plant growth, procedures net irrigation requirement (depth of irrigation), gross irrigation requirement, irrigation frequency and Irrigation efficiency (conveyance, application, storage, distribution, water use efficiency) with few numerical examples,

UNIT-II:
Gravity Water application methods-classification, border irrigation, components of border irrigation-Width, Length and Slope for different soils for different soils, Hydraulics of border irrigation (Advance curve, Recession Curve and Opportunity time through time and distance curve) design of border irrigation. Derivation of Israelson's equation for the width of the border Furrow irrigation system advantages and disadvantages, determination of infiltration depth in furrows by inflow-outflow method (Steam size, Distance Advance time, CS area and Wetted Perimeter data problem on computation of infiltration depth), Check basin irrigation–advantages and disadvantages, estimation of infiltration under check basin conditions, adaptability and design considerations. Surge irrigation: concepts, parameters, infiltration, hydraulics, efficiency & distribution uniformity.

UNIT-III:
Conveyance of irrigation water- methods assessment of design capacity of irrigation channels. Design of irrigation canals using Lacey's and Kennedy's theories and problems, Measurement of irrigation water-units of measurements, methods of measurement, direct and indirect methods, measurement of velocity using current meter-indirect methods such as area velocity method and coordinate method for measuring discharges form pipes, dethridge meter, tracer method, Direct methods of measurement of discharges; different devices such as weirs, flumes and notches and their installation procedures, equations for rectangular triangular and trapezoidal notches, explanation on RBC flumes (critical flow flumes).Underground pipe lines for irrigation water distribution, types of pipes used for underground pipe lines, testing of pipes for its water absorption and pressure requirements, estimating the discharge capacity of pipe lines, installation procedures of underground pipe lines and study of different structures associated with underground pipe lines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT-IV:

Drainage-definition, objective and types, familiarization with the drainage problems (twin problems of water logging and salinity) and extent of areas in irrigated areas in the state, Surface drainage: effects of poor drainage, areas requiring drainage, factors affecting drainage requirement, drainage coefficient, determination of drainage coefficient based on different criteria, Types of surface drainage: random field drain system, bedding system, parallel field drain, parallel lateral open ditch, cross slope drain system interception system, design of open drainage channels using Manning's equation and alignment of open ditches (radius of curvature), investigations on design parameters, hydraulic conductivity, drainable porosity fluctuations of depts., to water table in the areas, methods of determining hydraulic conductivity-single auger hole method and inverse auger hole: Sub-surface drainage systems, purpose and benefits, types of sub surface systems, tile drains, mole drains, drainage wells, deep open drains and combinations and their suitability for different conditions and limitations.

UNIT-V:

Components of Sub-surface drainage system: layouts and types –Random type herring bone, grid iron cutoff or interceptor drains, depth and spacing of drains, size of the pipe drains using Manning's equation, drain materials of burnt clay. Perforated corrugated and solid PVC and cement concrete, slope/grade for the drains, Envelope materials for sub-surface drains and selection criteria for uniform soils and graded soils, geo-textile and nylon mesh, outlets for sub surface drainage, gravity and pumped outlets. Design of sub surface drains under steady state (equilibrium) conditions and derivation of Hooghoudt's equation for spacing, the Ernst's derivation for drain spacing, Glover-Dumm equation (only) for spacing under non-steady state conditions of water table, drainage structures, loads on conduits, ditch conduit conditions and

projecting conduit conditions, construction and installation of drains, bio-drainage, vertical drainage and drainage of irrigated and humid areas, Salt balance, classification and reclamation of saline and alkaline soils, soil amendments, leaching requirement-leaching ratio, Economic aspects of drainage with a typical example for total cost estimation of SSD system and benefit – cost ratio.

TEXT BOOKS:

1. Irrigation Engineering, Muzumdar S K, 1983, Tat-McGraw Hill Publishing's. Co. Ltd., New Delhi.
2. Irrigation Theory & Practice, Michael A M, 2008, Vikas Publishing House, New Delhi.

REFERENCEBOOKS:

1. Drainage Engineering, Luthin J M, 1970, Wiley Eastern Ltd., New Delhi.
2. Soil and Water Conservation Engineering, Schwab G O, Frevert R K, Edminister T w and Barner K K, 1981, John-Wiley and Sons, New Delhi.
3. Land & Water management Engineering, Murthy V V N, 2004, Kalyani Publishers, New Delhi.

Course outcomes:

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

CO1: Explain the terminology related to Irrigation and calculate Soil moisture by different methods.
CO2: Determine infiltraction under check basin conditions and adaptability
CO3: Design irrigation canals using Lacey's and Kennedy's theories.
CO4: Describe the factors affecting drainage requirement, drainage coefficient based on the given criteria.
CO5: Design subsurface drains under Steady State conditions.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY (Professional Elective - III)					

Objective: To enable the students to understand the different processes and machinery involved in manufacturing the agricultural machines and to acquire knowledge on CNC tooling, turning tools, milling tools, drilling tools, finishing tools. To know the industrial lay out, planning, organization, administration and management.

UNIT-I:
Critical appraisal in production of agricultural machinery-Stresses in machine elements working stresses-stress analysis of machine parts by using standard software. Cutting tools including CNC tools and finishing tools-High speed steel cutting tools, cemented carbides, coated carbides, ceramics, drilling tools, types of drill bits, milling cutters.

UNIT-II:
CNC tooling-turning tools, milling tools, drilling tools, finishing tools associated with tool turrets, different types of tools used in CNC machining centers – vertical anis machining centers – twin turret tuning centre. CNC Turning centers – Multiple spindles turning centers – integrated material handling.

UNIT-III:
Powder metallurgy-introduction, powder metallurgy process, preparation of metal powders. Characteristics of metal powders – mixing compacting – sintering – hot pressing – applications of powder metallurgy. Limits fits & tolerances – limits and fits compound tolerances – conditions for the success of any system of limits & fits, Terms & definitions.

UNIT-IV:
Jigs & fixtures – Jigs, fixtures, differences between jigs & fixtures – advantages of jigs & fixtures – essential features of jigs & fixtures. General rules for designing jigs & fixtures – Different types of jigs – Types of fixtures. Controllers – CNC controlling for machine tools – motion control systems – Point to point control system – continuous path control system. CNC controlling for machine tools absolute incremental control system – open loop and closed loop system.

UNIT-V:
Machine control unit – introduction – configuration of machine control unit. Distributed numerical control – introduction and configuration. CNC part programming – Part programming fundamentals – manual part programming methods. CNC part programming – interpretation of Gcodes, computer Assisted part programming types quality of good industrial management. Advantages of good organization – economic order quantity – site selection of a factory – general location of a factory – plant lay out. Selection of stander and critical components for manufacturing agricultural machines. Case studies of manufacturing of agricultural machinery.

TEXTBOOKS:
1. CAD/CAM: Principles and Applications, Rao P.N, 2004, McGraw Hill Education India, New Delhi.
2. Engineering Metrology, Jain R.K., Khanna Publishers, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCEBOOKS:

1. Industrial Organization and Engineering, Banga T.R. and SharamS.C., 2004, Khanna Publishers, New Delhi.
2. Mechanisms and Machine Theory, Rao J.S. and Dukkipatti R.V., 1990, Wiley Astern Ltd., New Delhi.
3. Theory of Mechanisms and Machines, Jagdish La, 191, Metropolitan Book Co. Pvt. Ltd., New Delhi.

Course outcomes:

At the end of the course, student will be able to
CO1: Choose appropriate cutting tool material for a given application
CO2: Explain CNC tooling
CO3: Calculate limits, fits & tolerances.
CO4: Apply the relevant motion control system of CNC machine for a given application.
CO5: Develop Part programme for a given product.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
FOOD PLANT DESIGN AND MANAGEMENT (Professional Elective - III)					

Objective: Students will be trained in organization of food and agricultural processing plant machinery as per process flow, site selection, layout procedures, project design concepts, etc. will be explained for bringing the talent to establish an engineering industry.

UNIT-I

Plant layout – Definition, and principles, factors in planning layouts. Methods of layout planning – Unit areas concept, two – dimensional layouts, scale models. Principles of plant layout – Storage layout, equipment layout, safety, plant expansion, floor space, utilities servicing, building, materials handling equipment, rail road's and roads.

UNIT-II

Types of plant layout – salient features of horticultural, rice, maize, pulses, oil seeds, poultry, fish, meat, milk and milk product plants.

UNIT-III

Location selection criteria – Plant location, factors in selecting a plant, selection of the plant site, preparation of the layout. Selection of processes – Comparison of different processes, batch versus continuous operation. Plant capacity – Equipment design and specifications, scale – up in design, safety factors, specifications, materials of construction. Project design – Process design development, general overall design considerations, cost estimation, factors affecting profitability of investments, optimum design (economic and operation). Project design – Practical considerations in design, approach. Project design – Types of designs, feasibility survey, process development, design, construction and operation, design information from the literature.

UNIT-IV

Flow diagrams-qualitative and quantitative flow diagrams. Selection of equipment – Preliminary design, problem statement, literature survey, material and energy balance, equipment design and selection, problems, economics. Process and controls-Control systems, instrumentation control, maintenance, computer aided design. Handling equipment - Selection, factors, pumps, piping, fittings, solid feeders, plant layout. Plant elevation - Requirement of plant building and its components, foundation for equipment and dynamic loading, flooring, walls, roof, illumination, air-conditioning. Labor requirement for processing plant - Labor costs, maintenance.

UNIT-V

Food plant sanitation-Environmental protection, regulations, pollution control, air pollution abatement, particulate removal, noxious gas removal, thermal pollution control, recycling, CIP. Cost analysis cost indexes - Cash flow for industrial operations, factors affecting investment and production costs, capital investment, and estimation of capital investment. Cost analysis – Cost indexes, cost factors in capital investment, estimation of total product cost. Preparation of feasibility report -Types of repots, organization of reports, organization of a design report, preparing the report, rhetoric, checklist for the final report.

TEXT BOOK:

1. Dairy and Food Engineering, Farall F W 1992. John Wiley & Sons, New York.
2. Plant Layout and Design, James M Moor, Macmillan, New York.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCE BOOKS:

1. Milk Plant Layout, Hall H S and Y. Rosen, FAO publications, Rome.
2. Principles of Food Sanitation, Marriott N G 1985. Van Nostrand Reinhold Company, New York.
3. Food Technology Processing and Aylward F 2001. Allied Scientific Publishers, Bikaner. Laboratory Control.

Course outcomes:

At the end of the course, student will be able to
CO1: Explain the principles of plant layout.
CO2: Select a suitable plant layout for a given product.
CO3: Use principal considerations for plant location and design of layout
CO4: Describe the design criteria of plant building
CO5: Estimate Cost indices, total product cost.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
DESIGN OF SOIL AND WATER CONSERVATION AND FARM SYSTEMS (Professional Elective - IV)					

Objective: To enable the students to design and execute the structures for controlling soil erosion due to water, irrigation in fields and prepare cost estimates for the structures.

UNIT-I:
Flow in open channels – types of flow, state of flow, regimes of flow, energy and momentum – principles, specific energy and specific force – critical depth concept–stage discharge relationship– sequent depths. Hydraulic jump and its application, type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of energy – Froude number and its significance in the design of hydraulic structures.

