

**ANNA UNIVERSITY, CHENNAI**

**AFFILIATED INSTITUTIONS**

**R - 2013**

**B. E. AGRICULTURE ENGINEERING**

**I TO VIII SEMESTERS CURRICULUM & SYLLABUS**

**SEMESTER I**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	HS6151	Technical English - I	3	1	0	4
2	MA6151	Mathematics – I	3	1	0	4
3	PH6151	Engineering Physics – I	3	0	0	3
4	CY6151	Engineering Chemistry – I	3	0	0	3
5	GE6151	Computer Programming	3	0	0	3
6	GE6152	Engineering Graphics	2	0	3	4
<b>PRACTICAL</b>						
7	GE6161	Computer Practices Laboratory	0	0	3	2
8	GE6162	Engineering Practices Laboratory	0	0	3	2
9	GE6163	Physics and Chemistry Laboratory - I	0	0	2	1
<b>TOTAL</b>			<b>17</b>	<b>2</b>	<b>11</b>	<b>26</b>

**SEMESTER II**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	HS6251	Technical English - II	3	1	0	4
2	MA6251	Mathematics – II	3	1	0	4
3	GE6252	Basic Electrical & Electronics Engineering	4	0	0	4
4	GE6253	Engineering Mechanics	3	1	0	4
5	AI6201	Principles of Agricultural Engineering	3	0	0	3
6	AI6202	Principles and Practices of Crop Production	3	0	0	3
<b>PRACTICAL</b>						
7	AI6211	Agricultural Engineering Practices Lab	0	0	3	2
8	AI6212	Crop Husbandry Laboratory	0	0	3	2
<b>TOTAL</b>			<b>19</b>	<b>3</b>	<b>6</b>	<b>26</b>

**SEMESTER III**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	MA6351	Transforms and Partial Differential Equations	3	1	0	4
2	AI6301	Soil Science and Engineering	3	0	0	3
3	CE6306	Strength of Materials	3	1	0	4
4	AI6302	Fluid Mechanics and Hydraulics	3	1	0	4
5	AI6303	Surveying	3	0	0	3
6	AI6304	Theory of Machines	3	0	0	3
<b>PRACTICAL</b>						
7	AI6311	Surveying Laboratory	0	0	4	2
8	AI6312	Fluid Mechanics Laboratory	0	0	3	2
<b>TOTAL</b>			<b>18</b>	<b>3</b>	<b>7</b>	<b>25</b>

**SEMESTER IV**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	MA6468	Probability and Statistics	3	1	0	4
2	AI6401	Unit Operations in Agricultural Processing	3	0	0	3
3	AI6402	Tractor and Power Units	3	0	0	3
4	CE6567	Hydrology and Water Resources Engineering	3	0	0	3
5	MF6403	Thermodynamics	4	0	0	4
6	GE6351	Environmental Science and Engineering	3	0	0	3
<b>PRACTICAL</b>						
7	AI6411	Drawing of Farm Structures	0	0	3	2
8	CE6411	Strength of Materials Laboratory	0	0	3	2
<b>TOTAL</b>			<b>19</b>	<b>1</b>	<b>6</b>	<b>24</b>

**SEMESTER V**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	AI6501	Irrigation and Drainage Engineering	3	0	0	3
2	AI6502	Solar and Wind Energy Engineering	3	0	0	3
3	AI6503	Farm Equipment	3	0	0	3
4	AI6504	Design of Agricultural Machinery	3	1	0	4
5	AI6505	Post Harvest Technology	3	0	0	3
6	AI6506	Agricultural Economics and Farm Management	3	0	0	3
<b>PRACTICAL</b>						
7	AI6511	Operation and Maintenance of Farm machinery Lab	0	0	3	2
8	AI6512	Post Harvest Engineering Laboratory	0	0	3	2
<b>TOTAL</b>			<b>18</b>	<b>1</b>	<b>6</b>	<b>23</b>

**SEMESTER VI**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	AI6601	Groundwater and Well Engineering	3	0	0	3
2	AI6602	Dairy and Food Engineering	3	0	0	3
3	AI6603	Agricultural Extension	3	0	0	3
4	AI6604	Heat and Mass Transfer for Agricultural Engineers	3	1	0	4
5		Elective – I	3	0	0	3
<b>PRACTICAL</b>						
7	AI6611	CAD for Agricultural Engineering	0	0	4	2
8	GE6674	Communication and Soft skills- Laboratory Based	0	0	4	2
9	AI6612	Food Process Engineering Laboratory	0	0	3	2
<b>Total</b>			<b>15</b>	<b>1</b>	<b>11</b>	<b>22</b>

### SEMESTER VII

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	AI6701	IT in Agricultural Systems	3	0	0	3
2	AI6702	Soil and Water Conservation Engineering	3	0	0	3
3	AI6703	Construction materials, Estimation and Costing	3	0	0	3
4	AI6704	Remote Sensing and Geographical Information System	3	0	0	3
5	AI6705	Bio-Energy Resource Technology	3	0	0	3
6		Elective – II	3	0	0	3
<b>PRACTICAL</b>						
7	AI6711	GIS Laboratory for Agricultural Engineers	0	0	3	2
8	AI6712	Bio-Energy Laboratory	0	0	3	2
9	AI6713	Design Project	0	0	3	2
10	AI6714	Industrial Training (4 weeks)	0	0	0	2
<b>Total</b>			<b>18</b>	<b>0</b>	<b>9</b>	<b>26</b>

### SEMESTER VIII

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	AI6801	Sustainable Agriculture and Food Security	3	0	0	3
2		Elective – III	3	0	0	3
3		Elective – IV	3	0	0	3
<b>PRACTICAL</b>						
4	AI6811	Project work	0	0	12	6
<b>Total</b>			<b>9</b>	<b>0</b>	<b>12</b>	<b>15</b>

**TOTAL - 187 CREDITS**

### LIST OF ELECTIVES

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>General (Elective - I)</b>						
1	AI6001	Protected Cultivation	3	0	0	3
2	AI6002	Agricultural Business Management	3	0	0	3
3	AI6003	Systems Analysis and Soft Computing in Agricultural Engineering	3	0	0	3
4	AI6004	Climate change and adaptation	3	0	0	3
5	GE6075	Professional Ethics in Engineering	3	0	0	3
6	GE6083	Disaster Management	3	0	0	3
7	GE6084	Human Rights	3	0	0	3
8	MA6459	Numerical Methods	3	0	0	3
9	GE6078	Intellectual Property Rights	3	0	0	3
<b>Agricultural Processing (Elective - II)</b>						
1	AI6005	Refrigeration and Air Conditioning for Agricultural Engineers	3	0	0	3
2	AI6006	Storage and Packaging Technology	3	0	0	3
3	AI6007	Seed Technology Applications	3	0	0	3
<b>Soil and Water Conservation (Elective - III)</b>						
1	AI6008	Watershed Management	3	0	0	3
2	AI6009	Micro Irrigation	3	0	0	3
3	AI6010	On Farm Water Management	3	0	0	3
<b>Farm Machinery (Elective - IV)</b>						
1	AI6011	Farm Power and Machinery Management	3	0	0	3
2	AI6012	Mechanics of Tillage and Traction	3	0	0	3
3	AI6013	Special Farm Equipment	3	0	0	3

**\*\* The students will have to select one elective from each category / group listed above. (Elective I should be from the General category)**

**OBJECTIVES:**

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

**UNIT I****9+3**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

**UNIT II****9+3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

**UNIT III****9+3**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

**UNIT IV****9+3**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

**UNIT V****9+3**

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing,

Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

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

### **OUTCOMES:**

Learners should be able to

- speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- read different genres of texts adopting various reading strategies.
- listen/view and comprehend different spoken discourses/excerpts in different accents

### **TEXTBOOKS:**

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

### **REFERENCES:**

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011.
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006.
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001.
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008.

### **EXTENSIVE Reading (Not for Examination)**

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

### **WEBSITES:**

1. <http://www.usingenglish.com>
2. <http://www.uefap.com>

### **TEACHING METHODS:**

- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

### **EVALUATION PATTERN:**

**Internal assessment: 20%**

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews
- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- ✓ Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

**End Semester Examination: 80%**

**MA6151**

**MATHEMATICS – I**

**L T P C**

**3 1 0 4**

**OBJECTIVES:**

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

**UNIT I        MATRICES**

**9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

**UNIT II        SEQUENCES AND SERIES**

**9+3**

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D’Alembert’s ratio test – Alternating series – Leibnitz’s test – Series of positive and negative terms – Absolute and conditional convergence.

**UNIT III        APPLICATIONS OF DIFFERENTIAL CALCULUS**

**9+3**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

**UNIT IV        DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES**

**9+3**

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

**UNIT V      MULTIPLE INTEGRALS****9+3**

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

- This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

**TEXT BOOKS:**

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41<sup>st</sup> Edition, Khanna Publications, Delhi, 2011.

**REFERENCES:**

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.

**PH6151****ENGINEERING PHYSICS – I****L T P C  
3 0 0 3****OBJECTIVES:**

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

**UNIT I      CRYSTAL PHYSICS****9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

**UNIT II      PROPERTIES OF MATTER AND THERMAL PHYSICS****9**

Elasticity- Hooke's law - Relationship between three moduli of elasticity (qualitative) – stress - strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders  
Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel)

**UNIT III      QUANTUM PHYSICS****9**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment -Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave

function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

#### **UNIT IV ACOUSTICS AND ULTRASONICS 9**

Classification of Sound- decibel- Weber–Fechner law – Sabine’s formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications - Sonogram

#### **UNIT V PHOTONICS AND FIBRE OPTICS 9**

Spontaneous and stimulated emission- Population inversion -Einstein’s A and B coefficients - derivation. Types of lasers – Nd:YAG, CO<sub>2</sub>, Semiconductor lasers (homojunction & heterojunction)- Industrial and Medical Applications.

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

#### **TEXT BOOKS:**

1. Arumugam M. Engineering Physics. Anuradha publishers, 2010
2. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009
3. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing, 2011.

#### **REFERENCES:**

1. Searls and Zemansky. University Physics, 2009
2. Mani P. Engineering Physics I. Dhanam Publications, 2011
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011
6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

**CY6151**

**ENGINEERING CHEMISTRY - I**

**L T P C**

**3 0 0 3**

#### **OBJECTIVES:**

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

#### **UNIT I POLYMER CHEMISTRY 9**

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: T<sub>g</sub>, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

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

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

**UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY****9**

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination- Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

**UNIT IV PHASE RULE AND ALLOYS****9**

Phase rule: Introduction, definition of terms with examples, One Component System- water system - Reduced phase rule - Two Component Systems- classification – lead-silver system, zinc-magnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze.

