

# **AGRICULTURE ENGINEERING SEMESTER - I**

## **ENGG. MATHEMATICS-I**

Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordan method to find inverse of a matrix, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalisation of matrices, quadratic forms. PAQ form, Echelon form, Solution of linear equations, nature of rank, using Cayley-Hamilton theorem to find inverse of A. Differential calculus: Taylor's and Maclaurin's expansions; indeterminate form; curvature, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, maxima and minima. Integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration, application of double and triple integrals to find area and volume. Vector calculus: Differentiation of vectors, scalar and vector point functions, vector differential operator  $\text{Del}$ , Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, identities involving  $\text{Del}$ , second order differential operator; line, surface and volume integrals, Stoke's, divergence and Green's theorems (without proofs).

### **Suggested Readings**

Narayan Shanti. 2004. Differential Calculus. S. Chand and Co. Ltd. New Delhi.

Narayan Shanti. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.

Grewal B S. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.

Narayan Shanti. 2004. A Text Book of Vector. S. Chand and Co. Ltd. New Delhi.

# Engineering Physics

**Theory** Dia, Para and ferromagnetism-classification. Langevin theory of dia and paramagnetism. Adiabatic demagnetization. Weiss molecular field theory and ferromagnetism. Curie-Weiss law. Wave particle quality, de-Broglie concept, uncertainty principle. Wave function. Time dependent and time independent Schrodinger wave equation, Qualitative explanation of Zeeman effect, Stark effect and Paschan Back effect, Raman spectroscopy. Statement of Bloch's function. Bands in solids, velocity of Bloch's electron and effective mass. Distinction between metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, law of mass action. Determination of energy gap in semiconductors. Donors and acceptor levels. Superconductivity, critical magnetic field. Meissner effect. Isotope effect. Type-I and II superconductors, Josephson's effect DC and AC, Squids. Introduction to high Tc superconductors. Spontaneous and stimulated emission, Einstein A and B coefficients. Population inversion, He-Ne and Ruby lasers. Ammonia and Ruby masers, Holography-Note. Optical fiber. Physical structure. basic theory. Mode type, input output characteristics of optical fiber and applications. Illumination: laws of illumination, luminous flux, luminous intensity, candle power, brightness.

## Practical

To find the frequency of A.C. supply using an electrical vibrator; To find the low resistance using Carey Foster bridge without calibrating the bridge wire; To determine dielectric constant of material using De Sauty's bridge; To determine the value of specific charge ( $e/m$ ) for electrons by helical method; To study the induced e.m.f. as a function of velocity of the magnet; To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities; To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil; To determine the energy band gap in a semiconductor using a p-n Junction diode; To determine the slit width from Fraunhofer diffraction pattern using laser beam; To find the numerical aperture of optical fiber: To set up the fiber optic analog and digital link; To study the phase relationships in L.R. circuit; To study LCR circuit; To study the variations of thermo emf of a copper-constantan thermo-couple with temperature; To find the wave length of light by prism.

# Principles of Soil Science

## Theory

Nature and origin of soil; soil forming rocks and minerals, their classification and composition, soil forming processes, classification of soils – soil taxonomy orders; important soil physical properties; and their importance; soil particle distribution; soil inorganic colloids – their composition, properties and origin of charge; ion exchange in soil and nutrient availability; soil organic matter – its composition and decomposition, effect on soil fertility; soil reaction – acidic, saline and sodic soils; quality of irrigation water; essential plant nutrients – their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils. Use of saline and sodic water for crop production.

## Practical

Identification of rocks and minerals; Examination of soil profile in the field; Collection of Soil Sample; Determination of bulk density; particle density and porosity of soil; Determination of organic carbon of soil; Determination of Nitrogen, Determination of Phosphorus and Determination of Potassium; Identification of nutrient deficiency symptoms of crops in the field; Determination of gypsum requirement of sodic soils; Determination of water quality parameters.

## Suggested Readings

Brady Nyle C and Ray R Well. 2002. Nature and properties of soils. Pearson Education Inc., New Delhi.