UNIT-II:
Runoff measuring structures – Parshall flume, H-Flume and weirs, water stage recorders, straight drop spill way-general description, functional use, advantages and disadvantages, structural parts and functions, components of spillway. Three design phases – hydrologic and hydraulic design, free board and wave free board, aeration of weirs, concept of free and submerged flow. Structural design of a drop spillway–loads on headwall, variables affecting equivalent fluid pressure. Determination of saturation line for different flow conditions, seepage under the structure, equivalent fluid pressure of triangular load diagram for various flow conditions. Creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.

UNIT III:
Chute spillway- general description and its components, hydraulic design, energy dissipaters – uplift pressure diagram – analysis of various forces etc. Design criteria of a SAF stilling basic and its limitations. Drop inlet spillway – general description, types of possible flow conditions, pipe flow, orifice flow, functional use, design criteria. Irrigation Engineering structures – Various types and their purposes. Differences between soil conservation and irrigation structures.

UNIT-IV:
Canal falls – Types of canal falls with line diagrams (elevations). Design of trapezoidal notch fall. Design of syphon well drop type of canal falls. Cross drainage works – locations needing cross drainage works – aqueduct – super passage – inverted siphon aqueduct – inlets and outlets – different types of cross drainage works with line diagrams. Design principles of various cross drainage works – design of an aqueduct.

UNIT–V:
Irrigation outlets – non modular, semi modular rigid modular outlets battle sluice irrigation modules. Diversion head works – Different components of diversions head works – head regulator and cross regulator. Different types of weirs and barrages – Difference between a weir and barrage with example locations. Operation of gates in controlling water in irrigation structures.

TEXT BOOKS:
1. Soil and Water Conservation Engineering. Schwab G.O., Frevert R.K. Edminister T.W. and Barnes K.K. 1981. John Wiley and Sons, New York.
2. Irrigation Engineering and Hydraulic Structures. Garg S.K. 1986. Khanna Publications, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCEBOOKS:

1. Irrigation Engineering. Mazumdar. S.K. 1983. TMH Publishing Co. Ltd., New Delhi.
2. Irrigation Water Resources. Modi P.N. 1990. Standard Book House. Post Box No. 1074. New Delhi.
3. Hydrology and Soil Conservation Engineering. Ghanshyam Das 2009 PHI Learning Private Limited, New Delhi

Course outcomes:

At the end of the course, student will be able to
CO1: Analyze types of flow, state of flow, regimes of flow.
CO2: Estimate runoff by using Parshall flume, H-Flume and weirs, water stage recorders, straight drop spill way-general description.
CO3: Design Chute spillway and SAF stilling basic
CO4: Design trapezoidal notch fall and syphon well drop type of canal falls.
CO5: Analyze different components of diversions head works.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
FOOD PROCESS EQUIPMENT DESIGN (Professional Elective - IV)					

Objectives:
To evaluate students to understand the general procedure of designing different food processing equipment and optimizing the design with respect to process efficiency, energy and cost.

UNIT-I:
Introduction on process equipment design - factors influencing the design of vessels criteria in vessel design – application of design engineering for processing equipment, design parameters and general design procedure.

UNIT-II:
Material specification – types of material for process equipment, design procedure, material specification, types of material for process equipment design of shells and roofs – proporting, head selection, supporters, pressure and stress considerations in different process equipment – Design codes: design of different food process equipment to code specifications.

UNIT-III:
Design of different food processing equipment – pressure vessel design, design of vessels with closures operating under extended pressure, design pressure vessels to code specifications, design of high pressure monobolic and multilayer vessels, cleaners, tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger.

UNIT-IV:
Design of belt conveyer, screw conveyer and bucket elevator – Design of dryers – fluidized bed, rotary, rolling bed, conduction convection, spray and freeze dryers. Design of milling equipment – pulverizers, flour mills – hand operated and mechanical mills – disc mills, rotary mills, dry and wet mills.

UNIT-V:
Optimization design of food process equipment – factors to be considered in optimization of design of different food processing equipment – process efficiency, energy utilization, cost – computer aided design.

TEXT BOOKS:

1. Geankoplis C.J. 2003. Transport Processes and Unit Operations, Prentice-Hall, New York.
2. Bhattacharyya, B.C.2008. Introduction to Chemical Equipment Design, CBS Publishers and Distributors, New Delhi.

REFERENCEBOOKS:

1. Mahajani, V.V. and Umarji, S.B.2009. Process Equipment design, Macmillan, U.K.
2. Rao, D.G.2010. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.
3. Groover, M. and Zimmers, E. CAD/CAM Computer-aided design and manufacturing person Education, Inc., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes:

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

CO1: Apply design engineering principles for process Equipment Design

CO2: Design Food Process equipment.

CO3: Design high pressure monobolic and multilayer vessels.

CO4: Analyze the design Parameters of the Conveyors, dryers and other processing equipment.

CO5: Determine process efficiency, energy utilization and cost.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
DESIGN OF AGRICULTURAL MACHINERY (Professional Elective - IV)					

Objective: To enable the students to understand the general procedure for designing any machine parts. To know the design of cotter and knuckle joints, leavers, springs, various types of shafts, couplings bearings and various IC engine parts.

UNIT-I

Machine Design – Definition, Classification of machine design, General considerations in machine design, General procedure in machine design. Fundamental units, Mass and Weight, inertia, laws of motion, force, moment of force, couple mass density, torque, work, power and energy. Simple stress in machine parts – Introduction, load, stress, strain, tensile stress and strain, compressive stress and strain, Young's modulus, shear stress and strain, shear modulus, bearing stress.

UNIT-II

Stress strain diagram, working stress, Factor of safety and selection, stresses in composite bars, thermal stress, linear and lateral strain, Poisson's ratio, volumetric strain, bulk modulus and relations, impact stress, resilience. Principal stresses and principal planes – Theories of failure under static load, Rankine's theory, Guest's theory, maximum distortion theory, stress concentration, notch sensitivity - Important terms used in Limit System, fits, types of cotter joints, design of socket and spigot cotter joint. Knuckle joint, Dimensions of various parts of knuckles joint, methods of failure of knuckle joint, design procedure of knuckle joint.

UNIT-III

Levers – Introduction, application of levers in engineering practice, design of lever hand levers, foot lever, cranked lever. Springs – Introduction, types of springs, material for helical springs, spring wire, terminology, springs in series and parallel, flat spiral springs, leaf springs, construction of leaf springs.

UNIT-IV

Shafts – Material used for shafts, types and sizes of shafts, stresses in shafts, maximum working stresses. Design of shafts, for twisting moment, bending moments, fluctuating loads, axial load in addition to combined twisting and bending loads, design of shafts on the basis of rigidity. Keys and coupling – Introduction, types of keys, sunk keys, saddle keys, tangent keys, round keys, splines, forces acting on sunk keys, strength of sunk key. Effect of key ways, shaft couplings, types of shaft couplings, muff coupling, design of flange coupling.

UNIT-V

Design of Machinery: Design of Tillage equipment –a. Cultivator (Manually Drawn and Power Operated); b. Rotavator (Power Operated); c. M.B Plough (Manually Drawn and Power Operated). Design of Sowing Machinery – Tractor Operated seed cum Fertilize drill. Design of harvesting equipment: a. Reaper, b. Mower. Design of Thresher: Power operated thresher (Spike tooth and Rasp bar), Design of spraying equipment – Tractor mounted Boom sprayer.

TEXTBOOK:

1. Machine Design – Khurmi R.S. and Gupta J.K. 1996, Eurasia Publishing House Pvt. Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

REFERENCEBOOKS:

1. Machine Design – Jain R.K. 1991. Khanna Publishers, New Delhi.

Course outcomes:

At the end of the course, student will be able to
CO1: Analyze the general considerations in machine design.
CO2: Calculate the design Parameters of socket, spigot cotter joint and Knuckle joint.
CO3: Choose appropriate levers and springs for a given application.
CO4: Design shafts and keys for the specified conditions.
CO5: Design Tillage equipment.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
MICRO IRRIGATION ENGINEERING (Professional Elective - V)					

Objective: To impart knowledge and skills to students to design micro irrigation systems to improve water productivity of different crops and to perform economic analysis and to prepareproject proposals and cost estimates of Micro – Irrigation Systems.

UNIT-I

Sprinkler Irrigation, Historical development, Scenario in the World, Country and State, adoptability and limitations, Components of the sprinkler system, pump set, (Centrifugal, turbines and Submersible), Main lines, Lateral lines, Sprinkler heads, Debris screens, Desalting basins, booster pumps, Take-off valves, Flow control valves (individual sprinkler).

UNIT-II

Types of sprinkler Irrigation systems: A. Based on mechanism: i) Rotating head system, ii) Perforated pipe system, B. Based on portability: i) Portable systems, ii) Semi-portable systems, iii) Semi-permanent systems, iv) Permanent systems and v) Solid set systems. Precipitation profiles and Moisture distribution patterns, Recommended sprinkler spacings, Effects of wind speed on working of the system, Importance of distribution uniformity, Christiansen Uniformity coefficient, Distribution uniformity. Suitability of crops under sprinkler irrigation.

UNIT-III

Design of Sprinkler system, layout, laterals and mains: i) Inventory of Resources and Conditions, ii) Types of system and Layout, iii) Sprinkler Selection and Spacing, iv) Capacity of Sprinkler Systems, v) Hydraulic Design of Sprinkler Systems, vi) Selection of pump, Operation and maintenance of system, Field evaluation of the system, Cost analysis.

UNIT-IV

Drip Irrigation, Historical development, Scenario in the World, Country and State, Advantages and Limitations, Components of drip irrigation: A. Head Control- Non return valve, Air release & Vacuum breaker, Filter, Fertigation Tank, Throttle valve, Pressure gauge, other fittings, venture type Fertilizer injection pumps. B. Wayer carrier systems- PVC pipeline, Control valve, Flush valve, other fittings, C. Water distribution systems- Drip lateral, Drippers, Emitting pie, Grommet, Start connector, Nipple, End cap, Micro tube, Barbed connector, Drip Hydraulics, Pipe section, Water flow in pipes, Velocity recommended pressure, Press

UNIT-V

Types of Emitters: A) Based on Floe regime (Reynolds number): i) Laminar Flow, ii)Partially turbulent flow, iii) Fully turbulent flow and B) Based on Lateral connection: i) in-line and ii)online, Emitter flow equation, Emitter constants, Pressure variations (%) for different emitter flow variations and x-values, Emission uniformity (EU), Distribution Uniformity and Irrigation efficiency. Planning and design of drip system- Collection of primary data, Layout, crop water requirements, hydraulic design, selection of components, Economic pipe size selection, Pressure variation Along drip Irrigation and design criteria of lateral, sub-main and mail lines, Pai-wu I design charts. Installation, operation and Maintenance of drip irrigation systems, testing and field evaluation of the system, Computer Software programs for design of drip irrigation systems, Automation of drip irrigation systems – i) Volume based, ii) time based and iii) Soil moisture bases systems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

TEXT BOOKS:

1. Drip Irrigation & Sprinkler Irrigation, Sivanappan R K Padma Kumari O and Kumar V 1997, Keerthi Publishing House Pvt. Ltd., Coimbatore.
2. Drip and Sprinkler Irrigation Systems. Nakayama and Prucks.

REFERENCEBOOKS:

1. Micro-Irrigation for Crop Production, Design, Operation and Management, Freddie R. Lamm, James E. Ayars and Francis S, Nakayama, 2006, Elsevier Publications, Singapore.
2. Land and Water Management Principles, R. Suresh, 2008, Standard Publishers Distributors, Delhi.