**UNIT V NANOCHEMISTRY****9**

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications

**TOTAL :45 PERIODS****OUTCOMES:**

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

**TEXT BOOKS:**

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

**REFERENCES:**

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V.R. , Viswanathan N.V. and JayadevSreedhar, "Polymer Science", New Age International P (Ltd.), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., "Nanotechnology: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.

**GE6151****COMPUTER PROGRAMMING****L T P C****3 0 0 3****OBJECTIVES:****The students should be made to:**

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.

- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

**UNIT I INTRODUCTION 8**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

**UNIT II C PROGRAMMING BASICS 10**

Problem formulation – Problem Solving - Introduction to ‘C’ programming –fundamentals – structure of a ‘C’ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in ‘C’ – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

**UNIT III ARRAYS AND STRINGS 9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

**UNIT IV FUNCTIONS AND POINTERS 9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

**UNIT V STRUCTURES AND UNIONS 9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Design C Programs for problems.
- Write and execute C programs for simple applications.

**TEXTBOOKS:**

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. “ Let Us C”, BPB Publications, 2011.

**REFERENCES:**

1. Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.

**GE6152**

**ENGINEERING GRAPHICS**

**L T P C  
2 0 3 4**

**OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (Not for Examination)****1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREE HAND SKETCHING****5+9**

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

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES****5+9**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS****5+9**

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

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES****5+9**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS****6+9**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**COMPUTER AIDED DRAFTING (Demonstration Only)****3**

Introduction to drafting packages and demonstration of their use.

**TOTAL : 75 PERIODS****OUTCOMES:**

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

**TEXT BOOK:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.

**REFERENCES:**

1. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.

2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2<sup>nd</sup> Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Natrajan K.V., ".A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

**Publication of Bureau of Indian Standards:**

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

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

**GE6161**

**COMPUTER PRACTICES LABORATORY**

**L T P C  
0 0 3 2**

**OBJECTIVES:**

**The student should be made to:**

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

**LIST OF EXPERIMENTS:**

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Apply good programming design methods for program development.

- Design and implement C programs for simple applications.
- Develop recursive programs.

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

Standalone desktops with C compiler            30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

**GE6162**

**ENGINEERING PRACTICES LABORATORY**

**L T P C**

**0 0 3 2**

**OBJECTIVES:**

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)**

**I        CIVIL ENGINEERING PRACTICE**

**9**

**Buildings:**

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**Plumbing Works:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:  
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- (e) Demonstration of plumbing requirements of high-rise buildings.

**Carpentry using Power Tools only:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

**II        MECHANICAL ENGINEERING PRACTICE**

**13**

**Welding:**

- (a) Preparation of arc welding of butt joints, lap joints and tee joints.
- (b) Gas welding practice

**Basic Machining:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**Sheet Metal Work:**

- (a) Forming & Bending:
- (b) Model making – Trays, funnels, etc.
- (c) Different type of joints.

**Machine assembly practice:**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

**GROUP B (ELECTRICAL & ELECTRONICS)****III ELECTRICAL ENGINEERING PRACTICE 10**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

**IV ELECTRONICS ENGINEERING PRACTICE 13**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 45 PERIODS****OUTCOMES:**

- ability to fabricate carpentry components and pipe connections including plumbing works.
- ability to use welding equipments to join the structures.
- ability to fabricate electrical and electronics circuits.

**REFERENCES:**

1. Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
2. Jeyapooan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas PUBLISHING House Pvt.Ltd, 2006.
3. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A. & Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.
5. Kannaiah P. & Narayana K.L., “Manual on Workshop Practice”, Scitech Publications, 1999.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:****CIVIL**

- |   |          |
|---|----------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets. |
| 2. Carpentry vice (fitted to work bench)  | 15 Nos.  |
| 3. Standard woodworking tools   | 15 Sets. |
| 4. Models of industrial trusses, door joints, furniture joints  | 5 each   |
| 5. Power Tools: (a) Rotary Hammer   | 2 Nos    |

(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

### MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

### ELECTRICAL

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

### ELECTRONICS

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

**GE6163**

**PHYSICS AND CHEMISTRY LABORATORY – I**

**L T P C**

**0 0 2 1**

**PHYSICS LABORATORY – I**

#### OBJECTIVES:

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

#### LIST OF EXPERIMENTS

(Any FIVE Experiments)

- (a) Determination of Wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
- Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
- Determination of wavelength of mercury spectrum – spectrometer grating
- Determination of thermal conductivity of a bad conductor – Lee's Disc method.
- Determination of Young's modulus by Non uniform bending method
- Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

**OUTCOMES:**

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee's Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster's bridge set up

(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

**CHEMISTRY LABORATORY- I****OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by vacometry.

**LIST OF EXPERIMENTS**

(Any FIVE Experiments)

- 1 Determination of DO content of water sample by Winkler's method.
- 2 Determination of chloride content of water sample by argentometric method.
- 3 Determination of strength of given hydrochloric acid using pH meter.
- 4 Determination of strength of acids in a mixture using conductivity meter.
- 5 Estimation of iron content of the water sample using spectrophotometer. (1,10- phenanthroline / thiocyanate method).
- 6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
- 7 Conductometric titration of strong acid vs strong base.

**TOTAL: 30 PERIODS**

**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**REFERENCES:**

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore 1994.
3. Jeffery G.H., Bassett J., Mendham J. and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

- |                       |   |        |
|-----------------------|---|--------|
| 1. Iodine flask       | - | 30 Nos |
| 2. pH meter           | - | 5 Nos  |
| 3. Conductivity meter | - | 5 Nos  |
| 4. Spectrophotometer  | - | 5 Nos  |
| 5. Ostwald Viscometer | - | 10 Nos |

**Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (each 30 Nos.)**

**OBJECTIVES:**

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

**UNIT I****9+3**

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

**UNIT II****9+3**

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

**UNIT III****9+3**

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

**UNIT IV****9+3**

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

## UNIT V

9+3

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

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

### OUTCOMES:

Learners should be able to

- speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

### TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

### REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005
4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007

### EXTENSIVE Reading (Not for Examination)

1. Khera, Shiv. You can Win. Macmillan, Delhi. 1998.

### Websites

1. <http://www.englishclub.com>
2. <http://owl.english.purdue.edu>

### TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

## EVALUATION PATTERN:

### Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual presentations, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded following Bloom's taxonomy
- ✓ Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom's taxonomy.

### End Semester Examination: 80%

MA6251

MATHEMATICS – II

L T P C

3 1 0 4

### OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

### UNIT I VECTOR CALCULUS

9+3

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

### UNIT II ORDINARY DIFFERENTIAL EQUATIONS

9+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

### UNIT III LAPLACE TRANSFORM

9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

**UNIT IV ANALYTIC FUNCTIONS****9+3**

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping:  $w = z+k$ ,  $kz$ ,  $1/z$ ,  $z^2$ ,  $e^z$  and bilinear transformation.

**UNIT V COMPLEX INTEGRATION****9+3**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

**TEXTBOOKS:**

- Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,2011.
- Grewal. B.S, "Higher Engineering Mathematics", 41<sup>st</sup> Edition, Khanna Publications, Delhi, 2011.

**REFERENCES:**

- Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011
- Glyn James, "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2012.
- Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
- Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
- Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics" Volume II, Second Edition, PEARSON Publishing, 2011.

**GE6252****BASIC ELECTRICAL AND ELECTRONICS ENGINEERING****L T P C****4 0 0 4****OBJECTIVES:**

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics
- To impart knowledge of communication.

**UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS****12**

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

**UNIT II ELECTRICAL MECHANICS****12**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.





<b>UNIT I</b>	<b>INTRODUCTION, SOIL &amp; WATER CONSERVATION AND IRRIGATION ENGINEERING</b>	<b>10</b>
Agricultural Engineering – Introduction – Branches - Importance in national and global scenario – Institutes & organizations – Soil & water - Land development, Soil irrigability classification - Soil erosion and control, Soil conservation methods, Watershed management - Agro meteorology - Soil Water Plant relationship – Sources of water – Tanks – Wells & Reservoirs – Canal Network – Irrigation Scheduling – Irrigation methods – Micro irrigation - Participatory management of Irrigation Systems..		
<b>UNIT II</b>	<b>FARM STRUCTURES</b>	<b>8</b>
Farm stead, Farm Roads, Cattle sheds, Stanchion barn, Poultry shed, Hog housing, Machinery and implement shed, Storage structures for food grain, feed & forage - Structures for Plant environment - Green houses, Poly houses – Shade net.		
<b>UNIT III</b>	<b>FARM MACHINERY &amp; EQUIPMENT</b>	<b>8</b>
Tractor and Power Tiller – Tillage equipment – Sowing, Planting, Fertilizer application, Fertigation equipment - Spraying, Weeding and interculture – Harvesting and Mowing Equipment, Pumps.		
<b>UNIT IV</b>	<b>AGRICULTURAL PROCESS ENGINEERING</b>	<b>10</b>
Post harvest of crops, Unit operations in agricultural processing, Ripening chamber and Cold Storage - Packing of agricultural produces – Material handling equipments – Milk processing and dairy products.		
<b>UNIT V</b>	<b>AGRO ENERGY</b>	<b>9</b>
Energy requirement in agricultural operations - Solar (Thermal and Photovoltaic), Wind mills, Bio-gas energy and their utilization in agriculture – Gasification of biomass for IC Engines - Energy efficient cooking stoves and alternative cooking fuels – agricultural waste and their utilization.		
		<b>TOTAL : 45 PERIODS</b>

**OUTCOMES**

- The knowledge gained on soil water conservation, irrigation engineering and farm structures provide a strong platform to understand the concepts on these subjects for further learning.

**TEXTBOOKS:**

1. Michael, A.M. & Ojha, T.P. "Principles of Agricultural Engineering Vol. I & II", Seventh Edition, Jain Brothers, New Delhi, 2011.
2. Jagdishwar Sahay. "Elements of Agricultural Engineering", Standard Publishers Distributors, 2010.
3. Harry L. Field, John B. Solie, Introduction to Agricultural Engineering Technology – A problem solving approach, Springer Science, NY, USA, 2007.

<b>AI6202</b>	<b>PRINCIPLES AND PRACTICES OF CROP PRODUCTION</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To introduce the students to principles of agricultural and horticultural crop production and to introduce the production practices of crops.
- To delineate the role of agricultural and irrigation engineers in relation to various crop production practices.

<b>UNIT I</b>	<b>AGRICULTURE AND CROP PRODUCTION</b>	<b>9</b>
Introduction to agriculture and its crop production sub-sectors - field crop production and horticulture; Factors affecting crop growth and production: genetic (internal) and environmental (external) factors; Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices		

**UNIT II CROP SELECTION AND ESTABLISHMENT 9**

Regional and seasonal selection of crops; Systems of crop production; Competition among crop plants; Spacing and arrangement of crop plants; Field preparation for crops including systems of tillage; Establishment of an adequate crop stand and ground cover, including selection and treatment of seed, and nursery growing.