Course outcomes:

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

CO1: Explain the concept of Sprinkler Irrigation and its components.
CO2: Discuss Precipitation profiles and Moisture distribution patterns, sprinkler spacings.
CO3: Design Sprinkler system, layout, laterals and mains.
CO4: Describe drip Irrigation and its components.
CO5: Plan for installation of drip irrigation system.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
MECHATRONICS IN AGRICULTURAL ENGINEERING (Professional Elective - V)					

Objective: To impart knowledge and skills to students to understand the concept of mechatronics, measurement system, control systems, Signal conditioning process, Micro-processor & computer, Robotics, Robot components, robot classification, Assembly operations, Inspection automation and Future applications.

UNIT-I

Definition of mechatronics, measurement system, control systems, microprocessor-based controllers, mechatronics approach. Sensors and transducers, performance terminology, Displacement, Position & Proximity Sensors, photo-electric transducers, flow transducers, optical sensors and transducers.

UNIT-II

Actuators, Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor.

UNIT-III

Signal conditioning process, filtering digital signal, multiplexers, data acquisition, digital signal processing, measurement system, pulse modulation, data presentation systems. System modelling & control, Mathematical Models, Engineering Systems, Electro-mechanical & Hydraulic-mechanical Systems, Modelling Dynamic Systems, Transfer Functions, Control Modes, PID Controller.

UNIT-IV

Micro-processor & computer, Computer and Interfacing, Micro-computer Structure, Micro-controllers, Application of Microcontrollers, PLC.

UNIT-V

Robotics, Robot components, robot classification and specification, Work envelopes, other basic parameters of robots. Robot applications, Robot applications in manufacturing, Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Future applications.

TEXTBOOKS:

1. Bolton, W. Mechatronics. Pearson Education Asia.
2. Wolfram, Stadler. Analytical Robotics and Mechatronics. Mc-Graw Hill.
3. Doeblin E.O. Measurement Systems. Mc-Graw Hill.

REFERENCEBOOKS:

1. Mahind, A.P. Introduction to Digital Computer Electronics. TMH.
2. Niku, S.Y. Introduction to Robotics: Analysis, systems and applications", Pearson Education Asia.
3. Craig, J.J. Introduction to Robotics. Pearson Education Asia.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course Outcomes: At the end of the course, student will be able to

CO1: Describe various mechatronics systems, measurement systems, sensors and transducers.
CO2: Explain the functionality of solid state electronic devices.
CO3: Identify the components in the design of electro mechanical systems.
CO4: Apply the concepts of digital electronics and applications of PLCs forcontrol.
CO5: Analyze the system interfacing, data acquisition and design of mechatronics systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
DAIRY AND FOOD ENGINEERING (Professional Elective - V)					

Objective: The student Knowledge on milk processing and unit operations in dairy processing including offer strength to students to handle pasteurization, sterilization, packaging, etc. of dairy products and control spoilage through process operations such as evaporation, freezing, membrane processing etc.,

UNIT–I:
Dairy development in India - Indian dairy industry products concentrated whole mile products– Composition, physic-chemical properties of milk, water content, acidity, pH, developed acidity, natural acidity, total acidity, density, specific gravity, freezing point colour and flavor of milk, Unit operations of various diary and food processing systems- centrifugation, separation, separation by cyclone (application of separation in the dairy industry, velocity of particles in agravitational field, distribution of fat globule diameters in milk, velocity of particles in acentrifugal field, strength of centrifugal bowl, disc bowl centrifuge, design of centrifuges and methods of application, decanting centrifuge for lactose and casein, cyclones for separation from gas phase).

UNIT–II:
Milk receiving – quantity determination, quality evaluation, clearing and disinfection of transport facilities, milk returns, procedures for reception and returns, process flow charts for product manufacture – pasteurized milk, process steps, person method and mass balance method for making balance of cream and fat in making whole milk, butter, cheese, ice cream manufacture, process steps, over run. Pasteurization- purpose, microorganisms and enzymes and their reaction to temperature and other influences, bacteria in milk, effect of temperature. Pasteurization –methods of heating, design and mode of operation heating equipment (vat, tubular heat exchanger, plate heat exchanger), Sterilization – UHT method (direct and indirect heating), sterilization in the package (temperature and pressure patterns), equipment for sterilizing goods in the package (batch autoclaves, continuously operating sterilizers). Freezing – Introduction, freezing point curve for food and water, freezing points of common food materials, freezing time calculation by using Plank's equation, types of freezing equipment types of equipment of leaching. Filtration – ultra-filtration, processing variables, applications or ultra-filtration in milk processing, reverse osmosis, Membrane separation – Membrane separation methods, gel filtration and on exchange, Thermal processing.

UNIT–III:
Homogenization – emulsifying, types of emulsions, emulsifiers, homogenizing (application, mode of operation, technical execution, effect of the product), filling and packaging – packaging of milk, cultured milk, cheese, butter, concentrated milk, products, dried milk products and packaging materials, filling and metering, packaging methods. Butter manufacture – principle, treatment of cream, churning, overrun, factors affecting churn ability, methods (butter churn, continuous butter making), butter oil and special butter products (Composition, methods of manufacturing, direct evaporation method, decantation, centrifugal separation, vacuum method).Thermal death time curve, reaction kinetics of the heat treatment of milk and its use for the assessment of UHT treatment methods, change in milk produced by heating, Plant utilities requirement – Electricity, water, power. Dairy plant design and layout – factors in planning, importance of site selection, location of building, size and type of dairy building, advantages of good plant layout, functional design, operating schedule and layout, process selection, floor space, walls and ceiling ventilation, doors, windows, lighting, flooring and drainage.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT-IV:

Composition and proximate analysis of food products- carbohydrates, protein, lipids, minerals, vitamins, Deterioration in products and their controls – food as a substitute to micro organisms, food preservation methods, principles of food preservation, causes of food spoilage and classification of food with respect to spoilage and consumption, Principles of food preservation, effects of pH and water content on growth of microorganisms, methods of controlling water content, effect of water activity, methods of measuring a oxidation-reduction potential effect on micro organisms, effect of nutrient content and effect of inhibitory substances, biological structures, physical, chemical, and biological methods of food preservation, change undergone by food components during processing –Changes during heating, evaporation, drying, freezing, juice extraction, filtration and separation.

UNIT–V:

Evaporation – applications, functions, factors affecting rate of evaporation, basic evaporator construction, factors affecting liquid boiling point, thermodynamics of evaporation (phase change, boiling point elevation, Duhring plot, factor influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation, factors influencing the economy of evaporation, types of evaporation equipment. Natural circulation evaporators – batch type, horizontal short-tube, vertical short tube, natural circulation with external calendria, long tube, forced circulation(general forced circulation, plate, expanding flow, mechanical /agitated thin film), drying – Drying methods (radiation, dielectric, spray, foam, spray, roller, fluidized bed, freeze).

TEXT BOOKS:

1. Food Engineering and Dairy Technology, Kessler H G 1981. Veriag A. Kessler, Freising.
2. Outlines of Dairy Technology, Sukumar De 2005. Oxford University Press, New Delhi

REFERENCE BOOKS:

1. Principles of Food Science, Fennema O R 2006. Marcel Dekkar Inc., New York.
2. Food Science, Chemistry and Experimental Foods, Swaminathan M 2006. The Bangalore Printing & Publishing Co., Ltd., Bangalore

Course outcomes:

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

CO1: Estimate the physical and chemical properties of milk, water content, acidity, pH, developed acidity.

CO2: Analyze the parameters that influence Pasteurization

CO3: Describe emulsification and types of emulsions

CO4: Estimate the carbohydrates, protein, lipids, minerals, vitamins in food product.

CO5: Analyze the factors influencing rate of evaporation, thermodynamics of evaporation, circulation in Evaporators.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
Open Elective – III (*Offered by other departments*)					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
Open Elective – IV (*Offered by other departments*)					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
UNIVERSAL HUMAN VALUES: 2 UNDERSTANDING HARMONY (Humanities and Social Science Elective)					

Human Values Courses

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester forwhich the foundation course named as "H-102 Universal Human Values 2: Understanding Harmony"is designed which may be covered in their III or IV semester. During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

1. Objective:

The objective of the course is four fold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

2. Course Topics:

The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than asarbitrariness in choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensureSanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family**.**

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010
2. India Wins Freedom - Maulana Abdul Kalam Azad
3. 12. Vivekananda - Romain Rolland (English)
4. 13. Gandhi - Romain Rolland (English)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews

OUTCOME OF THE COURSE:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

1. They would have better critical ability.
2. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
3. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
4. This is only an introductory foundational input. It would be desirable to follow it up by
   a) faculty-student or mentor-mentee programs throughout their time with the institution
   b) Higher level courses on human values in every aspect of living. E.g. as a professional

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		1	0	2	2
COMPUTATIONAL FLUID DYNAMICS WITH FLUENT (Skill Oriented Course)					

Course Objectives:

1. To explain elementary details and numerical techniques for solving various engineering problems involving fluid flow.
2. To study about finite difference applications in heat conduction and convection.
3. To use finite difference for flow modeling
4. To understand the concepts of finite volume method.
5. To understand the concepts of finite element method applied to heat transfer problems.

UNIT– I:

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations (Derivation), conservation of energy principle, and special forms of the Navier-stokes equations.

APPLIED NUMERICAL METHODS: Solution of a system of simultaneous linear algebraic equations, iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices, TDMA – Algorithms.

UNIT– II:

FINITE DIFFERENCE APPLICATIONS: Steady flow, dimensionless form of momentum and energy equations, stokes equation, conservative body force fields, stream function -vorticity formulation.

Finite difference applications in heat conduction and convection –heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

UNIT– III:

FINITE DIFFERENCE FOR FLOW MODELING: Discretization, consistency, stability and fundamentals of fluid flow modelling: introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT– IV:

FLUID FLOW MODELING: Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the upwind scheme.

FINITE VOLUME METHOD: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

UNIT– V:

FINITE ELEMENT METHODS: Introduction – Weighted Residual and Variational Formulations – Rayleigh-Ritz Method – Interpolation – One dimensional and Two dimensional regions – Error Control – Applications of FEM to One dimensional Problems (Steady and Transient) – Two dimensional problems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

TEXT BOOKS:

1. Numerical heat transfer and fluid flow/Suhas V. Patankar/Butter-worth Publishers
2. Computational fluid dynamics-Basics with applications/John.D.Anderson/McGraw Hill.

REFERENCES:

1. Computational Fluid Flow and Heat Transfer/ Niyogi /Pearson Publications
2. Introduction to CFD: Finite Volume Method – H. Versteeg and W. Malalasekahara
3. Fundamentals of Computational Fluid Dynamics /Tapan K. Sengupta/Universities Press.
4. Computational fluid dynamics: An introduction, 3rd edition/John.F Wendt/Springer publishers

Course Outcomes: At the end of the course, student will be able to

CO1: Explain elementary details and numerical techniques for solving various engineering problems involving fluid flow.
CO2: Study about finite difference applications in heat conduction and convection.
CO3: Apply finite difference for flow modeling.
CO4: Understand the concepts of finite volume method.
CO5: Understand the concepts of finite element method applied to heat transfer problems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
Industrial/Research Internship 2 Months (Mandatory) after Third Year (to be evaluated during VII Semester					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year - II Semester		L	T	P	C
		0	0	0	12
MAJOR PROJECT					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
MANAGEMENT OF CANAL IRRIGATION SYSTEM					

Objectives: To enable the students to understand Concept of ill effects of irrigation, typical network of canal irrigation system, Estimation of water requirements for canal command areas and determination of canal capacity, Silt theory, measurement of discharge in canals, types of canal escapes; requirements of a good canal outlet and types of outlet.