**UNIT III CROP MANAGEMENT 9**

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

**UNIT IV PRODUCTION PRACTICES OF AGRICULTURAL CROPS 9**

Generalized management and cultivation practices for important groups of field crops in Tamil Nadu: cereal crops, grain legumes, oil seed crops, sugarcane, and fiber crops, and special purpose crops such as those grown for green manure and fodder.

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

Important groups of horticultural crops in Tamil Nadu such as vegetable crops, fruit crops, flower crops; Cultivation practices of representatives of each group; Special features of production of horticultural crops - green house cultivation.

**TOTAL: 45 PERIODS**

**OUTCOMES**

- Students completing this course would have acquired knowledge on crop selection, crop production crop management.
- The students will have the required knowledge in the area of production of agricultural and horticultural crops.

**TEXTBOOKS:**

1. Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2005.
2. Reddy T. Sankara G.H. Yellamanda Reddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 1995.
3. Handbook of Agriculture. ICAR Publications, New Delhi.

**REFERENCES:**

1. Kumar, N., "Introduction to Horticulture", Rajalakshmi Publications. Nagercoil, 1993.
2. Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan, I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil. 1993.
3. Shanmugavel, K.G. Production Technology of Vegetable Crops. Oxford India Publications, New Delhi. 1989.
4. Bose T. K. and L.P.Yadav. Commercial Flowers, Nayaprakash, Calcutta. 1989.
5. Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005

**AI6211 AGRICULTURAL ENGINEERING PRACTICES LAB**

**L T P C  
0 0 3 2**

**OBJECTIVE:**

- Students should be able to understand the various aspects of agricultural engineering studied in theory by performing basic experiments in lab.

**AGROMETEOROLOGY**

**12**

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

**SEEDS AND CROPS****12**

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

**SOIL AND WATER PARAMETERS****9**

7. Soil Moisture estimation by different methods
8. pH and EC measurement using electrode device

**AGRICULTURAL MACHINERY****12**

9. Demonstration of Agricultural machineries and equipment
10. Demonstration of Agricultural processing equipment
11. Demonstration of Agro-energy equipment

**TOTAL: 45 PERIODS****OUTCOMES**

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

- Use various aspects of agricultural and irrigation engineering practices like measurement of evaporation, humidity, soil moisture estimation and familiarize with agricultural processing equipments.

**REFERENCES:**

1. Michael, A.M. & Ojha, T.P. Principles of Agricultural Engineering Vol. I & II, Seventh Edition, Jain Brothers, New Delhi, 2011.
2. Harry L. Field, John B. Solie, Introduction to Agricultural Engineering Technology – A problem solving approach, Springer Science, NY, USA, 2007.

**LIST OF EQUIPMENTS REQUIRED**

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

**AI6212****CROP HUSBANDRY LABORATORY****L T P C  
0 0 3 2****OBJECTIVE:**

- To introduce the different crop production practices in wet land, dry land and garden land through hands on experience and demonstrations.

**List of Experiments:**

1. Field preparation studies
2. Seed selection and seed treatment procedures
3. Seed bed and nursery preparation
4. Sowing / Transplanting
5. Biometric observation for crops
6. Nutrient management studies

7. Water management and irrigation scheduling
8. Weed management studies
9. Integrated Pest Management studies
10. Harvesting
11. Post harvesting

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENTS REQUIRED**

1. A wet land / garden land for a minimum of 5 cents area for each / group of students.
2. An open / borewell as water source to support cultivation

<b>MA6351</b>	<b>TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS</b>	<b>L T P C</b>
		<b>3 1 0 4</b>

**OBJECTIVES:**

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3**

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

**UNIT II FOURIER SERIES 9+3**

Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval’s identity – Harmonic analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3**

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

**UNIT IV FOURIER TRANSFORMS 9+3**

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

**UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3**

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

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

**OUTCOMES:**

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

**TEXTBOOKS:**

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

**REFERENCES:**

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

**AI6301****SOIL SCIENCE AND ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

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

**UNIT I INTRODUCTION AND SOIL PHYSICS****9**

Soil - definition - major components –Soil forming minerals and processes- soil profile -Physical properties - texture –density-porosity-consistence-colour- -specific gravity - capillary and non-capillary -plasticity. Soil air - soil temperature - soil water - classification of soil water- Movement soil water. Soil colloids – organic and inorganic matter-Ion exchange- pH – Plant nutrient availability

**UNIT II SOIL CLASSIFICATION AND SURVEY****9**

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

**UNIT III PHASE RELATIONSHIP AND SOIL COMPACTION****9**

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

**UNIT IV ENGINEERING PROPERTIES OF SOIL****9**

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

**UNIT V BEARING CAPACITY AND SLOPE STABILITY****9**

Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow foundations-Terzaghi's formula- BIS standards - Slope stability-Analysis of infinite and finite slopes- friction circle method- slope protection measures.

**TOTAL: 45 PERIODS**

## OUTCOMES

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

- Fundamental knowledge of soil physical parameters.
- The procedures involved in soil survey, soil classification.
- The phase relationship and soil compaction.
- Concepts of bearing capacity and slope stability.

## TEXTBOOKS:

1. Nyle C. Brady, "The Nature and Properties of Soil", Macmillan Publishing Company, 10<sup>th</sup> Edition, New York, 2008.
2. Punmia, B.C., "Soil Mechanics and Foundation "Laxmi Publishers, New Delhi, 2007.

## REFERENCES:

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

**CE6306**

**STRENGTH OF MATERIALS**

**L T P C**

**3 1 0 4**

## OBJECTIVES:

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

### **UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9+3**

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

### **UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9+3**

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

### **UNIT III TORSION 9+3**

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

### **UNIT IV DEFLECTION OF BEAMS 9+3**

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

### **UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9+3**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theorem.

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

## OUTCOMES:

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures.

- Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

#### TEXTBOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

#### REFERENCES:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,2007.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.

**AI6302**

**FLUID MECHANICS AND HYDRAULICS**

**L T P C  
3 1 0 4**

#### OBJECTIVES:

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.
- To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic pumps. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

#### UNIT I PROPERTIES OF FLUIDS

**9+3**

Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity - equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity - surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges – calibration. Hydrostatic forces on surfaces – total pressure and centre of pressure - Horizontal- vertical and inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles – buoyancy – meta centre – metacentric height.

#### UNIT II FLUID FLOW ANALYSIS

**9+3**

Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube path line – streak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.

#### UNIT III FLOW MEASUREMENTS

**9+3**

Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter - rota meter – elbow meter - pitot tube – Orifice – sharp edged orifice discharging free – submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-William's formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of valves

**UNIT IV OPEN CHANNEL FLOW****9+3**

Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific energy and critical depth - momentum in open channel flow – specific force – critical flow – computation. Flow measurement in channels – notches – rectangular, Cipolletti and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume.

**UNIT V DIMENSIONAL ANALYSIS & PUMPS****9+3**

Dimensional analysis – Fundamental dimensions – dimensional homogeneity – Rayleigh’s method and Buckingham Pi-Theorem - concept of geometric, kinematic and dynamic similarity. Important non dimensional numbers – Reynolds, Froude, Euler, Mach and Weber - Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming – cavitation – specific speed – characteristic curves. Turbine and submersible pumps - Jet pump – jet assembly - Other pumps – Air lift pump - reciprocating pump - sludge pump and vacuum pump- Hydraulic ram.

**TOTAL: (L:45+T:15):60 PERIODS****OUTCOMES:**

- The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- They will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

**TEXTBOOKS:**

1. Modi, P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Publishers Distributors, New Delhi, 2010.
2. Bansal, R.K., A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi Publications (P) Ltd., New Delhi, 2002.
3. Jagdish Lal., Hydraulic Machines. Metropolitan Book House, New Delhi, 2000.

**REFERENCES:**

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

**Web sites**

1. [www.onesmartclick.com/engineering/fluid-mechanics.html](http://www.onesmartclick.com/engineering/fluid-mechanics.html)
2. [www.it.iitb.ac.in/vweb/engr/civil/fluid\\_mech/course.html](http://www.it.iitb.ac.in/vweb/engr/civil/fluid_mech/course.html)

**AI6303****SURVEYING****L T P C  
3 0 0 3****OBJECTIVE:**

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

**UNIT I FUNDAMENTALS AND CHAIN SURVEYING****9**

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

**UNIT II COMPASS AND PLANE TABLE SURVEYING 9**  
Compass – Basic principles - Types - Bearing – Systems and conversions – Sources of errors - Local attraction - Magnetic declination-Dip-Traversing - Plotting - Adjustment of closing error – applications - Plane table and its accessories - Merits and demerits - Radiation - Intersection - Resection – Traversing- sources of errors – applications.

**UNIT III THEODOLITE AND MODERN SURVEYING 9**  
Theodolite - Types - Description - Horizontal and vertical angles - Temporary and Permanent adjustments – Heights and distances– Tangential and Stadia Tacheometry – Subtense methods - Stadia constants - Anallactic lens - Traversing - Gale's table - Total Station- Global Positioning System (GPS).

**UNIT IV LEVELLING 9**  
Level line - Horizontal line - Datum - Bench marks -Levels and staves - temporary and permanent adjustments – Methods of leveling - Fly levelling - Check levelling - Procedure in levelling - Booking -Reduction - Curvature and refraction - Reciprocal levelling - sources of errors in leveling- Precise levelling - Types of instruments - Adjustments - Field procedure.

**UNIT V LEVELLING APPLICATIONS 9**  
Longitudinal and Cross-section-Plotting - Contouring - Methods – Characteristics and uses of contours- Plotting – Methods of interpolating contours – computation of cross sectional area and volumes - Earthwork calculations - Capacity of reservoirs - Mass haul diagrams

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Students are expected to use all surveying equipments, prepare LS & CS, contour maps and carryout surveying works related to land and civil engineering projects.

**TEXTBOOKS:**

1. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.
2. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.

**REFERENCES:**

1. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice Hall of India 2004.
2. A.M. Chandra, Plane Surveying, New Age International Publishers 2002.
3. Alak De, Plane Surveying, S. Chand & Company Ltd., 2000.

**AI6304**

**THEORY OF MACHINES**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To introduce the students the theory of machines pertaining to agricultural engineering.

**UNIT I TERMINOLOGY 9**  
Definitions - Kinematic links - Pairs - Chain - Machines and mechanism - Types and uses – Kinematic inversion of four bar chain and slider crank mechanism. Velocity and acceleration in simple mechanisms - Vector polygon and instantaneous centre methods – Coriolis component of acceleration.

**UNIT II FRICTION AND APPLICATIONS 9**  
Sliding and rolling friction –friction in screw threads-Bearing and lubrication- Friction clutches- Belt drives- Friction aspects in brakes.