UNIT - I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

Water control and diversion structures, Functions of distributary head and cross regulators; canal falls, their necessity and factors affecting canal fall; sources of surplus water in canals and types of canal escapes; requirements of a good canal outlet and types of outlet.

Text Books:

1. Irrigation, Water Power and Water Resources Engineering. Arora, K.R. 2001. Standard Publishers Distributors, Delhi.
2. Irrigation Engineering and Hydraulic Structures. Garg, S.K. 2014. Khanna Publishers New Delhi.

Reference Books:

1. Irrigation Engineering and Hydraulic structures. Sahasrabudhe, S.R. 2011. SK Kataria & Sons Reprint 2015.
2. Irrigation Theory and Practice by A M Michael, Second Edition, Vikas Publishing house Pvt Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course Outcomes: At the end of the Course, Student will be able to:
CO1: Apply the knowledge on canal classification and its alignment.
CO2: Determine duty, delta, base period relationships and canal capacity.
CO3: Design channels using Kennedy's theory and Lacey's regime theory.
CO4: Differentiate between lined and unlined channels.
CO5: Explain different irrigation structures.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
MECHANICS OF TILLAGE AND TRACTION					

Objectives: To enable the students to understand Concept of Soil physical properties, engineering properties of soil, soil dynamic characteristics, mechanics of simple reaction in inclined, vertical, wider and narrow tools, Coulomb's failure criteria, traction performance equations, function, types and terminology, tyre selection, tracks, Variability and application of GIS in soil dynamics.

UNIT - I

Dynamic Properties of Soil and their Measurement: Soil physical properties, engineering properties of soil, soil dynamic characteristics, soil shear strength, soil cohesion, soil-soil friction, soli- metal friction, stress-strain relationships, measurement of soil dynamic properties, direct shear test, triaxial test, unconfined compression test and tensile test, field measurement of soil shear strength: field shear apparatus and vane shear apparatus.

UNIT – II

Mechanics of Tillage Tools: Geometry of soil tool system, mechanics of simple reaction in inclined, vertical, wider and narrow tools, design parameters and performance of tillage tools.

UNIT – III

Traction Mechanics: Mohr- Coulomb's failure criteria, traction performance equations, traction prediction models, dimensional analysis of different variables related to soil-tyre system, soil vehicle models.

UNIT – IV

Introduction of traction devices: Tyres, function, types and terminology, tyre selection, tracks, traction device at wetland condition, deflection and traction devices, soil slippage and sinkage of wheels. Ballasting and its methods.

UNIT – V

Evaluation and prediction of traction performance: Design of traction and transport devices. Soil compaction by agricultural vehicles and machines. Variability and application of GIS in soil dynamics.

Text Books:

1. Soil Dynamics in Tillage and Traction. Gill & Vandenberg.1968. Supdt. Of Documents, U.S. Govt. Printing Office, Washington, D.C.
2. Sineokov GN. 1965. Design of Soil Tillage Machines. INSDOC, New Delhi.
3. Terzaghi K & Peck Ralph B.1967. Soil Mechanics in Engineering Practices. JohnWiley &Sons.

Reference Books:

1. Soil Dynamics in Tillage and Traction, by W R Gill, G E Vanden Berg, Scientific Publishers (India); 1stedition.
2. Soil Dynamics in Tillage and Traction, by William R. Gill, Glen E. Vanden Berg, Agricultural Research Service,1967.
3. Soil Dynamics in Tillage and Traction: No.316, by United States Department of Agriculture, United States Department of Agriculture Press- (1968).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
POST HARVEST ENGINEERING OF HORTICULTURAL CROPS					

Objectives: To enable the students to understand Concept of Structure and Composition of Fruits, Vegetables and Flowers. Physiology and Biochemistry of Horticultural Produce, Maturity indices in horticultural produce. Methods for determination of harvesting indices, wet and dry brushing, chemical washing, Chemical preservation with sulphur dioxide and benzoic acid, advantages, disadvantages, Chemical preservation with sulphur dioxide, Quality and grades specification of horticultural produce.

UNIT - I

Importance of Post Harvest Technology in in Horticultural Crops. Structure and Composition of Fruits, Vegetables and Flowers. Physiology and Biochemistry of Horticultural Produce. Causes of Postharvest losses. Factors affecting fruits and vegetables quality: Pre-harvest factors, environmental factors, cultural factors and post-harvest factors. Maturity indices in horticultural produce. Methods for determination of harvesting indices. Handling and transportation of fruits and vegetables. Determination of quality parameters for fruits and vegetables: aroma, fruit ripening, leaf changes, firmness, juice content, sugar content, skin color, total soluble solids, pH and acidity.

UNIT – II

Post-Harvest Operations: Pre-cooling, Cleaning of fruits & vegetables: soaking, rinsing, sanitizing, washing methods: agitating, spraying water, wet and dry brushing, chemical washing. Peeling of fruits and vegetables: hand peeling, mechanical peeling, peeling by heat treatment and lye peeling. Grading of fruits & vegetables, factors affecting grading, types of graders: screen grader, roller grader, rope and cable type grader and weight grader. Canning of fruits & vegetables: grading, washing, peeling, cutting, blanching, cooling, filling, syruping/brining, exhausting, sealing, retorting, cooling, storage, labeling. Cans making, causes of spoilage of canned foods.

UNIT – III

Principles of Preservation of Fruits & Vegetables: Asepsis, preservation by high temperature: pasteurization, flash pasteurization, sterilization. Chemical preservation with sulphur dioxide and benzoic acid, advantages, disadvantages. Sprout Suppressants. Fruit coating-Waxing. Drying and dehydration of fruits & vegetables (flow chart), types of dryers: cabinet dryer, tray dryers, tunnel dryer, freeze drying. Rehydration, ratio of rehydration coefficient. Freezing: Definition and methods - slow freezing, quick freezing and IQF, advantages and disadvantages. Types of freezing - direct immersion, indirect contact with refrigerant, air blast, cryogenic and de-hydro freezing. Cooling methods - pre-cooling, room cooling, hydro cooling, refrigerated trucks.

UNIT – IV

Storage of Horticultural crops: Traditional storage, Improved storage methods, Controlled atmospheric storage (CAS), factors effecting on CAS, modified atmosphere storage/packaging (MAS/MAP), maintenance of MAP, active modification, passive modification, requirements of fresh fruits package under CAS or MAS. Packaging of fruits and vegetables, advantages and disadvantages. Packaging materials: Corrugated fibre-board boxes, cellophane, poly vinyl chloride, polyethylene, ethyl vinyl alcohol.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

UNIT – V

Post-harvest disorders in horticultural produce: Causes of physiological disorders, Mineral deficiency disorders, Low-temperature disorders, Important physiological disorders of vegetable crops. Quality and grades specification of horticultural produce. Regulation of ripening

Text Books:

1. Fruits and Vegetable Preservation: Principles and Practices, Srivastava, R.P. & Kumar, S. CBS Publishing, 3rd edition, 2014.
2. Food Science by Potter N. and Hotchkiss J. H, An Aspen Publication, 5th edition, 2007.
3. The Complete Technology Book on Processing, Dehydration, Canning, Preservation of Fruits & Vegetables by NIIR Project Consultancy Services, 3rd edition, 2016.

Reference Books:

1. Fruits: Tropical and subtropical, Bose T. K & Mitre, S. K. Naya Prakash, 3rd edition, 2001.
2. Fruits and Vegetable processing, Bhatti, S. and Varma U., 1st edition, CBS Publishers, 2007.
3. Food Processing and Preservation, Sivasenkar, B., CBS Publications, 2002.

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

CO1: Explain about the properties and factors affecting quality of fruits and vegetables.
CO2: Classify post harvest operations involved in horticulture processing.
CO3: Identify preservation techniques for processed foods.
CO4: Apply the advanced packaging technology in food preservation.
CO5: Identify post harvest disorders in horticultural produce.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
INFORMATION TECHNOLOGY FOR LAND AND WATER MANAGEMENT					

Objectives: To enable the students to understand Concept of Information Technology, Existing system of information generation, Application and production of multimedia, geographic information system, Agricultural information management systems, Video-conferencing of scientific information.

UNIT-I

Concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. Existing system of information generation and organizations involved in the field of land and water management.

UNIT-II

Application and production of multimedia. Internet application tools and web technology. Networking system of information. Problems and prospects of new information and communication technology.

UNIT-III

Development of database concept for effective natural resources management. Application of remote sensing, geographic information system (GIS) and GPS. Rational data base management system.

UNIT-IV

Object oriented approaches. Information system, decision support systems and expert systems. Agricultural information management systems - use of mathematical models and programmes.

UNIT-V

Application of decision support systems, multi sensor data loggers and overview of software packages in natural resource management. Video-conferencing of scientific information.

Textbooks

1. Climate-Smart Agriculture – Source Book. 2013. Food and Agriculture Organization, Rome.
2. Daniel P. Loucks and Eelco van Beek. 2005. Water Resources Systems Planning and Management - An Introduction to Methods, Models and Applications. UNESCO, Paris.
3. Dipak De and Basavaprabhu Jirli (Eds.). 2010. Communication Support for Sustainable Development. Ganga Kaveri Publishing House, Varanasi – 221001.
4. FAO. 1998. Land and Water Resources Information Systems. FAO Land and Water Bulletin 7, Rome.

Reference Books

1. Fuling Bian and Yichun Xie (Eds.). 2015. Geo-Informatics in Resource Management and Sustainable Ecosystem. Springer, New York.
2. ICFAI Business School (IBS). 2012. Information Technology and Systems. IBS Centre for Management Research, Hyderabad.
3. Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management. Environmental Science. Springer, New York.
4. Sarvanan. R. 2011. Information and Communication Technology for Agriculture and Rural Development. New India Publishing Agency, New Delhi.
5. Soam, S.K., P.D. Sreekanth and N.H. Rao (Eds.). 2013. Geospatial Technologies for Natural Resources Management. New India Publishing Agency, Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes: At the end of the course, student will be able to
CO1: Analyze Information Technology (IT) and its application potential
CO2: Discuss about application and production of multimedia, internet application tools and web technology.
CO3: Development of database concept for effective natural resources management.
CO4: Apply agricultural information management systems.
CO5: Application of decision support systems, multi sensor data loggers.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
THEORY OF MACHINES					

Objective: To educate the students about the kinematics of machine elements, links and pairs and other systems in different machines for applications in the manufacturing of machines and their elements.

UNIT-I

Introduction, element, link, pairs. kinematics of chains and pairs - Types, lower and higher pairs. Mechanism – Types and inversions. Lower and higher pairs. Four bar chain, slider crank chain and their inversions - Determination of velocity and acceleration using graphical (relative velocity and acceleration) methods. Instantaneous center – Lindring.

UNIT II

Types of gears, law of gearing. Velocity of sliding between two teeth in mesh Involute and cucloidal profile for gear teeth. Spur gear, nomenclature, interference and undercutting. Introduction to helical, spiral, bevel and worm gear. Simple, compound, reverted and epicyclical gear trains - Determining the velocity ratio by tabular method. Turning moment diagrams, coefficient of fluctuation of speed and energy.

UNIT-III:

Weight of fly wheel, flywheel applications. Belt drives, types of drives. Belt materials, length of belt, power transmitted, velocity ratio, belt size for flat and v-belts. Effect of centrifugal tension, creep and slop on power transmission, chain drives. Types of friction, laws of dry fiction, friction of pivots and collars. Single disc, multiple disc and cone clutches. Rolling friction, anti - friction bearings.