**UNIT III MOTION OF CAM AND FOLLOWER 9**  
Cam and follower - types - application – displacement diagrams - profile layout for uniform velocity - Uniform acceleration and retardation - simple harmonic and cycloidal motion.

**UNIT IV      GEARS AND GEAR TRAINS****9**

Gears - classification - terminology -law of gearing - tooth profile - interference between rack and pinion. Gear trains - simple - compound reverted. Simple epicyclic gear trains.

**UNIT V      FLYWHEEL AND BALANCING****9**

Inertia - turning moment - flywheel - fluctuation of speed and energy. Balancing of rotating masses and reciprocating masses.

**TOTAL: 45 PERIODS****OUTCOMES:**

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

- Basic knowledge on the friction applications, gear and gear trains.
- Learn the fundamentals related to motion of cam and follower and fly wheel balancing

**TEXTBOOKS:**

1. Rattan, S.S, Theory of Machines, 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2009.
2. Khurmi, R.S. and Gupta, J.K, Theory of machines, Eurasia Publication House, 1994.

**REFERENCES:**

1. Thomas Beven, Theory of Machines, CBS Publishers and Distributors, New Delhi, 1984.
2. Ballaney, P.L, Theory of machines, Khanna Publishers, New Delhi, 1994
3. <http://www.softintegration.com/chhtml/toolkit/mechanism/>

**AI6311****SURVEYING LABORATORY****L T P C  
0 0 4 2****OBJECTIVE:**

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

**1) CHAIN SURVEYING**

- a) Ranging, Chaining and Pacing
- b) Chain traversing

**2) COMPASS SURVEYING**

- a) Triangulation Problem
- b) Compass traversing

**3) PLANE TABLE SURVEYING**

- a) Radiation
- b) Intersection - Triangulation problem
- c) Plane table traversing

**4) THEODOLITE SURVEYING**

- a) Measurement of horizontal & vertical angles
- b) Tangential & Stadia Tacheometry

**5) LEVELLING**

- a) Fly levelling using Dumpy level
- b) Fly levelling using Tilting level
- c) Check levelling
- d) Block Levelling
- e) Radial Contouring

**6) DEMONSTRATION OF TOTAL STATION AND GPS****OUTCOMES**

- Students completing this course would have acquired practical knowledge on handling basic survey instruments including leveling and development of contour map of given area.

**TOTAL: 60 PERIODS**

**OBJECTIVE:**

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

**LIST OF EXPERIMENTS**

<b>1. Flow Measurement</b>	<b>24</b>
1. Calibration of Rotometer	
2. Flow through Venturimeter	
3. Flow through a circular Orifice	
4. Determination of mean velocity by Pitot tube	
5. Verification of Bernoulli's Theorem	
6. Flow through a Triangular Notch	
7. Flow through a Rectangular Notch	
<b>2. Losses in Pipes</b>	<b>6</b>
8. Determination of friction coefficient in pipes	
9. Determination of losses due to bends, fittings and elbows	
<b>3. Pumps</b>	<b>15</b>
10. Characteristics of Centrifugal pump	
11. Characteristics of Submersible pump	
12. Characteristics of Reciprocating pump	
13. Characteristics of Jet pump	

**TOTAL: 45 PERIODS****OUTCOMES:**

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

**REFERENCES:**

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2004.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House, New Delhi, 2000.
3. Subramanya, K. Flow in Open Channels, Tata McGraw - Hill Pub. Co.1992.
4. Subramanya, K. Fluid Mechanics, Tata McGraw- Hill Pub. Co., New Delhi, 1992.

**LIST OF EQUIPMENTS REQUIRED**

1. Rotometer – 1 no.
2. Venturimeter – 1 no.
3. Orificemeter – 1 no.
4. Pitot tube – 1 no.
5. Bernoulli's theorem apparatus – 1 no.
6. Triangular notch and Rectangular notch – 1 each (with a lined open channel setup)
7. Coefficient of friction apparatus
8. Pipe setup with bends, fittings and elbows for estimating minor losses
9. Centrifugal pump, Reciprocating pump, Submersible pump, Jet pump – 1 each
10. Collecting tank, Stop watch – 1 no. for each experiment

**OBJECTIVES:**

- This course aims at providing the required skill to apply the statistical tools in engineering problems.

**UNIT I RANDOM VARIABLES****9+3**

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

**UNIT II TWO - DIMENSIONAL RANDOM VARIABLES****9+3**

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

**UNIT III TESTING OF HYPOTHESIS****9+3**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

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

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design -  $2^2$  factorial design.

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

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

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

- The students will have a fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real life phenomenon. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

**TEXTBOOKS:**

- Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4<sup>th</sup> Edition, 2007.
- Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7<sup>th</sup> Edition, 2007.
- Papoulis. A and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes " McGraw Hill Education India , 4<sup>th</sup> Edition, New Delhi , 2010.

**REFERENCES:**

- Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8<sup>th</sup> Edition, 2012.
- Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8<sup>th</sup> Edition, 2007.
- Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
- Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

**OBJECTIVES:**

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

**UNIT I EVAPORATION AND CONCENTRATION****9**

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

**UNITII FILTRATION AND SEDIMENTATION****9**

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

**UNIT III SIZE REDUCTION****9**

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

**UNIT IV PROCESSING****9**

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

**UNIT V CRYSTALLISATION AND DISTILLATION****9**

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

**TOTAL : 45 PERIODS****TEXTBOOKS:**

1. Earle, R.L., "Unit operations in Food Processing", Pergamon Press, Oxford, U.K, 1985.
2. McCabe, W.L., and Smith, J.C., "Unit Operations of Chemical Engineering", Mc-Graw-Hill Inc., Kosaido Printing Ltd., Tokyo, 1990.

**REFERENCE:**

1. Coulson, J.M., and Richardson, J.F., "Chemical Engineering", Vol. 1, The Pergamon Press, New York, 1977.

**OBJECTIVE :**

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

**UNIT I TRACTORS****9**

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

**UNIT II ENGINE SYSTEMS****9**

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

**UNIT III TRANSMISSION SYSTEMS****9**

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

**UNIT IV HYDRAULIC SYSTEMS****9**

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

**UNIT V POWER TILLER AND TRACTOR TESTING****9**

Power tiller - special features - clutch - gear box - steering and brake. Makes of tractors and power tillers. Types of tests- test procedure - need for testing & evaluation of farm tractor -Test code for performance testing of tractors and power tillers.

**TOTAL: 45 PERIODS****OUTCOME**

- The students will be able to understand the various equipments and mechanizations used in the farm.
- The students will have the knowledge on earth moving machineries, tractor classification and tillage implements.

**TEXTBOOK:**

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

**REFERENCES:**

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

**OBJECTIVES:**

- To introduce the student to the concept of hydrological aspects of water availability and requirements and should be able to quantify, control and regulate the water resources.

**UNIT I PRECIPITATION AND ABSTRACTIONS****10**

Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods-



Second law of Thermodynamics – Entropy – Carnot principles – Change in Entropy – Entropy and irreversibility -Applications.

**UNIT III HEAT ENGINES 15**

Internal Combustion Engines – C.I and S.I Engines – Four Stroke and Two Stroke Engines – Gas Turbines - Boilers – Fire Tube Boiler & Water Tube Boilers , Boiler Accessories and Components. Turbines – Impulse Turbine and Reaction Turbine , Turbine Components - Refrigeration Cycle – Vapour Compression & Vapour Absorption System ,Gas Refrigeration System – Environmental friendly Refrigerants – Air Conditioning.

**UNIT IV GASES AND VAPOUR MIXTURES 11**

Ideal and Real gases – Vander waals equations – Reduced property – Compressibility chart - Properties of mixture of gases – Dalton’s law and Gibbs – Dalton law – Internal energy, Enthalpy and specific heats of gas mixtures.

**UNIT V HEAT TRANSFER 11**

Conduction – Plane Wall, Cylinder system, Composite Walls – Critical insulation thickness – Simple, fins convection – Free convection and forced convection – Flow over Flat plates and Flow through Pipes – Radiation – Black Body, Grey Body Radiation.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to understand different gas power cycles and use of them in IC and R&AC applications.

**TEXTBOOKS:**

1. Yunus A. Cengel and Michael A.Boles, “Thermodynamics: An Engineering Approach”, Fourth Edition, Tata McGraw-hill, 2004.
2. Michael J.Moran, Howard N.Shapiro, “Fundamentals of Engineering Thermodynamics”, Fourth Editon, John wiley &Sons, 2000.

**REFERENCES:**

1. R.K.Rajput, “A Text book of Engineering Thermodynamics”, Third Edition, Laxmi publication (P) Ltd., 2007.
2. Nag.P.K., “Engineering Thermodynamics”, Third Edition, Tata McGraw hill, 2005.
3. Domkundwar.S., C.P.Kothandaraman “A Course in Thermal Engineering”, Fifth Edition, Dhanpat Rai & Co (p) Ltd, 2000.

**GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C  
3 0 0 3**

**OBJECTIVES:**

To study the nature and facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth’s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12**

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an

ecosystem – producers, consumers and decomposers- Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

## **UNIT II ENVIRONMENTAL POLLUTION 10**

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO<sub>2</sub>, NO<sub>x</sub>, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies –

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

## **UNIT III NATURAL RESOURCES 10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins – Biochemical degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

## **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

## **UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6**

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

welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

**TEXTBOOKS :**

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> Edition, Pearson Education, 2004
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw Hill, New Delhi, 2006.

**REFERENCES :**

1. Trivedi R.K. 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham W.P.Cooper., T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publishing House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan R, 'Environmental Studies - From Crisis to Cure', Oxford University Press, 2005

**AI6411**

**DRAWING OF FARM STRUCTURES**

**L T P C  
0 0 3 2**

**OBJECTIVE:**

- To conceive and design various farm structures related to agricultural engineering.
1. Planning and Layout of farmstead
  2. Design of stall bam
  3. Design of loose housing and milk parlors
  4. Design of poultry house
  5. Design of a sheep / goat house
  6. Design of ventilation system for dairy and poultry house
  7. Design of silos – over ground and underground and hay storages
  8. Design of farm fencing system
  9. Design of farm trusses
  10. Design of machinery and equipment shed and workshops
  11. Design of septic tank and sanitary structures
  12. Design of rural/farm roads and culverts.
  13. Design of biogas plant

**TOTAL: 45 PERIODS**

**TEXTBOOKS:**

1. Barre, H.J. and Sammet, L.L. "Farm Structures". John Wiley and Sons Inc. 1950."
2. Neubaur, L. W. and Walker, H.B. "Farm Buildings Design". Prentice Hall Inc., 1961.
3. Khanna, S.K. and Justo, C.E.G. "Highway Engineering". Nemchand and Bros., Roorkee, India.
4. Dutta, B.N. "Estimating and Costing in Civil Engineering Theory and Practice". S. Dutta and Co.
5. Bazirani, V.N. and Ratwani, M.M. "Steel Structures". Khanna Publishers, Delhi, 1981.

6. Justo, C.E.G. and Khanna, S.K. "Highway Engineering". Nemchand and Bros., Roorkee, India (Revised).

**CE6411**

**STRENGTH OF MATERIALS LABORATORY**

**L T P C  
0 0 3 2**

**OBJECTIVES:**

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

**LIST OF EXPERIMENTS**

- Tension test on mild steel rod
- Compression test on wood
- Double shear test on metal
- Torsion test on mild steel rod
- Impact test on metal specimen (Izod and Charpy)
- Hardness test on metals (Rockwell and Brinell Hardness Tests)
- Deflection test on metal beam
- Compression test on helical spring
- Deflection test on carriage spring
- Test on Cement

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**REFERENCES:**

- Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
- IS1786-2008, Specification for cold worked steel high strength deformed bars for concrete reinforcement, 2008.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	UTM of minimum 400 kN capacity	1
2.	Torsion testing machine for steel rods	1
3.	Izod impact testing machine	1
4.	Hardness testing machine Rockwell Vicker's } (any 2) Brinell	1 each
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few
9	Le Chatelier's apparatus	2
10	Vicat's apparatus	2
11	Mortar cube moulds	10

**AI6501**

**IRRIGATION AND DRAINAGE ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- At the completion of the course the students should be able to understand the necessity of planning an irrigation system to provide water at the right time and right place.
- To understand the basic concepts for planning, design and management of land drainage works in cultivated areas

**UNIT I WATER RESOURCES AND IRRIGATION REQUIREMENT 9**

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

**UNIT II METHODS OF IRRIGATION 9**

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

**UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9**

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

**UNIT IV CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT 9**

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

**UNIT V AGRICULTURAL DRAINAGE 9**

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

**TOTAL: 45 PERIODS**

**OUT COMES:**

- The students will have knowledge and skills on Planning, design, operation and management of reservoir system.
- The student will gain knowledge on different methods of irrigation including canal irrigation.

**TEXTBOOKS:**

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

**REFERENCES:**

1. Basak, N.N., “Irrigation Engineering”, Tata McGraw-Hill Publishing Co, New Delhi, 2008.
2. Murthy, V.V.N. Land and water management, Kalyani publishing, New Delhi, 1998.
3. Bhattacharya, A.K., and Michael, A.M., “Land Drainage – Principles, Methods and Applications”, Konark Publishers Pvt. Ltd., New Delhi, 2003.
4. Irrigation water Management, Training Manual No 6, Drainage of Irrigated Lands, Food and Agriculture Organisation, Rome 1996
5. Kessler, J., “Drainage Principles and Applications”, Vol. II and IV, International Institute of Land Reclamation and Improvement, Netherlands, 1979.

**AI6502**

**SOLAR AND WIND ENERGY ENGINEERING**

**L T P C**

**3 0 0 3**

**OBJECTIVE:**

- The student will be exposed to Solar energy and its applications, wind energy and its applications, alternate energy sources

**UNIT I SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS 9**

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

**UNIT II SOLAR CONCENTRATING COLLECTORS AND PV TECHNOLOGY 9**

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

**UNIT III WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND 9**

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

**UNIT IV WIND MILL DESIGN AND APPLICATIONS 9**

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

**UNIT V ALTERNATE ENERGY SOURCES 9**

Ocean energy- off shore and on shore ocean energy conversion technologies- OTEC principles – open and closed cycles. Tidal energy – high and low tides – tidal power- tidal energy conversion schemes. Geothermal energy – resources – classification and types of geothermal power plants. Nuclear energy – reactions – fusion fission hybrid. Fuel cell – principle and operation – classification and types. Energy storage – pumped hydro and underground pumped hydro – compressed air - battery - flywheel – thermal.

**TOTAL: 45 PERIODS**

**TEXTBOOKS:**

1. Rai., G.D. “Solar Energy Utilization” Khanna publishers, New Delhi, 2002
2. More, H.S and R.C. Maheshwari, “ Wind Energy Utilization in India” CIAE Publication – Bhopal, 1982
3. Rao. S and B.B. Parulekar. Energy Technology – Non conventional, Renewable and Conventional. Khanna Publishers, Delhi, 2000.

**REFERENCES:**

1. Mathew Buresch, Photovoltaics Energy Systems. McGraw-Hill Book Company, London, 1986.
2. Jui Sheng Hsieh. Solar Energy Engineering, Prentice Hall, London, 1986.
3. Tany Burtar, Hand book of wind energy. John Wiley and Sons, 2001,
4. J.G.Mc Gowan, Manwell, J.F. and A.L.Rogers. Wind Energy Explained – Theory Design and Application, John Wiley and Sons Ltd, 2004.
5. John Twidell. A guide to small wind energy conversion system, Cambridge University press. UK, 1987.
6. Rai. G.D. “Non Conventional Sources of Energy”, Khanna Publishers, New Delhi, 2002

**Web resources**

1. [www.freesolaronline.com](http://www.freesolaronline.com)
2. [www.rsnz.org](http://www.rsnz.org)
3. [www.finwea.org](http://www.finwea.org)
4. [www.mnre.gov.in](http://www.mnre.gov.in)

## OBJECTIVES:

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

### UNIT I FARM MECHANIZATION 9

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

### UNIT II PRIMARY AND SECONDARY TILLAGE IMPLEMENTS 9

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

### UNIT III SOWING AND FERTILIZING EQUIPMENT 9

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

### UNIT IV WEEDING AND PLANT PROTECTION EQUIPMENT 9

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

### UNIT V HARVESTING MACHINERY 9

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

**TOTAL: 45 PERIODS**

## OUTCOMES:

- The students will be able to understand the mechanization and various equipment used in the farm for different field operations.

## TEXTBOOKS :

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

## REFERENCES:

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

**OBJECTIVES:**

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

**UNIT I STRESSES IN MACHINE MEMBERS 9+3**

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

**UNIT II DESIGN OF POWER TRANSMISSION SYSTEMS 9+3**

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

**UNIT III DESIGN OF SHAFTS AND COUPLINGS 9+3**

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

**UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9+3**

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

**UNIT V DESIGN OF GEARS AND BEARINGS 9+3**

Gears - spur gear and helical gear - terminology - strength of gear teeth - Lewis equation - Buckingham equation. - Failure of gear teeth.

Design of bearings – sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions.

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

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

**OUTCOME**

- At the end of the course the student will have the knowledge on agricultural machineries and detailed design and drawing of various components.

**TEXTBOOKS:**

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

**REFERENCES:**

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

## OBJECTIVES:

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

## UNIT I FUNDAMENTALS OF POST HARVESTING 9

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

## UNIT II PSYCHROMETRY AND DRYING 9

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

## UNIT III CLEANING AND GRADING 9

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

## UNIT IV SHELLING AND HANDLING 9

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

## UNIT V PADDY AND CROP PROCESSING 9

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

**TOTAL: 45 PERIODS**

## OUTCOMES

- At the end of the study the student will have knowledge on
- Material handling equipments
- Different Post Harvest operations and processing methods of harvested crops.
- fundamentals of various unit operations of Agricultural Processing.

## TEXTBOOKS:

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

## REFERENCES:

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

## **OBJECTIVES :**

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

### **UNIT I FARM MANAGEMENT**

**9**

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

### **UNIT II LAWS OF ECONOMICS**

**9**

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

### **UNIT III COST CURVES**

**9**

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

### **UNIT IV MANAGEMENT OF RESOURCES**

**9**

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

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

**9**

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

**TOTAL: 45 PERIODS**

## **OUTCOME**

- Students are able to plan the financial aspects related to farm management in a cost effective manner.

## **TEXTBOOKS:**

1. Johl, S.S., and Kapur, T.R., 'Fundamentals of Farm Business Management', Kalyani publishers, Ludhiana, 2007.
2. Subba Reddy, S., Raghu Ram, P., Neelakanta Sastry T.V and Bhavani
3. Devi, I., 'Agricultural Economics' Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

## **REFERENCES:**

1. Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
2. Subba Reddy, S., and Raghu Ram, P. 'Agricultural Finance and Management', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
3. Sankhayan, P.L. 'Introduction to Farm Management', Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001

- Muniraj, R., "Farm Finance for Development", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2000.

**AI6511 OPERATION AND MAINTENANCE OF FARM MACHINERY LAB**

**L T P C  
0 0 3 2**

**OBJECTIVES:**

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

**LIST OF EXPERIMENTS**

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

**TOTAL : 45 PERIODS**

**TEXTBOOKS:**

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

**REFERENCES:**

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

**LIST OF EQUIPMENTS REQUIRED**

- Tractor – 1 no.
- Power tiller – 1 no.
- Disc plough – 1 no.
- Disc harrow – 1 no.
- Multi tyne cultivator – 1 no.
- Paddy Transplanter – 1 no.
- Seed drill – 1 no.
- Spayer – 1 no.
- Mower – 1 no.
- Weeder -1 no.
- Combine harvester -1 no. (optional) – can be had as demonstration

**AI6512**

**POST HARVEST ENGINEERING LABORATORY**

**L T P C**

**OBJECTIVE:**

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

**LIST OF EXPERIMENTS**

1. Determination of moisture content of grains by oven method and moisture meter.
2. Determination of porosity of grains.
3. Determination of coefficient of friction and angle of repose of grains.
4. Testing of paddy thresher & paddy winnower.
5. Testing of groundnut decorticator & maize sheller
6. Evaluation of thin layer drier
7. Evaluation of L.S.U. drier.
8. Determining the efficiency of bucket elevator and screw conveyor
9. Evaluation of shelling efficiency of rubber roll sheller
10. Determining the oil content of oil seeds.
11. Visit to modern rice mill
12. Visit to pulse milling industry

**TOTAL: 45 PERIODS****TEXTBOOKS:**

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

**REFERENCES:**

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

**LIST OF EQUIPMENTS REQUIRED**

1. Hot air oven, Grain moisturemeter – 1 no. each
2. Porosity apparatus – 1 no.
3. Coefficient of friction apparatus – 1 no.
4. Angle of repose – round type and L type – 1 no.each.
5. Paddy thresher – 1 no.
6. Groundnut decorticator and maize sheller – 1 no. each
7. Thin layer dryer – 1 no.
8. LSU dryer – 1 no.
9. Bucket elevator and screw conveyor – 1 no. each
10. Rubber roll sheller – 1 no.
11. Oil expeller – 1 no.

**OBJECTIVES:**

- To introduce the concepts of groundwater, its availability, assessment and utilization
- To understand the theory behind well design, construction and management of wells.