UNIT -IV

Types of governors, Constructional details and analysis of Watt, Porter and Proell governors – Spread of governors. Effect of friction, controlling force, curves, sensitiveness, stability, hunting, Isochronism's, power and effort of a governor.

UNIT-V:

Static and dynamic balancing, Balancing of rotating masses in one and different planes. Partial primary balancing of reciprocating masses. Cams and foversees.

TEXT BOOK:

1. Theory of Mechanisms and Machines, Jagdish Lal 1991. Metropolitan Book Co. Pvt. Ltd., 1 Netaji Subash Marg, New Delhi.
2. Theory of Machines, Khurmi R S and Gupta JK 1994. Eurasia Publishing House Pvt. Ltd., Ram Nagar, New Delhi.

REFERENCES:

1. Theory of Machines, Thomas Bevan 1984. CBS Publishers
2. Theory of Machines, Ballaney P L 1985 Khanna Publishers, 2- B Nath Market, Nai Sarak, New Delhi
3. Mechanisms and Machine Theory, Rao J S and Dukkipatti R V 1990. Wiley Astern Ltd., New Delhi
4. Theory of Machines, Rattan S B 1993. Tata McGraw Hill Publishing Co. Ltd., 12/4 Asf Ali Road, New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes: At the end of the course, student will be able to
CO1: Analyze element, link, pairs. kinematics of chains and pairs
CO2: Apply helical, spiral, bevel and worm gear. Simple, compound, reverted and epicyclical mechanisms
CO3: Estimate the length of belt, power transmitted, velocity ratio, belt size for flat and v-belts
CO4: Discus Effect of friction, controlling force, curves, sensitiveness, stability, hunting, Isochronism's, power and effort of a governor.
CO5: Apply Partial primary balancing of reciprocating masses.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY					

Objectives: To enable the students to understand Concept of characteristics of instruments, Temperature and temperature scales, Liquid level measurement, Measurement of moisture content, pneumatic and electrical control systems; Various process controls and different controllers and indicators.

UNIT-I
Introduction, definitions, characteristics of instruments, static and dynamic characteristics; Temperature and temperature scales; Various types of thermometers; thermocouples, resistance thermometers and pyrometers; Pressure and pressure scales, manometers, pressure elements differential pressure;

UNIT-II
Liquid level measurement, different methods of liquid level measurement; Flow measurement: Kinds of flow, rate of flow, total flow differential pressure meters, variable area meters, food flow metering; Weight measurement: Mechanical scale, electronic tank scale, conveyor scale;

UNIT-III
Measurement of moisture content, specific gravity, measurement of humidity, measurement of viscosity, turbidity, color, measurement of density, brix, pH, enzyme sensors, automatic valves; Transmission: Pneumatic and electrical; Control elements, control actions, pneumatic and electrical control systems;

UNIT-IV
Process control: Definition, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware; Frequency response analysis, frequency response characteristics, Bode diagram and Nyquist plots and stability analysis; Transducers: Classification, self-generating transducers, variable parameter type, digital, actuating and controlling devices;

UNIT-V
Controllers and indicators: Temperature control, electronic controllers, flow ratio control, atmosphere control, timers and indicators, food sorting and grading control, discrete controllers, adaptive and intelligent controllers; Computer-based monitoring and control: Importance, hardware features of data acquisition and control computer, signal interfacing, examples in food processing.

Textbooks

1. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
2. Bela G. Liptak. 2003. Instrument Engineer's Handbook, Vol. I and II, 4th Ed. CRC Press, Boca Raton, FL, USA.

Reference Books

1. Curtis D. Johnson. 2003. Process Control Instrumentation Technology, 7th Ed. Prentice Hall of India Pvt. Ltd., New Delhi.
2. D.V.S. Murty. 2004. Transducers and Instrumentation. Prentice-Hall of India Pvt. Ltd. New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes: At the end of the course, student will be able to
CO1: Estimate Temperature and temperature scales
CO2: Analyze the different methods of liquid level measurement
CO3: Estimate the moisture content, specific gravity, measurement of humidity
CO4: Discus simple system analysis, dynamic behaviour of simple process
CO5: Apply Temperature control, electronic controllers, flow ratio control, atmosphere control

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
LANDSCAPE IRRIGATION DESIGN AND MANAGEMENT					

Objective: To enable the students to understand the concepts of Conventional method of landscape irrigation, Modern methods of landscape irrigation, Water requirement for different landscapes, Types of pipes, pressure ratings, sizing and selection criteria, Design of modern landscape irrigation systems

UNIT-I
Conventional method of landscape irrigation- hose irrigation system, quick release coupling system and portable sprinkler with hose pipes.

UNIT-II
Modern methods of landscape irrigation- popup sprinklers, spray pop-up sprinkler, shrub adopter, drip irrigation and bubblers; Merits and demerits of conventional and modern irrigation systems, types of landscapes and suitability of different irrigation methods.

UNIT-III
Water requirement for different landscapes, Segments of landscape irrigation systems, Main components of modern landscape irrigation systems and their selection criteria.

UNIT-IV
Types of pipes, pressure ratings, sizing and selection criteria; Automation system for landscape irrigation- main components, types of controllers and their application.

UNIT-V
Design of modern landscape irrigation systems, operation and maintenance of landscape irrigation systems.

Textbooks

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

Reference Books

1. Smith Stepehen W. Landscape Irrigation and Management. Amazon.com
2. Singh Neeraj Partap. 2010. Landscape Irrigation and Floriculture Terminology, Bangalore.

Course outcomes:

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

CO1: Discus landscape irrigation- hose irrigation system, quick release coupling system

CO2: Incorporate modern methods of landscape irrigation- popup sprinklers, spray pop-up sprinkler, shrub adopter.

CO3: Estimation of Modern methods of landscape irrigation- popup sprinklers, spray pop-up sprinkler, shrub adopter.

CO4: Apply Automation system for landscape irrigation

CO5: Design of modern landscape irrigation systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
TRACTOR SYSTEMS AND CONTROLS					

Objective: To enable the students to understand the concepts of transmission system in a tractor, major functional systems, Gearing theory, principle of operation, gear box types, functional requirements, Study of Brake system, Familiarization with the Hydraulic system adjustments and Study of tractor mechanics.

UNIT-I

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

UNIT-II

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

UNIT-III

Study of Brake system – types, principle of operation, construction, calculation for braking torque. Study of steering system – requirements, steering geometry characteristics, functional components, calculation for turning radius. Familiarization with Ackerman steering. Steering systems in track type tractors. Study of Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements.

UNIT-IV

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

UNIT-V

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

Textbooks

1. Liljedahl J B and Others. Tractors and Their Power Units.
2. Rodichev V and G Rodicheva. Tractors and Automobiles.

Reference Books

1. C.B.Richey. Agricultural Engineering Handbook.
2. John Deere. Fundamentals of Service Hydraul
3. Singh Kirpal. Automobile Engineering – Vol I.
4. Heitner Joseph. Automotive Mechanics: Principles and Practices.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes:

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

CO 1: Analyze functions of power transmission system and clutch system.

CO 2: Discus Gear Box – Gearing theory, principle of operation, gear box types.

CO 3: Apply principle of operation, construction, calculation for braking torque.

CO 4: Familiarization with system the Hydraulic adjustments and ADDC

CO 5: Analyze the importance of moment of inertia of a tractor. Study of tractor static equilibrium, tractor stability especially at turns.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
FOOD QUALITY AND CONTROL					

Objectives: To enable the students to understand the basics of food science, different quality parameters of food, laws and regulations governing food quality.

UNIT-I

Basics of Food Science and Food Analysis, Concept, objectives and need and scope of food quality – general concepts of quality control, major quality control functions. Measurement of colour, flavor, consistency, viscosity, texture and their relationship with food quality and composition.

UNIT-II

Sampling: purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials, Quality control: Quality control tools, Statistical considerations in sampling and quality control.

UNIT-III

Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality.

UNIT-IV

Sources of contaminant and a septic handling of foods. Food adulteration and food safety. TQM and TQC consumer preferences and acceptance, Detection of adulteration and examination of various food products – ghee, spices, milk and milk products, fruit products (jams, jelly, marmalades) for quality standards and specifications.

UNIT-V

Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industries. Sanitations and phytosanitory procedures in food industries. Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimantarious Commission). Food processing laws – maintenance of records and reports – traceability and Quality Assurance system in a process plant. Food laws – Role of voluntary agencies and legal aspects of consumer protection.

Textbooks

1. Ranganna S. 1986. Hand book of Analysis and Quality Control for Fruit and Vegetable Products. TMH, New Delhi.
2. Sharma Avanthi. 2006. A text book of Food Science and Technology, CBS Publishers, New Delhi.
3. The Food Safety and Standards Act along with Rules & Regulations. Commercial Law Publishers (India) Pvt. Ltd. New Delhi.

Reference Books

1. Mumbai Sumati R., Rao Shalini M. and Rajagopal M.V.2006. Food Science, New Age, International, Hyderabad.
2. Potter N. N. and Hotchkiss J. H. 1995 Food Science, Springer, U.S.A.
3. Dev Raj, Rakesh Sharma and Joshi V. K. 2001. Quality Control for Value Addition in Food Processing. New India Publishing Agencies, Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes:

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

CO 1: Estimate Measurement of colour, flavor, consistency, viscosity, texture and their relationship with food quality

CO 2: Analyze sampling: purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials.

CO 3: Interpretation of sensory results. Instrumental method for testing quality.

CO 4: Detection of adulteration and examination of various food products

CO 5: Discus about Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
FLOODS AND CONTROL MEASURES					

Objectives: To enable the students to understand concept of Floods, Flood forecasting, Gully erosion and its control structures, design and implementation, Design and construction of earthen dam and Check dam.

UNIT-I

Floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, flood estimation - methods of estimation; estimation of flood peak - rational method, empirical methods, unit hydrograph method. Statistics in hydrology, flood frequency methods – log normal, Gumbel's extreme value, log-Pearson type-III distribution; depth-area-duration analysis.

UNIT-II

Flood forecasting. Flood routing - channel routing, Muskingum structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement.

UNIT-III

Gully erosion and its control structures - design and implementation. Ravine control measures. River training works, planning of flood control projects and their economics. Earthen embankments - functions, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type, foundation requirements, grouting, seepage through dams, flow net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes.

UNIT-IV

Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc., stability of slopes - analysis of failure by different methods. Subsurface dams - site selection and constructional features.

UNIT-V

Check dam - Small earthen embankments - types and design criteria. Subsurface dams - site selection and constructional features.

Textbooks

1. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
2. Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
3. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
4. Mutreja, K.N. 1990. Applied Hydrology. Tata McGraw-Hill Publishing Co., New York, Delhi.

Reference Books

1. Arora, K.R. 2014. Soil Mechanics and Foundation Engineering (Geotechnical Engineering). Standard Publishers Distributors, Delhi.
2. Garg, S.K. 2014. Soil Mechanics and Foundation Engineering. Khanna Publishers Pvt. Ltd., New Delhi.

3. Stephens Tim. 2010. Manual on Small Earth Dams - A Guide to Siting, Design and Construction. Food and Agriculture Organization of the United Nations, Rome.
4. Subramanya, K. 2008. Engineering Hydrology. 3rd Edition, Tata McGraw-Hill Publishing Co., New Delhi.
5. Bureau of Reclamation. 1987. Design of Small Dams. US Department of Interior, Washington DC, USA.

Course outcomes:

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

CO1: Estimation and cause of floods.