**UNIT I HYDROGEOLOGIC PARAMETERS 9**

Water Balance – Distribution of subsurface water – Water bearing properties of Rocks – Types of Aquifers – Aquifer properties Estimation – Pumping test :- Permeability, Specific yield, transmissivity and Storage coefficient – Methods of Estimation – Ground water table fluctuation method – GEC Norms – Ground water development and potential in India - Groundwater prospectives - Geophysical techniques – Electrical resistivity survey

**UNIT II WELL HYDRAULICS 9**

Darcy's law – Groundwater Flow Equation – Steady state flow – Dupuit Forcheimer Assumption – Theim's Equation - unsteady flow – Theis method and Jacob method – Image well theory – Partial penetration of wells.

**UNIT III WELL DESIGN 9**

Design characteristics – Design of wells - Well diameter, depth and Well screen design – Materials for well screens – Well casing – Design of collector wells and Infiltration gallery – Dug wells versus tube wells

**UNIT IV WELL CONSTRUCTION AND MAINTENANCE 9**

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

**UNIT V SPECIAL TOPICS 9**

Artificial Recharge Techniques – Sea water Intrusion – Ground water modeling Techniques – Ground water pollution and legislation - Ground water development and potential in India – Hazardous substances – Hazard identification – Dose response assessment – Risk analysis

**TOTAL: 45 PERIODS****OUTCOMES:**

- Students know the technical aspects of groundwater, its availability, assessment and utilization
- Familiarized with the theory behind well design, construction and management of wells.

**TEXTBOOKS:**

1. Karanth, K.R. Groundwater Assessment, Development and Management. Tata Mc-Graw Hill, 2008.
2. Raghunath, H.M. Groundwater Hydrology, Wiley Eastern Ltd., 2000.

**REFERENCES:**

1. Rastogi,A.K. Numerical Groundwater Hydrology, Penram International Publishing. Pvt. Ltd., Bombay, 2008.
2. David Keith Todd. Groundwater Hydrology, John Wiley & Sons, Inc. 2007
3. Fletcher.G.Driscoll, "Groundwater and Wells", Johnson Revision, New York, 1987.

**AI6602****DAIRY AND FOOD ENGINEERING****L T P C****3 0 0 3****OBJECTIVES :**

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

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

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

**UNIT II DAIRY PRODUCTS 9**

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

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

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

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

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

**UNIT V QUALITY CONTROL 8**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**TEXTBOOKS:**

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

**REFERENCES:**

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

**OBJECTIVES :**

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

**UNIT I COMMUNICATION AND PROGRAMME PLANNING 9**

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

**UNIT II EXTENSION TEACHING METHODS 9**

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

**UNIT III MODERN COMMUNICATION GADGETS 9**

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

**UNIT IV DIFFUSION AND ADOPTION 9**

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

**UNIT V CAPACITY BUILDING 9**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

After completion of this course, the students will

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

**TEXT BOOKS**

1. Ray, G.L., 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
2. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi

**REFERENCES**

1. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, Newyork
2. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

**OBJECTIVES:**

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

**UNIT I CONDUCTION 9+3**

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

**UNIT II CONVECTION 9+3**

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

**UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9+3**

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

**UNIT IV RADIATION 9+3**

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

**UNIT V MASS TRANSFER 9+3**

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

**OBJECTIVE**

- To draft the agricultural engineering related machineries and structures manually and also by computer aided methods.
1. Design and Drawing of Underground pipeline system 8
  2. Design and Drawing of Check dam 6
  3. Design and Drawing of Mould board plough 8
  4. Design and Drawing of Disk plough 8
  5. Design and Drawing of Post harvest technology units (threshers and winnowers) 8
  6. Design and Drawing of Biogas plant. 6
  7. Introduction & demonstration on 3D modeling softwares like Pro/E, Creo, Solid works, Solid Edge etc. 16

**TOTAL: 60 PERIODS****OUTCOMES:**

- The student will be able to understand the plan and layout of underground pipes, post harvesting units and check dams.
- The students also will be able to design and draw the components using computer aided methods

**REFERENCES**

1. Michael, A.M. "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.
2. Rai, G.D. "Nonconventional Sources of Energy", Khanna publishers, New Delhi, 1995.
3. Srivastava, A.C."Elements of Farm Machinery", Oxford and IBH Publications Co., New Delhi, 1990.
4. Vijay Duggal. "A general guide to Computer Aided Design & Drafting, Mailmax Publications, 2000
5. Tadeusz Stolarski et al. "Engineering Analysis with ANSYS Software", Butterworth Heinemann Publications, 2006
6. Louis Gary Lamit, "Introduction to Pro/ENGINEER" SDC Publications, 2004.

**GE6674 COMMUNICATION AND SOFT SKILLS- LABORATORY BASED****L T P C  
0 0 4 2****OBJECTIVES:**

To enable learners to,

- Develop their communicative competence in English with specific reference to speaking and listening
- Enhance their ability to communicate effectively in interviews.
- Strengthen their prospects of success in competitive examinations.

**UNIT I LISTENING AND SPEAKING SKILLS****12**

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

**UNIT II READING AND WRITING SKILLS****12**

Reading different genres of texts ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

**UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS****12**

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service(Language related)- Verbal Ability.

**UNIT IV INTERVIEW SKILLS 12**

Different types of Interview format- answering questions- offering information- mock interviews- body language( paralinguistic features)- articulation of sounds- intonation.

**UNIT V SOFT SKILLS 12**

Motivation- emotional intelligence-Multiple intelligences- emotional intelligence- managing changes-time management-stress management-leadership straits-team work- career planning - intercultural communication- creative and critical thinking

**TOTAL: 60 PERIODS**

**Teaching Methods:**

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for gaining proficiency and better participation in the class.

**Lab Infrastructure:**

S. No.	Description of Equipment (minimum configuration)	Qty Required
1	<b>Server</b>	1 No.
	• PIV System	
	• 1 GB RAM / 40 GB HDD	
	• OS: Win 2000 server	
	• Audio card with headphones	
• JRE 1.3		
2	<b>Client Systems</b>	60 Nos.
	• PIII or above	
	• 256 or 512 MB RAM / 40 GB HDD	
	• OS: Win 2000	
	• Audio card with headphones	
• JRE 1.3		
3	Handicam	1 No.
4	Television 46"	1 No.
5	Collar mike	1 No.
6	Cordless mike	1 No.
7	Audio Mixer	1 No.
8	DVD recorder/player	1 No.
9	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No.

**Evaluation:**

**Internal: 20 marks**

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

**External: 80 marks**

Online Test	- 35 marks
Interview	- 15 marks
Presentation	- 15 marks
Group Discussion	- 15 marks

**Note on Internal and External Evaluation:**

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
  - a. Marketing engineer convincing a customer to buy his product.
  - b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics.
4. Discussion – topics of different kinds; general topics, and case studies.

**OUTCOMES:****At the end of the course, learners should be able to**

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

**REFERENCES:**

1. **Business English Certificate Materials**, Cambridge University Press.
2. **Graded Examinations in Spoken English and Spoken English for Work** downloadable materials from Trinity College, London.
3. **International English Language Testing System** Practice Tests, Cambridge University Press.
4. Interactive Multimedia Programs on **Managing Time and Stress**.
5. **Personality Development** (CD-ROM), Times Multimedia, Mumbai.
6. Robert M Sherfield and et al. **“Developing Soft Skills”** 4th edition, New Delhi: Pearson Education, 2009.

**Web Sources:**

- <http://www.slideshare.net/rohitjsh/presentation-on-group-discussion>
- [http://www.washington.edu/doi/TeamN/present\\_tips.html](http://www.washington.edu/doi/TeamN/present_tips.html)
- <http://www.oxforddictionaries.com/words/writing-job-applications>
- <http://www.kent.ac.uk/careers/cv/coveringletters.htm>
- [http://www.mindtools.com/pages/article/newCDV\\_34.htm](http://www.mindtools.com/pages/article/newCDV_34.htm)

**OBJECTIVE:**

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

The lab includes visit to food processing and dairy industry

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**LIST OF EQUIPMENTS REQUIRED**

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

Other basic requirements like weighing balance, physical balance, blotting papers, tracing sheets, burette, vernier calipers, pipette, conical flask, test tubes, beakers, spatula and other glasswares, food samples, chemicals should be available.

**TEXT BOOKS**

1. Singh, R.Paul. and Heldman, R.Dennis.2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.
2. Kessler, H.G.1981. Food engineering and dairy technology. Verlag A.Kessler, Freising.

**REFERENCES**

1. Walstra, P. T.J. Geurts, A. Nooman, A. Jellema and M.A. J.S Van Boekel. 2005. Dairy Technology. Marcel Dekker Inc. New york.
2. Clunie Harvey, W.M and Harry Hill. 2009 Milk Products. IV Edition Biotech Books, New Delhi.
3. Robinson, R.K.1986. Modern dairy technology Vol.I Advances in Milk processing. Elsevier Applied Science Publishes, London.
4. Charm, S.E.1971. The fundamentals of Food engineering, AVI pub.Co.,Inc,

5. Karel Marcus, Fennama, R.Owen and Lund, B.Dayal. 1975. Principles of food science, Part II - Physical principles of food preservation, Marcel Dakker, Inc.
6. Hall,C.W and T.J.Hedrick. 1971. Drying of milk and milk products. AVI Publishing Co., West Port, Connecticut.

**AI6701**

**IT IN AGRICULTURAL SYSTEMS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I           PRECISION FARMING**

**9**

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

**UNIT II           ENVIRONMENT CONTROL SYSTEMS**

**9**

Artificial light systems, management of crop growth in greenhouses, simulation of CO<sub>2</sub> consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

**UNIT III          AGRICULTURAL SYSTEMS MANAGEMENT**

**9**

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

**UNIT IV          WEATHER PREDICTION MODELS**

**9**

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

**UNIT V          E-GOVERNANCE IN AGRICULTURAL SYSTEMS**

**9**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**TEXTBOOKS:**

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

**REFERENCES:**

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

**OBJECTIVES:**

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

**UNIT I SOIL EROSION PRINCIPLES****9**

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

**UNIT II ESTIMATION OF SOIL EROSION****9**

Runoff computation for soil conservation: SCS-CN method – Evolution of Universal Soil Loss Equation: Applications and Limitations – Modified Universal Soil Loss Equation – Revised Universal Soil Loss Equation-2 - Permissible erosion – Land use capability classification - Classification of eroded soils.

**UNIT III EROSION CONTROL MEASURES****10**

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

**UNIT IV WATER CONSERVATION MEASURES****9**

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

**UNIT V SEDIMENTATION****8**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

- The students will be able to gain fundamental knowledge on the concepts of erosion and sedimentation.
- They will have sufficient knowledge on soil and water conservation measures.