CO2: Discus flood forecasting. Flood routing - channel routing, Muskingum structural and non-structural measures of flood control.

CO3: Analyze the Gully erosion and its control structures.

CO4: Design and construction of earthen dam, stability of earthen embankments against failure by tension,

CO5: Discus about Subsurface dams - site selection and constructional features.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
BIO-ENERGY SYSTEMS: DESIGN AND APPLICATIONS					

Objectives: To enable the students to understand concept of Fermentation processes and its general requirements, Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential, thermo-chemical degradation, Environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.

UNIT-I

Fermentation processes and its general requirements, An overview of aerobic and anaerobic fermentation processes and their industrial application. Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential.

UNIT-II

Biomass Production: Wastelands, classification and their use through energy plantation, election of species, methods of field preparation and transplanting. Harvesting of biomass and coppicing characteristics.

UNIT-III

Biomass preparation techniques for harnessing (size reduction, densification and drying).

UNIT-IV

Thermo-chemical degradation. History of small gas producer engine system. Chemistry of gasification. Gas producer – type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas.

UNIT-V

Application, shaft power generation, thermal application and economics. Transesterification for biodiesel production. A range of bio-hydrogen production routes. Environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.

Textbooks

1. British BioGen. 1997, Anaerobic digestion of farm and food processing practices- Good practice guidelines, London, available on www.britishbiogen.co.UK.
2. Butler, S. 2005. Renewable Energy Academy: Training wood energy professionals.

Reference Books

1. Centre for biomass energy. 1998. Straw for energy production; Technology- Environment-
2. Ecology. Available: www.ens.dk.

Course outcomes:

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

CO1: Analyze fermentation processes and its general requirements.
CO2: Discus Biomass Production.
CO3: Apply Biomass preparation techniques for harnessing.
CO4: Discus about Biomass preparation techniques for harnessing.
CO5: Apply shaft power generation, thermal application and economics

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

HONORS COURSE		L	T	P	C
		3	1	0	4
AQUACULTURAL ENGINEERING					

Objectives: To enable the students to understand concept of types of farms; fresh water, brackish water and marine farms, calculation of area of regular and irregular plane surfaces, calculation of volume of pond. Earth work calculations- excavation, embankment, longitudinal slope, classification of ponds; excavated ponds, embankment ponds, barrage and diversion ponds; rosary system and parallel system, site selection, infrastructural facilities; water supply system, main hatchery complex viz. Layout plan and design of hatcheries- brood stock ponds, artemia hatching tanks, sheds etc,.

UNIT-I

Fish Farm- Definition, objectives, types of farms; fresh water, brackish water and marine farms. Selection of site for aqua farm- site selection criteria, pre-investment survey viz., accessibility, physical features of the ground, detailed survey viz., site condition, topography, soil characteristics.

UNIT-II

Calculation of area of regular and irregular plane surfaces, Trapezoidal and Simpson's rule, volume of regular and irregular shape as applied to stacks and heaps, calculation of volume of pond. Earth work calculations- excavation, embankment, longitudinal slope and cross slope, calculation of volume of earth work as applied to roads and channels.

UNIT-III

Ponds - classification of ponds; excavated ponds, embankment ponds, barrage and diversion ponds; rosary system and parallel system. Planning of fish ponds, layout planning, materials planning, manual planning, comparison of square and rectangular ponds, large and small ponds; Types of ponds; nursing ponds, rearing ponds and stocking ponds. Design of ponds, pond geometry; shape, size, bottom slope of pond *etc*., construction ponds viz., marking, excavation etc., Dykes, types of dykes viz., peripheral dykes, secondary dyke, design of dykes, construction of dykes.

UNIT-IV

Water distribution system- canal, types of canals; feeder canal, diversion canal etc., Pipe line system, Water control structures- types of inlet and out let and their construction. Water budget equation, Pond drainage system; seepage and the methods used for seepage control, evaporation; factors affecting evaporation, erosion of soil in dykes and its control. Site selection, planning and construction of coastal aqua farms. Brackish water fish farms- tide fed, pump fed farms, site selection - topography, tidal amplitude, soil and water sources, etc.

UNIT-V

Hatcheries- site selection, infrastructural facilities; water supply system, main hatchery complex viz. Layout plan and design of hatcheries- brood stock ponds, artemia hatching tanks, sheds etc, Raceway culture system- site selection, layout plan, types of raceway culture system viz., parallel system, series system etc., Aerators- principles, classification of aerators and placement aerators. Pumps purpose of pumping, types, selection of pump, total head, horse power calculation. Filters- types and constructions.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

TEXTBOOKS:

1. Textbook of Aquaculture by Sathya Narayana and Amitabh Patel. Pacific Books International Publishers.
2. Handbook of Fisheries and Aquaculture by ICAR, New Delhi

REFERENCES:

1. Aquaculture Engineering by Pradeep Shrivastava and Abha Swarup. Discovery Publishing House Pvt.Ltd
2. Aquaculture Engineering 2nd Edition by Lekang O I and John Wiley

Course outcomes:

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

CO1: Analyze fresh water, brackish water and marine farms.

CO2: Estimation of area of regular and irregular plane surfaces.

CO3: Plan for fish ponds, layout planning, materials planning, manual planning, comparison of square and rectangular ponds, large and small ponds.

CO4: Plan for construction of coastal aqua farms. Brackish water fish farms- tide fed, pump fed farms.

CO5: Discus about pumps purpose of pumping, types, selection of pump, total head, horse power calculation. Filters- types and constructions.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
PRECISION FARMING TECHNIQUES FOR PROTECTED CULTIVATION					

Objectives: To enable the students to acquire knowledge about importance of greenhouse and shadenet house in protected cultivation by controlling all crop required environment factors like light, temperature, relative humidity with installation of fan and pad cooling system, fog cooling systems and irrigation system respectively.

UNIT-I

Protected cultivation: Introduction, History, origin, development, National and International Scenario, components of green house, perspective, Types of green houses, polyhouses /shednets, Cladding materials. Plant environment interactions – principles of limiting factors, solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbondioxide enrichment.

UNIT-II

Design and construction of greenhouses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment. Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fan-pad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care, etc.

UNIT-III

Greenhouse heating – necessity, components, methods, design of heating system. Root media – types – soil and soil less media, composition, estimation, preparation and disinfection, bed preparation. Planting techniques in green house cultivation. Irrigation in greenhouse and net house – Water quality, types of irrigation system, components, design, installation and material requirement.

UNIT-IV

Fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement. Maintenance of irrigation and fogging systems. Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, principles of selection of proper application of fertilizers, fertilizer scheduling, rate of application of fertilizers, methods, automated fertilizer application.

UNIT-V

Greenhouse climate measurement, control and management. Insect and disease management in greenhouse and net houses Selection of crops for greenhouse cultivation, major crops in greenhouse – irrigation requirement, fertilizer management, cultivation, harvesting and post harvest techniques; Economic analysis.

Textbook

1. Singh Brahma and Balraj Singh. 2014. Advances in protected cultivation, New India Publishing Company.

Reference Book

1. Sharma P. 2007. Precision Farming. Daya Publishing House New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Course outcomes:

Upon successful completion of this course, learner will be able to:

CO1: Analyze the importance of agro climatic factors available inside of green house

CO2: Discuss about controlling of greenhouse environment factors by using active devices

CO3: Design and installation of micro irrigation system inside the greenhouse

CO4: Optimize temperature and relative humidity in green house.

CO5: Select Crops for green house cultivation.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
WASTELAND DEVELOPMENT					

Objective: To enable the students to understand the basic concept of arid, semiarid, humid and subhumid regions, factors causing, classification and mapping of wastelands, gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods, water scarce areas, reclamation of waterlogged and salt-affected lands, proposal for wasteland development and benefit-cost analysis.

UNIT-I

Land degradation – concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands. Wastelands - factors causing, classification and mapping of wastelands, planning of wastelands development - constraints, agroclimatic conditions, development options, contingency plans.

UNIT-II

Conservation structures – gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods. Afforestation - agro-horti-forestry-silvipasture methods, forage and fuel crops - socioeconomic constraints. Shifting cultivation, optimal land use options.

UNIT-III

Wasteland development – hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands.

UNIT-IV

Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management. Micro-irrigation in wastelands development.

UNIT-V

Sustainable wasteland development - drought situations, socio-economic perspectives. Government policies. Participatory approach. Preparation of proposal for wasteland development and benefit-cost analysis.

Textbooks

1. Abrol, I.P., and V.V. Dhruvanarayana. 1998. Technologies for Wasteland Development. ICAR, New Delhi.
2. Ambast, S.K., S.K. Gupta and Gurcharan Singh (Eds.) 2007. Agricultural Land Drainage – Reclamation of Waterlogged Saline Lands. Central Soil Salinity Research Institute, Karnal, Haryana.
3. Hridai Ram Yadav. 2013. Management of Wastelands. Concept Publishing Company. New Delhi.
4. Karthikeyan, C., K. Thangaraja, C. Cinthia Fernandez and K. Chandrakandon. 2009. Dryland
5. Agriculture and Wasteland Management. Atlantic Publishers and Distributors Pvt. Ltd., New Delhi.
6. Rattan Lal and B.A. Stewart (Ed.). 2015. Soil Management of Smallholder Agriculture. Volume 21 of Advances in Soil Science. CRC Press, Taylor and Francis Group, Florida, USA.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Reference Books

1. Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management.
2. Springer Heidelberg, New York.
3. Swaminathan, M.S. 2010. Science and Integrated Rural Development. Concept Publishing
4. Company (P) Ltd., Delhi.
5. The Energy and Resources Institute. 2003. Looking Back to Think Ahead-Green India 2047.
6. Growth with Resource Enhancement of Environment and Nature. New Delhi.
7. Virmani, S.M. (Ed.). 2010. Degraded and Wastelands of India: Status and Spatial Distribution. ICAR, New Delhi.

Course outcomes:

Upon successful completion of this course, learner will be able to:

CO1: Plan for the development of wasteland.
CO2: Analyze about conservation structures.
CO3: Discuss the reclamation of water logged and salt –affected lands.
CO4: Interpret the impact of land degradation, reclamation and rehabilitation.
CO5: Prepare proposal for wasteland development and benefit-cost analysis.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
FARM MACHINERY DESIGN AND PRODUCTION					

Objective: To enable the students to understand the basic concept of design parameters of agricultural machines & design procedure, design parameters of agricultural machines & design procedure, Heat Treatment of steels including pack carburizing, shot pining process, etc. Limits, Fits & Tolerances, Jigs & Fixtures and Quality production management

UNIT - I

Introduction to design parameters of agricultural machines & design procedure. Characteristics of farm machinery design. Research and development aspects of farm machinery.

UNIT – II

Design of standard power transmission components used in agricultural machines: mechanical & hydraulic units. Introduction to safety in power transmission. Application of design principles to the systems of selected farm machines.

UNIT – III

Critical appraisal in production of Agricultural Machinery; Advances Introduction to design parameters of agricultural machines & design procedure. Research and development aspects of farm machinery. Selection of material used for agricultural machinery. Cutting tools including CNC tools and finishing tools.

UNIT – IV

Advanced manufacturing techniques including powder metallurgy, EDM (Electro-Discharge Machining), Heat Treatment of steels including pack carburizing, shot pining process, etc. Limits, Fits & Tolerances, Jigs & Fixtures.

UNIT – V

Industrial lay-out planning, Quality production management. Reliability. Economics of process selection. Familiarization with Project Report. Problems on Economics of process selection; Preparation of a project report; Case study for manufacturing of simple agricultural machinery.