**TEXTBOOKS:**

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

**REFERENCES:**

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

**OBJECTIVES:**

- To introduce students to various materials commonly used in civil engineering construction and their properties.
- To provide the student with the ability to estimate the quantities of item of works involved in different constructions and also to prepare reports for estimation of various items.

**UNIT I STONES AND BRICKS 9**

Classification of rocks - Characteristics of Stones -Testing of Stones-Manufacture of Bricks - Moulding - Drying and Burning of bricks-Properties of good Brick -Classification of bricks -Clay Products-Ceramics - Tiles - Earthenware and Stoneware and uses

**UNIT II LIME AND CEMENT 9**

Lime- Natural Sources -Types of lime – Calcination-Cement -Raw materials – Water Cement Ratio- Manufacture of Portland Cement Wet and Dry process-Standard Specifications- Storage of cement-Timber – Definition - Defects in timber-Qualities of good timber

**UNIT III BRICK AND STONE MASONRY 10**

Concept of Foundation -Factors affecting Selection of Foundations -Types of soils-Subsurface Investigations -Bearing Capacity of soil -Testing &Improving Bearing Capacity of soil- Types of Foundations-Piles - Foundation in Black Cotton soil-Site Selection - Design of Foundation - General principles - precautions in brick masonry -Stone Masonry -Comparison between Brick and Stone Masonry -Classification -General Principles and Precautions in Stone Masonry – Specification

**UNIT IV CONCRETE, TIMBER AND OTHER MATERIALS 9**

Concrete – Ingredients – Manufacturing Process –Properties of fresh concrete – Slump – Flow and compaction Factor – Properties of hardened concrete –Tests – Mix specification – Mix proportioning – BIS method – High Strength Concrete and HPC – Self compacting Concrete – Other types of Concrete – Durability of Concrete - Timber – Market forms – Industrial timber– Plywood – Veneer – Thermacole – Panels of laminates – Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumens.

**UNIT V ESTIMATING AND COSTING 8**

PWD schedule of rates – data sheet – detailed estimate – abstract estimate - preparation of estimate.

**TOTAL: 45 PERIODS****OUTCOMES:**

On completion of this course the students will be able to

- compare the properties of most common and advanced building materials.
- understand the typical and potential applications of these materials
- understand the relationship between material properties and structural form
- understand the importance of experimental verification of material properties.
- estimate the material quantities, prepare a bill of quantities, make specifications and prepare tender documents. Student shall be able to prepare value estimates.

**TEXTBOOKS**

1. Deodhar, S.V. and Singhal, 2001. Civil engineering materials. Khanna publishers, 2B, Nath market, Naisark, Delhi -6.
2. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2012.
3. Rangwala. S.C., 1991. Estimating and costing. Charotar book stall, station road, Anand.

## REFERENCES

1. Deodhar, S.V. and Singhal, 2001. Civil engineering materials. Khanna publishers, 2B, Nath Market, Naisark, Delhi -6.
2. Handoo, B.L. and Mahajan,V.M., 1995. Civil engineering materials. Sathyaprakasam, 16/7698, New market, New Rohtak road, New Delhi-5.
3. Datta. B.N, 2002. Estimation and costing. Published by the Author, Tagore Palli, Motilal Bose road, Lucknow -1.

## AI6704 REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

L T P C  
3 0 0 3

### OBJECTIVES:

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

### UNIT I CONCEPTS OF REMOTE SENSING AND SATELLITES 9

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

### UNIT II DATA PRODUCTS AND IMAGE ANALYSIS 9

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

### UNIT III CONCEPTS OF GIS 9

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

### UNIT IV DATA INPUT AND ANALYSIS 9

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

### UNIT V APPLICATION OF RS AND GIS 9

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

**TOTAL: 45 PERIODS**



**OUTCOME:**

- The students will be able to understand the concepts of bio energy sources and its applications.

**TEXTBOOKS:**

1. Rai G.D, Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
2. Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986

**REFERENCE:**

1. Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986.

**AI6711****GIS LABORATORY FOR AGRICULTURAL ENGINEERS****L T P C****0 0 3 2****OBJECTIVES:**

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

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

**TOTAL: 45 PERIODS****OUTCOME:**

- On completion of the lab course, the students will have adequate knowledge in application of RS and GIS in various fields of agricultural engineering.

**TEXTBOOKS**

1. Lillesand, T.M. and Kiefer, R.W. 2005. "Remote Sensing and Image Interpretation ", II edition. John Wiley & sons.
2. Heywood, I., Cornelius. S., Carver. S 2002. An Introduction to Geographical Information Systems. Addison Wesley Longman, New York.

**REFERENCES**

1. Floyd F.Sabins. 2005. "Remote Sensing: Principles and Interpretation", III edition. Freeman and Company New York.
2. Jensen, J.R., 2004. "Introductory Digital Image Processing: A Remote Sensing Perspective". Prentice – Hall. New Jersey.

**OBJECTIVES:**

- To introduce the various applications of bio energy
1. Characterisation of biomass
  2. Design of KVIC model / Deenbandhu mode biogas plant
  3. Purification of biogas – CO<sub>2</sub> and H<sub>2</sub>S removal
  4. Study on biogas appliances and utilization of biogas for engine running.
  5. Estimation of manurial value of biodigested slurry
  6. Estimation of BOD and COD
  7. Study on briquetting and Stoichiometric calculations
  8. Performance evaluation of agro residue gasifier
  9. Study on utilization of producer gas for engine running
  10. Study on pyrolysis plant
  11. Waste heat recovery calculation.
  12. Testing of solar water heater
  13. Design of rotor blade for horizontal axis wind mill

The lab includes visit to biomass power plant

**TOTAL: 45 PERIODS**

**OUTCOME:**

On completion of the lab course, the students will

- have adequate knowledge in different applications of biomass and their performance evaluation.
- be exposed to different non conventional energy sources and their applications

**TEXTBOOKS**

1. Chawla, O.P.1986. "Advances in Biogas Technology". ICAR Publication, New Delhi.
2. Rao. S and B.B. Parulekar. 2000. Energy Technology – Non conventional, Renewable and Conventional. Khanna Publishers, New Delhi.
3. Horlock JH, 1987. Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford Press.

**REFERENCES**

1. Khandelwal K.C. and Mahdi, S.S. 1986. Biogas Technology. Tata Mc Graw Hill Pub. Co. Ltd., New Delhi.
2. Srivastava, P.K., Shukla, B.D. and Ojha, T.P. 1993. Technology and application of biogas. Jain Brothers, New Delhi.
3. Mathur,A.N.and Rathore,N.S.1993.,Biogas production Management and Utilisation. Himanshu Publication. New Delhi.
4. Chakraverty, A. 1993. Biotechnology and other alternate technologies for utilisation of biomass. Oxford and IBH Publising Co., New Delhi.

**OBJECTIVE:**

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

**STRATEGY**

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

**TOTAL: 45 PERIODS**

**OBJECTIVES**

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

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

**OBJECTIVES:**

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

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

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

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

Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Ground water & Surface water)

**UNIT III SUSTAINABLE AGRICULTURE & ORGANIC FARMING****9**

Agro-ecosystems - Impact of climate change on Agriculture, Effect on crop yield, effect on Soil fertility – Food grain production at State Level – Indicators of Sustainable food availability – Indicators of food production sustenance – Natural farming principles – Sustainability in rainfed farming – organic farming – principles and practices.

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

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

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

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**TEXTBOOKS:**

1. M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.
2. B.K.Desai and Pujari, B.T. Sustainable Agriculture : A vision for future, New India Publishing Agency, New Delhi, 2007.

**REFERENCES:**

1. Swarna S.Vepa et al., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999.
3. Tanji, K. K., and Yaron, B. Management of water use in agriculture, Springer Verlag, Berlin, Germany, 1994.

**AI6811****PROJECT WORK**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>12</b>	<b>6</b>

**OBJECTIVES:**

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

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

**TOTAL: 180 PERIODS****OUTCOMES:**

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

**AI6001****PROTECTED CULTIVATION**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES**

- To impart knowledge on the protected cultivation of vegetables, fruits and flower crops.
- To sensitize the students on hi-tech production technology of fruits, vegetables and flower crops.



**OBJECTIVES:**

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

**UNIT I CONCEPTS OF AGRICULTURAL BUSINESS 9**

Agri-business - scope, characteristics, types. Management - importance, definition, management and administration, management thoughts, Small business - characteristics and stages of growth - Management functions - planning, organizing, leading.

**UNIT II AGRI – BUSINESS ORGANIZATION 9**

Principles, forms of agri-business organizations, staffing, directing, supervision and motivation. Controlling - types, performance evaluation and control techniques. Management approaches - Profit Centered Approach, Management by objectives and Quality Circles. Strength, Weakness, Opportunities and Threat (SWOT) Analysis.

**UNIT III AGRICULTURAL MARKETING 9**

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

**UNIT IV AGRICULTURAL BUSINESS FINANCE 9**

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

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

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

**TOTAL: 45 PERIODS****OUTCOME:**

- The students shall be exposed to various trends in agricultural business management.

**TEXTBOOKS:**

1. Himanshu, "Agri Business Management – Problems and prospects", Ritu Publications, Jaipur, 2005.
2. Smita Diwase, "Indian Agriculture and Agribusiness Management", Krishi resource Management Network, Pune 2004.

**REFERENCES:**

1. Chandra Prasanna, "Projects: Preparation, Appraisal, Budgeting and Implementation", Tata McGraw Hill Publications, New Delhi, 2001.
2. Kotler, P., "Marketing Management. Analysis, Planning and Control", Prentice Hall Inc., New York, 2001.
3. Rao, V.S.P., and Narayana, P.S., "Principles and Practices of Management", Konark Publishing Private Limited, New Delhi, 2001.
4. Tripathy, P.C., and Reddy, P.N., "Principles of Management", Tata McGraw Hill Publications, New Delhi, 2000.

**OBJECTIVES**

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

**UNIT I SYSTEM CONCEPTS****9**

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

**UNIT II LINEAR PROGRAMMING & DYNAMIC PROGRAMMING****9**

Introduction to operations research – Linear programming, problem formulation, graphical solution, solution by simplex method – Sensitivity analysis – application - Bellman's optimality criteria, problem formulation and solutions – application.

**UNIT III SIMULATION****9**

Basic principles and concepts – Random variate and random process – Monte Carlo techniques – Model development – Inputs and outputs – Deterministic and stochastic simulation – Irrigation Scheduling - application.

**UNIT IV NEURAL NETWORKS****9**

Neuron, Nerve structure and synapse, Artificial Neuron and its model, Neural network architecture: networks, Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory- Architecture: model, solution, single layer and multilayer perception model; back propagation learning methods, applications.

**UNIT V FUZZY LOGIC AND GENETIC ALGORITHM****9**

Basic concepts of fuzzy logic, Fuzzy set theory and operations, Properties of fuzzy sets, Membership functions, interference in fuzzy logic, Fuzzy implications and Fuzzy algorithms, Fuzzy Controller, Industrial applications.

Genetic Algorithm (GA) - Basic concepts, working principle, procedures, flow chart, Genetic representations, encoding, Initialization and selection, Genetic operators, Mutation - applications

**TOTAL: 45 PERIODS****OUTCOMES:**

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

**TEXTBOOKS**

1. Vedula, S., and Majumdar, P.P. Water Resources Systems – Modeling Techniques and Analysis Tata McGraw Hill, New Delhi, Fifth reprint, 2010.
2. Gupta, P.K., and Man Mohan, "Problems in Operations Research", (Methods and Solutions), Sultan Chand and Sons, New Delhi, 1995.
3. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.

**REFERENCES**

1. Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, New Delhi, 1997.
2. Taha, H.A., "Operations Research", McMillan Publication Co., New York, 1995.
3. Hiller, F.S., and Liebermann, G.J., "Operations Research", CBS Publications and Distributions, New Delhi, 1992.
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.

**OBJECTIVES**

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

**UNIT I EARTH'S CLIMATE SYSTEM 9**

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

**UNIT II ATMOSPHERE AND ITS COMPONENTS 9**

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

**UNIT III IMPACTS OF CLIMATE CHANGE 9**

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

**UNIT IV OBSERVED CHANGES AND ITS CAUSES 9**

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

**UNIT V CLIMATE CHANGE AND MITIGATION MEASURES 9**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

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

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

**TEXTBOOK**

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

**REFERENCES**

1. Adaptation and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge, 2006.
2. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006.
3. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

**OBJECTIVES:**

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

**UNIT I HUMAN VALUES 10**

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

**UNIT II ENGINEERING ETHICS 9**

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

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9**

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

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

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

**UNIT V GLOBAL ISSUES 8**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

**TEXTBOOKS:**

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

**REFERENCES:**

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

**Web sources:**

- [www.onlineethics.org](http://www.onlineethics.org)
- [www.nspe.org](http://www.nspe.org)
- [www.globalethics.org](http://www.globalethics.org)
- [www.ethics.org](http://www.ethics.org)

**OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS 9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

**TEXTBOOKS:**

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

**REFERENCES**

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

**GE6084****HUMAN RIGHTS****L T P C****3 0 0 3****OBJECTIVES :**

- To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I****9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

**UNIT II****9**

Evolution of the concept of Human Rights Magna carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

**UNIT III****9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

**UNIT IV****9**

Human Rights in India – Constitutional Provisions / Guarantees.

**UNIT V****9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL : 45 PERIODS****OUTCOME :**

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi

**OBJECTIVE:**

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

**UNIT I INTRODUCTION****9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

**UNIT II REGISTRATION OF IPRs****10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

**UNIT III AGREEMENTS AND LEGISLATIONS****10**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

**UNIT IV DIGITAL PRODUCTS AND LAW****9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

**UNIT V ENFORCEMENT OF IPRs****7**

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

**TOTAL:45 PERIODS****OUTCOME:**

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

**TEXT BOOKS**

- V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
- Intellectual Property Rights and Copy Rights, Ess Ess Publications.

**REFERENCES**

- Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
- Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
- Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

**OBJECTIVES:**

- This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology

**UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS****10+3**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method.



- UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING 9**  
Compressors – reciprocating & rotary (elementary treatment) – condensers – evaporators cooling towers. Refrigerants – Properties – selection of refrigerants, Alternative refrigerants, cycle controls.
- UNIT III PSYCHROMETRY 10**  
Psychrometric processes use of psychrometric charts – grand and room sensible heat factors – bypass factors – air washers, requirements of comfort air conditioning, summer and winter air conditioning.
- UNIT IV AIR CONDITIONING SYSTEMS 9**  
Cooling load calculation working principles of – centralized Air conditioning systems, split, ductable split, packaged air conditioning, VAV & VRV systems. Duct design by equal friction method, indoor air quality concepts.
- UNIT V UNCONVENTIONAL REFRIGERATION CYCLES 9**  
Vapor absorption systems – Ejector jet, steam jet refrigeration, thermo electric refrigeration. Applications: ice – plant – food storage plants – milk chilling plants.

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**TEXTBOOKS:**

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

**REFERENCES:**

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

**AI6006 STORAGE AND PACKAGING TECHNOLOGY L T P C**  
**3 0 0 3**

**OBJECTIVES:**

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

- UNIT I SPOILAGE AND STORAGE 9**  
Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses.
- UNIT II STORAGE METHODS 9**  
Improved storage methods for grain-modern storage structures-infestation-temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities
- UNIT III FUNCTIONS OF PACKAGING MATERIALS 9**  
Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials.

**UNIT IV FOOD PACKAGING MATERIALS AND TESTING 9**

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

**UNIT V SPECIAL PACKAGING TECHNIQUES 9**

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

**TOTAL: 45 PERIODS****OUTCOME:**

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

**TEXTBOOKS:**

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

**REFERENCES:**

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

**AI6007****SEED TECHNOLOGY APPLICATIONS****L T P C  
3 0 0 3****OBJECTIVES**

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

**UNIT I SEED CHARACTERS 9**

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

**UNIT II SEED PRODUCTION AND CERTIFICATION 9**

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

**UNIT III SEED PROCESSING AND TESTING 9**

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



**UNIT IV WATER CONSERVATION PRACTICES 9**

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

**UNIT V WATERSHED DEVELOPMENT PROGRAMME 9**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**TEXT BOOKS**

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

**REFERENCES**

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

**AI6009**

**MICRO IRRIGATION**

**L T P C  
3 0 0 3**

**OBJECTIVES**

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

**UNIT I WATER LIFTS AND PUMPS 8**

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

**UNIT II PUMP VALVES 7**

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

**UNIT III MICRO IRRIGATION CONCEPT AND APPLICATIONS 10**

Micro irrigation- Comparison between Traditional and Micro irrigation methods -Merits and demerits of micro-irrigation system, Types and components of micro irrigation system- Scope and potential problem of micro irrigation - Low cost Micro irrigation Technologies- Gravity fed micro

irrigation -Care and maintenance of micro-irrigation System- Economics of micro-irrigation system  
- Automation in micro-irrigation-Surge and cablegation irrigation- Greenhouse irrigation system.

**UNIT IV DRIP IRRIGATION DESIGN**

**10**

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

**UNIT V SPRINKLER IRRIGATION DESIGN**

**10**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

- After completion of the course, the students will have a thorough knowledge on micro irrigation, its concepts and design of a sprinkler and drip system

**TEXTBOOKS**

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

**REFERENCES**

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

**AI6010**

**ON FARM WATER MANAGEMENT**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I DESIGN OF IRRIGATION CHANNELS**

**9**

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

**UNIT II COMMAND AREA**

**9**

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

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

**9**

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

**UNIT IV WATER BALANCE 9**  
Groundwater balance model – Weekly water balance - Performance indicators – Adequacy, Dependability, Equity and efficiency – conjunctive use plan by optimization – Agricultural productivity indicators – Water use efficiency

**UNIT V SPECIAL TOPICS 9**  
National water policy - Institutional aspects - Socio-economic perspective- Reclamation of salt affected soils- Seepage loss in command area- Irrigation conflicts- Water productivity – Water pricing.

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**TEXTBOOK**

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

**REFERENCES:**

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

**AI6011 FARM POWER AND MACHINERY MANAGEMENT L T P C  
3 0 0 3**

**OBJECTIVES**

- To acquaint and equip with the latest design procedures of farm power and machinery systems.
- To provide sufficient knowledge of mechanization status in the country and management techniques for future requirements.

**UNIT I INTRODUCTION TO FARM POWER AND DESIGN CRITERIA 9**  
Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems - Reliability criteria in design and its application.

**UNIT II MACHINERY MANAGEMENT 9**  
Maintenance and scheduling of operations. Replacement of old machines, repair and maintenance of agricultural machinery, inventory control of spare parts, work study, productivity, method study. First order Markov chains and their applications in sales forecasting and in problems of inventory control and modeling of workshop processes and quality control.

**UNIT III SYSTEMS APPROACH 9**  
System approach in farm machinery management and application of programming techniques to the problems of farm power and machinery selection.

**UNIT IV PLANNING OF MACHINERY 9**

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

**UNIT V ECONOMIC ANALYSIS**

**9**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The students will be able to understand the concepts of bio energy sources and its applications.

**TEXTBOOKS**

1. Bainer, R. Kepner, R.A. and Barger, E.L. 1978. Principles of farm machinery. John Wiley and Sons. New York.
2. Liljedahl, B: Tumquist, PK: Smith, DW; and Hoki, M. 1989. Tractor and its Power Units. Van Nostrand Reinhold
3. Culpin, C. 1978. Farm Machinery. Granada Publishing Ltd., London.
4. Kepner, R.A., Bainer, R. and Barger, E.L. 1987. Principles of Farm Machinery. C.S.B. Publishers and distributors, New Delhi.
5. Smith, H.P. and Wilkes, L.H. 1979. Farm Machinery and Equipment. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

**AI6012**

**MECHANICS OF TILLAGE AND TRACTION**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I MECHANICS OF TILLAGE**

**9**

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

**UNIT II DYNAMICSOFTILLAGE**

**9**

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

**UNIT III TRACTION**

**9**

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

**UNIT IV TYRES**

**9**

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

**UNIT V APPLICATIONS**

**9**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

## TEXTBOOKS

1. Klenin, N.L.; Popov, I.F. and V.A. Sakum, (1985). Agricultural machines. Amerind Pub. Co. NewYork
2. J. B. Liljedahl, P. K. Turnquist, D. W. Smith, & M. Hoki , 1996. Tractors and their power units. Fourth ed. American Society of Agricultural Engineers, ASAE
3. Kepner, R. A., Roy Bainer and E. L. Barger. 1978. Principles of farm machinery. Third edition; AVI Publishing Company Inc: Westport, Connecticut.

## REFERENCES

1. Ralph Alcock.1986. Tractor Implements System. AVI Publ.
2. S. C. Jain, Farm Machinery- An Approach

**AI6013**

**SPECIAL FARM EQUIPMENT**

**L T P C**

**3 0 0 3**

### OBJECTIVES:

- To study the special machineries used for agricultural applications

### UNIT I WEEDING EQUIPMENT

**9**

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

### UNIT II SPRAYERS AND DUSTERS

**9**

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

### UNIT III MOWERS AND HARVESTERS

**9**

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

### UNIT IV THRESHERS AND OTHER MACHINERIES

**9**

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

### UNIT V SPECIALIZED FARM EQUIPMENT

**9**

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

**TOTAL: 45 PERIODS**

### OUTCOME:

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

## TEXTBOOKS

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

## **REFERENCES**

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