Text Books:

1. Farm Machinery Design Principles & Problems by Sharma D N, Jain Bros, 2013
2. Richey, C.B. Agricultural Engineering Handbook.

Reference Books:

1. Design of machine elements, by Bhandari, McGraw Hill Education India Private Limited; 4th edition, 2017.
2. Adinath M and AB Gupta. Manufacturing Technology.
3. Narula V. Manufacturing process.
4. Chakrabarti NR. Data book for Machine Design.

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

CO1: Explain the basic concept of machine design.
CO2: Apply principles of design to mechanical power transmission elements such as shafts, keys & couplings, bearings.
CO3: Apply principles of design in designing farm machinery implements
CO4: Explain the advanced manufacturing techniques in Production.
CO5: Explain Industrial lay-out planning.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
TESTING AND EVALUATION OF TRACTORS AND FARM EQUIPMENT					

Objectives: Gaining knowledge about testing of agricultural machines and testing of farm tractor, tractor test code BIS: ISO: OECD and Nebraska.

UNIT I
Importance and significance of testing and types of tests. Testing of agricultural machines: M.B. Plough, disc plough. Test procedures and various test codes: National and International.

UNIT II
Testing of agricultural machines: Sub-soiler, laser land leveler, Rotavator, Cultivator, Disc Harrow, Seed cum fertilizer drill and planters.

UNIT III
Testing of agricultural machines: Manual and power operated weeders, reaper, thresher and chaff cutter.

UNIT IV
Testing of agricultural machines: Combine harvesters. Plant protection machines. Laboratory and field testing of straw combine and combine harvester. Review and interpretation of test reports. Importance and need of standardization of components of agricultural equipment.

UNIT V
Testing of farm tractor – Tractor test codes: BIS, ISO, OECD and Nebraska.

Textbooks
1. BIS test codes for farm machines and tractors
2. ISO test code for farm machines and tractor Nebraska tractor test code

Reference Books
1. OECD tractor test code
2. RNAM test codes for farm machines Testing manual, CIAE, Bhopal.

Course outcomes:
At the end of the course, student will be able to
CO1: Testing of agricultural machines
CO2: Testing of Sub-soiler, laser land leveler, Rotavator, Cultivator, Disc Harrow, Seed cum fertilizer drill and planters.
CO3: Testing of manual and power operated weeders, reaper and thresher.
CO4: Testing of Combine harvesters. Plant protection machines
CO5: Testing of farm tractor.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
EARTH MOVING MACHINES					

Objective: To equip with the applications of land grading machinery, their design, operation and maintenance. To understand the different types of earth moving systems and their applications.

UNIT-I
Objectives, methods and equipment for land clearing and development. Machinery selection, mechanics of operation and vegetation types. Engineering fundamentals related earth moving machinery, swell, shrinkage and compaction measurements, use of tractors and crawlers and effect of altitude and temperature on their performance.

UNIT-II
Grading of slopy lands. Principles of mechanisms used in crawler mounted tractors. Dump trucks and their mechanisms. Load hoisting equipment.

UNIT-III
Land cleaning and reclamation equipment, power shovels, drag lines and cam shells, rubber tyre for earth moving machinery.

UNIT-IV
Earth diggers and ditchers. Bull dozers and scrapers. Elevating and self-powered graders. Trenching machineries and wagons.

UNIT-V
Automation of earth moving and grading machines. Boring machines. Different methods of boring. Economic analysis of land development machinery.

Textbooks:

1. Dutta S K. 1987. Soil conservation and land management, International Distributors, Dehradun.
2. Sigma and Jagmohan. 1976. Earth moving machinery, Oxford and IBH

Reference books:

1. Wood and Stuart. 1977. Earth moving machinery, Prentice Hall.
2. Nicolas H L, Day D H. 1998. Moving the earth, The work book of excavation, McGraw Hill
3. Eric C Orlem.1997. *Earth-Moving Machines*. Motor books International.
4. Roger V Amato & Donald J Heimburger 2003. *Classic Vintage Crawlers and Dozers*. B Heimburger House Publ.

Course outcomes:
On completion of this course, the student would be able to:

1. Explain Engineering fundamentals of Earth Moving Machines.
2. Apply Principles of mechanisms in Crawler mounted tractors and Dump trucks.
3. Select suitable equipment for Land cleaning and reclamation.
4. Discuss the role of Earth diggers and ditches.
5. Analyze land development machines on Economic aspects.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
SPRINKLER AND MICRO IRRIGATION SYSTEMS					

Objective: To enable the students to understand the basic concept of sprinkler irrigation historical development, booster pumps, main lines, lateral lines, sprinkler heads, debris screens, desilting basins, take-off valves, layout of laterals and mains, Selection of pump, Operation, maintenance, field evaluation and head loss calculation, Water distribution systems, drip lateral, drippers, emitting pipe, grommet, start connector, nipple, end cap, micro tube, barbed connector, their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation.

UNIT - I

Sprinkler Irrigation: Sprinkler irrigation historical development, scenario in the world, country and state, adoptability and limitations. Components of the sprinkler system; pump set, (centrifugal, turbines and submersible), booster pumps, main lines, lateral lines, sprinkler heads, debris screens, desilting basins, take-off valves, flow control valves, sprinkler heads, fertigation equipment. types of sprinkler irrigation systems: a) Based on mechanism: i. Rotating head system, ii. Perforated pipe system. b) Based on portability: i. Portable systems, ii. Semi-portable systems, iii. Semi-permanent systems, iv. Permanent systems and v. Solid set systems.

UNIT – II

Design and Performance evaluation of Sprinkler Irrigation Systems: Precipitation profiles and Moisture distribution patterns, recommended sprinkler spacing, Effects of wind speed on working sprinkler irrigation system. Design of Sprinkler system: layout of laterals and mains: i. Inventory of Resources and Conditions, ii. Types of system and Layout, iii. Sprinkler Selection and Spacing, iv. Capacity of Sprinkler Systems, v. Hydraulic design of lateral, submain and main pipe line, vi. Selection of pump, Operation, maintenance, field evaluation and head loss calculation of the sprinkler irrigation system, Cost analysis. Importance of distribution uniformity, Christiansen Uniformity coefficient and Pattern efficiency.

UNIT – III

Micro Irrigation Systems: Types-drip, spray, & bubbler systems, merits and demerits, different components, Drip Irrigation and Components: Historical development, scenario in the world, country and state, advantages and limitations. Components of drip irrigation: A) Head control, non return valve, air release & vacuum breaker, filters, fertigation tank, throttle valve, pressure gauge and other fittings. B) Wayer's carrier systems, PVC pipeline, control valve, flush valve, other fittings. C) Water distribution systems, drip lateral, drippers, emitting pipe, grommet, start connector, nipple, end cap, micro tube, barbed connector, drip hydraulics, pipe section, water flow in pipes, velocity recommended pressure, pressure and hydrostatic, pressure due to gravity, friction and pressure losses, coefficient of friction;

UNIT – IV

Types and efficiency of Drip Irrigation: Types of emitters: A) Based on flow regime (reynolds number): i. Laminar flow, ii. Partially turbulent flow, iii. Fully turbulent flow and B) Based on Lateral connection with dripper: i. In-line and ii. On-line. Emitter flow equation, emitter constants, pressure variations (%) for different emitter flow variations and x-values, Manufacturers coefficient of variation, Emission uniformity (EU), distribution uniformity and irrigation efficiency. Design of drip irrigation system: Collection of primary data, layout, crop water requirements, hydraulic design, selection of components, economic pipe size selection, pressure variation along drip irrigation and design criteria of lateral, sub-main and main lines, pai- wu

design charts. Installation, operation, testing, field evaluation and head loss calculation of drip irrigation systems. Computer software programs for design of drip irrigation systems. Automation of drip irrigation systems based on– i. Volume based, ii. Time based and iii. Soil moisture.

UNIT – V

Maintenance of micro irrigation system: clogging problems, filter cleaning, flushing and chemical treatment, Fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation.

Text Books:

1. Principles of Sprinkler Irrigation systems, Mane M. S and Ayare B. L., Jain Brothers, New Delhi.
2. Irrigation Theory and Practice by A M Michael, Second Edition, Vikas Publishing house Pvt Ltd., New Delhi.

Reference Books:

1. Sprinkler and Trickle Irrigation by Keller Jack and Bliesner Ron D, Springer Science business Media, New York.
2. Land and Water Management by VVN Murthy, - Kalyani Publications.
3. Micro Irrigation Systems, Sirisha Adamala and YV Krishna Reddy, LAP LAMBERT Academic Publishing.

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

CO1: Explain scenario, types and different components of sprinkler irrigation system.
CO2: Evaluate performance and head losses calculation in sprinkler irrigation system.
CO3: Explain about various micro irrigation systems and components of drip irrigation system.
CO4: Evaluate performance and head losses calculation in drip irrigation system.
CO5: Identify proper method for maintenance of emitter and apply fertilizer through drip irrigation system.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
MINOR IRRIGATION AND COMMAND AREA DEVELOPMENT					

Objective: To enable the students to understand the basic concept of minor irrigation systems in India, grouping of tanks, storage capacity, supply works and sluices; command area development (CAD) programme, components, need, scope, techniques for CAD works; water productivity: concepts and measures for enhancing water productivity; Farmers' participation in command area development.

UNIT-I
Factors affecting performance of irrigation projects; types of minor irrigation systems in India; lift irrigation systems: feasibility, type of pumping stations and their site selection

UNIT-II
Design of lift irrigation systems; tank Irrigation: grouping of tanks, storage capacity, supply works and sluices; command area development (CAD) program

UNIT-III
Components, need, scope, and development approaches, historical perspective, command area development authorities functions and responsibilities on farm development works,

UNIT-IV
Reclamation works, use of remote sensing techniques for CAD works; water productivity: concepts and measures for enhancing water productivity; Farmers' participation in command area development;

UNIT-V
Preparation of command area development layout plan; Irrigation water requirement of crops; Preparation of irrigation schedules; Planning and layout of water conveyance system, design of surplus weir of tanks; determination of storage capacity of tanks; design of intake pipe and pump house.

Textbooks

1. Arora, K.R. 2001. Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.
2. Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.

Reference Books

1. Sahasrabudhe SR. 2011. Irrigation Engineering and Hydraulic structures. SK Kataria& Sons Reprint 2015.
2. Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Publ.House New Delhi.

Course Outcomes: At the end of the Course, Student will be able to:
CO1: Analyze the Factors affecting performance of irrigation projects
CO2: Design lift irrigation systems
CO3: Explain Components, need, scope of command area development
CO4: Use remote sensing techniques for CAD works and enhancing water productivity
CO5: Plan and layout the water Conveyance systems and determine Storage Capacity of Tanks.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
DEVELOPMENT OF PROCESSED FOOD PRODUCTS					

Objective: To enable the students to understand the basic concept of unit operations and equipment for processing, technology for value added products from cereal, pulses and oilseeds, flaking, roasting, bakery products, snack food, extruded products, oil extraction and refining, process flow diagram and study of various models of the machines used in a sugar mill.

UNIT-I
Process design, Process flow chart with mass and energy balance, Unit operations and equipment for processing

UNIT-II
New product development, Technology for value added products from cereal, pulses and oilseeds

UNIT-III
Milling, puffing, flaking, Roasting, Bakery products, snack food. Extruded products, oil extraction and refining,

UNIT-IV
Technology for value added products from fruits, vegetables and spices, Canned foods, Frozen foods, dried and fried foods, Fruit juices, Sauce, Sugar based confection, Candy, Fermented food product, spice extracts,

UNIT-V
Technology for animal produce processing, meat, poultry, fish, egg products, Health food, Nutraceuticals and functional food, Organic food. Practical Process design and process flow chart preparation, preparation of different value-added products, Visit to roller wheat flour milling, rice milling, spice grinding mill, milk plant, dal and oil mill, fruit/vegetable processing plants & study of operations and machinery, Process flow diagram and study of various models of the machines used in a sugar mill.

Textbooks

1. Geankoplis C. J. Transport processes and unit operations, Prentice-Hall.
2. Rao, D. G. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.
3. Norman N. Potter and Joseph H. Hotchikss. Food Science. Chapman and Hall Pub.

Reference Books

1. Mudambi Sumati R., Shalini M. Rao and M V Rajgopal. Food Science. New Age International Publishers.
2. Negi H.P.S., Savita Sharma, K. S. Sekhon. Hand book of Cereal technology. Kalyani Pub.
3. Acharya, K T Everyday Indian Processed foods. National Book Trust.

Course Outcomes: At the end of the Course, Student will be able to:
CO1: Analyze the unit operations and equipment for processing
CO2: Development of new products
CO3: Extraction of oil and refining of oil.
CO4: Study about value added products from fruits, vegetables and spices, Canned foods.
CO5: Preparation of Practical Process design and process flow chart

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
ENGINEERING PROPERTIES OF AGRICULTURAL PRODUCE					

Objective: To enable the students to understand the basic concept of application of engineering properties of biological material, rheology, basic concepts, classification of rheology, Flow behavior of biological materials, Measurement of viscosity using viscometer, types of viscometer, problems on viscometer, rolling resistance, angle of internal friction and angle of repose, applications of frictional properties in design of processing equipment, Specific heat, thermal conductivity, thermal diffusivity, latent heat of vaporization, latent heat of fusion, sensible heat, enthalpy and heat energy calculation.

UNIT - I

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

UNIT – II

Rheology: Introduction to rheology, basic concepts, Classification of rheology, ASTM standard definition of terms. Rheological Properties, Flow behavior of biological materials, force deformation curve; linear elastic limit, yield point, bio-yield point and rupture point. Stress relaxation and creep behavior. Visco-elasticity and visco-plasticity.

UNIT – III

Rheological models: Introduction to mechanical models. Kelvin and maxwell models. Electrical equivalence of mechanical models. Rheological equations of maxwell model, generalized maxwell model, kelvin model and generalized kelvin model. Difference between kelvin and maxwell model. Viscosity; Measurement of viscosity using viscometer, types of viscometer, problems on viscometer.

UNIT – IV

Frictional Properties: Basic concepts, effect of load sliding velocity. Friction in agricultural materials, measurement. Rolling resistance, angle of internal friction and angle of repose. Applications of frictional properties in design of processing equipment. Aerodynamic Properties: Importance of aerodynamic properties in Agricultural Processing equipments with examples. Terminal velocity and drag coefficient; frictional drag
and profit drag or pressure drag. Terminal velocity of different grains, working of pneumatic conveyor based on aerodynamic properties.

UNIT – V

Electrical properties: Di-electrical properties; Dielectric loss factor and dielectric constant. Applications and role of electrical properties in food processing. Thermal Properties: Introduction to thermal properties; Specific heat, thermal conductivity, thermal diffusivity, latent heat of vaporization, latent heat of fusion, sensible heat, enthalpy and heat energy calculation.

Text Books:

1. Physical properties of plant and animal materials, Mohsenin N N, Gordon and Breach Science Publishers, New York, 2nd edition ,1986.
2. Engineering Properties of Foods, Rao M A, Syed S H Rizvi and Ashim K Datta, CRC Press – Taylor & Francis Group, Boca Raton, FL, 4th edition, 2014

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Reference Books:

1. Food and Process Engineering Technology, Wilhelm LR, Suler W A and Brusewitz, G H, American Society of Agricultural Engineers (ASAE), St. Joseph, Ml.
2. Engineering Properties of Biological Materials, O.P. Singhal and D.V.K. Samuel, Saroj Prakashan, Allahabad, 1st edition, 2003.

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

CO1: Calculate the basic engineering properties of a biological material.
CO2: Analyze the flow behavior of biological materials and force deformation.
CO3: Analyze the Maxwell and Kelvin model equations in the rheology for important biological materials.
CO4: Explain the applications of frictional and aerodynamic properties in the design of processing equipment.
CO5: Explain the applications of electrical and thermal properties in the design of processing equipment.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
AGRICULTURAL STRUCTURES AND ENVIRONMENTAL CONTROL					

Objective: To enable the students to understand the basic concept of Planning and layout of farmstead. Scope, importance, construction and cost estimation of farm structures; animal shelters, compost pit, Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, community sanitation system, sewage system and its design, cost and maintenance, design of septic tank for small family. Estimation of domestic power requirement, source of power supply and electrification of rural housing.

UNIT-I

Planning and layout of farmstead. Scope, importance and need for environmental control, physiological reaction of livestock environmental factors, environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods,

UNIT-II

Livestock production facilities, BIS Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc. Storage of grains, Causes of spoilage, Water activity for low and high moisture food and its limits for storage, Moisture and temperature changes in grain bins;

UNIT-III

Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins),Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin, Calculation of pressure in bins, Storage of seeds. Rural living and development, rural roads, their construction cost and repair and maintenance.

UNIT-IV

Sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community. Site and orientation of building in regard to sanitation, community sanitation system, sewage system and its design, cost and maintenance, design of septic tank for small family. Estimation of domestic power requirement, source of power supply and electrification of rural housing.

UNIT-V

Measurements for environmental parameters and cooling load of a farm building, Design and layout of a dairy farm, Design and layout of a poultry house, Design and layout of a goat house/sheep house, Design of a farm fencing system, Design of a feed/fodder storage structures, Design of grain storage structures, Design and layout of commercial bag and bulk storage facilities, Study and performance evaluation of different domestic storage structure, Estimation of a Farm building.

Textbooks

1. Pandey, P.H. Principles and practices of Agricultural Structures and Environmental Control,Kalyani Publishers, Ludhiana.
2. Ojha, T.P and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers,Karol Bag, New Delhi.
3. Nathonson, J.A. Basic Environmental Technology, Prentice Hall of India, New Delhi.
4. Venugopal Rao, P. Text Book of Environmental Engineering, Prentice Hall of India, NewDelhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

Reference Books:

1. Dutta, B.N. Estimating and Costing in Civil Engineering, Duttta& CO, Lucknow.
2. Khanna, P.N. Indian Practical Civil Engineer's Hand Book, Engineer's Publishers, NewDelhi.
3. Sahay, K.M. and Singh, K.K. Unit Operations of Agricultural Processing, Vikas publishingpvt. Ltd, Noida.
4. Banerjee, G.C. A Text Book of Animal Husbandry, Oxford IBH Publishing Co, New Delhi.
5. Garg, S.K. Water Supply Engineering, Khanna Publishers, New Delhi-6.

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

CO1: Plan and layout farmstead.

CO2: Design farm structures

CO3: Design grain storage godowns, Bag storage structures, Shallow and Deep bin

CO4: Analyze the sources of water supply, norms of water supply for human beings and animals

CO5: Measure environmental parameters and cooling load of a farm building

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

MINOR COURSE		L	T	P	C
		3	1	0	4
FOOD WASTE AND BY-PRODUCTS UTILIZATION					

Objective: To enable the students to understand the basic concept of Agro-industries-Definition, classification, factors responsible for establishment, characteristics, uses, production of pure silica and silicon, uses of amorphous silica, grades of silicon, structure of rice husk silica, edible copra based oil, milling copra, quality of copra, raw materials for paper production, paper board production from agricultural wastes, mechanically aerated lagoons, diffused air systems and waste for reuse

UNIT - I

Introduction: Agro-industries-Definition, classification, factors responsible for establishment. By-products utilization, Establishment of agro processing industries in rural areas, factors affecting for establishing of agro processing plants, cost benefit ratio for agro processing industries, employment generation.

UNIT – II

Rise husk& bran and its by-products: Rice husk-Introduction, characteristics, uses, production of pure silica and silicon, uses of amorphous silica, grades of silicon, structure of rice husk silica. Burning of rice husk for production of white ash, production of high purity silicon (calcium reduction process). Ceramic materials from rice husk – Classification of ceramics, advantages of rice husk white ash, raw materials for ceramics, production process, merits of process. Rice husk combustion.

UNIT – III

Coconut based products: Coconut coir and shell utilization – Introduction. Commercial products of coconut – Edible copra based oil, milling copra, quality of copra and oil. Fresh kernel based products – Desiccated coconut, canned coconut cream, and coconut water. Coconut toddy production. Coir based products – Brown fiber milling, manufacture of white fiber. Coconut shell products. Mango stone and peel utilization – Mango vinegar, mango leather, mango flour-Cashew nut based products: Cashew products – Nuts, testa, apple, cashew nut shell liquid, extraction of CNSL. Banana pseudo stem – Pseudo stem, banana stem candy, banana starch from pseudo stem, banana cheese from peel, banana pectin from peel, banana vinegar from pulp and peel, banana peel as cattle feed.

UNIT – IV

By-products of sugarcane products: Sugarcane bagasse – Molasses, bagasse, filter mud, sugarcane wax. Paper making from agricultural wastes – paper processing – Manufacture of pulp and paper. Raw materials for paper production, paper board production from agricultural wastes. Feed processing plants: Introduction, feedstuffs from cereals, classification of feeds, specialized feeding requirements, feed manufacturing processes, forms of feed. Equipment for unit operations in feed processing – Liquid feed blenders, flaking, milling, mixing, pelleting and extruding. Formulating feeds, layout of feed mills for commercial production.

UNIT – V

Biological treatment: Introduction. Anaerobic decomposition, lagoon systems, anaerobic lagoons, advantages and disadvantages of anaerobic lagoons. Design of anaerobic lagoons, problems on design of anaerobic lagoons, anaerobic lagoon sludge. Aerobic treatment – Introduction, reactions and processes for anaerobic treatment, advantages and disadvantages of anaerobic treatment. Types of aeration systems: Natural aeration - Introduction, planning and design, Mechanical

aeration – Film reactors – Tricking filters, rotating biological contactors, problems on tricking filters. Floc reactors – Mechanically aerated lagoons, diffused air systems, Waste for reuse. Briquetting – Introduction, principle, briquetting machines. Processing – Direct compaction, carbonization and extrusion.

Text Books:

1. Modern Abattoir Practices and Animal by Products, Sharma, B.D, Jaypee Brothers medical Publishers.
2. Food from Wastes, Ervan, international Publishers, Delhi.

Reference Books:

1. Food Agricultural Waste Manual, Vandersholm D H, New Zealand.
2. Agricultural Waste Management Field Hand Book, USDA: New York, USA.
3. Manure Production and Characteristics. Standards, ASAE: Am. Soc. of Agricultural Engineers, New York

Course Outcomes: At the end of the Course, Student will be able to:
CO1: Analyze the basic applications of agro industries and by- products utilization, importance of rice husk and their uses and rice husk combustion
CO2: Describe the manufacturing of alcohol processes and production of furfural
CO3: Explain by-products of coconut, mango, cashew nut and banana
CO4: Explain about the feed manufacturing equipments, paper making process and different types of sugarcane by-products.
CO5: Justify the biological treatment with their advantages and disadvantages.