Indian Society of Soil Science. 1998. Fundamentals of Soil Science. IARI, New Delhi.

Sehgal J.. A. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.

Hillel D. 1982. Introduction to Soil Physics. Academic Press, London.

# Workshop Technology and Practice

## Theory

Timber, Various methods of conversion of timber, hard wood and soft wood, Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Casting processes; Classification, constructional details of center lathe, Main accessories and attachments. Main operations and tools used on center lathes. Types of drilling machines. Constructional details of pillar types and radial drilling machines. Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Main operations on milling machine.

## Practical

Preparation of simple joints: Cross half Lap joint and T-Halving joint; Preparation of Dovetail joint, Mortise and tenon joint; Jobs on Bending, shaping etc.; Jobs on Drawing, Punching, Rivetting. Introduction to tools and measuring instruments for fitting; Jobs on sawing, filing and right angle fitting of MS Flat; Practical in more complex fitting job; Operations of drilling, reaming, and threading with tap and dies; Introduction to tools and operations in sheet metal work; Making different types of sheet metal joints using G.I. sheets. Introduction to welding equipment, processes tools, their use and precautions; Jobs on ARC welding – Lap joint, butt joint; T-Joint and corner joint in Arc welding; Gas welding Practice – Lab, butt and T-Joints; Introduction to metal casting equipment, tools and their use; Mould making using one-piece pattern and two pieces pattern; Demonstration of mould making using sweep pattern, and match plate patterns; Introduction to machine shop machines and tools; Demonstration on Processes in machining and use of measuring instruments; Practical jobs on simple turning, step turning; Practical job on taper turning, drilling and threading; Operations on shaper and planer, changing a round MS rod into square section on a shaper; Demonstration of important operations on a milling machine, making a plot, gear tooth forming and indexing; Any additional job.

## Suggested Readings

Hazra, Choudari S K and Bose S K. 1982. Elements of Workshop technology (Vol. I and II). Media Promoters and Publishers Pvt. Ltd., Mumbai.

Chapman W A J. 1989. Workshop Technology ( Part I and II). Arnold Publishers (India) Pvt. Ltd., AB/9 Safdarjung Enclave, New Delhi.

Raghuwamsi B S. 1996. A Course in Workshop Technology (Vol. I and II). Dhanpat Rai and Sons, 1682 Nai Darak, New Delhi.

# Environmental Science and Disaster Management

## Theory

**Environmental Studies:** Scope and importance. Natural Resources: Renewable and nonrenewable resources Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) 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. Ecosystems: Concept, Structure, function, Producers, consumers, decomposers, Energy flow, ecological succession, food chains, food webs, ecological pyramids. Introduction, types, characteristic features, structure and function of the forest, grassland, desert and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and bio-geographical 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. Environmental Pollution: definition, cause, effects and control measures of a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Social Issues and the Environment from Unsustainable to Sustainable development, Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

**Disaster Management:** Natural Disasters and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

## Suggested Readings

Bharucha Erach. 2005. Text Book of Environmental Studies for Undergraduate Courses. University Grants Commission, University Press, Hyderabad.

# Communication Skills and Personality Development

## Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

## Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations.

## Suggested Readings

- Balasubramanian T. 1989. A Text book of Phonetics for Indian Students. Orient Longman, New Delhi.
- Balasubrmanyam M. 1985. Business Communication. Vani Educational Books, New Delhi.
- Naterop, Jean, B. and Rod Revell. 1997. Telephoning in English. Cambridge University Press, Cambridge.
- Mohan Krishna and Meera Banerjee. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
- Krishnaswamy, N and Sriraman, T. 1995. Current English for Colleges. Macmillan India Ltd. Madras.
- Narayanaswamy V R. 1979. Strengthen your writing. Orient Longman, New Delhi.
- Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill publishing Company, New Delhi.

# Engineering Drawing

## Practical

Introduction of drawing scales; First and third angle methods of projection. Principles of orthographic projections; Reference planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines; Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids. Preparation of working drawing from models and isometric views. Drawing of missing views. Different methods of dimensioning. Concept of sectioning. Revolved and oblique sections. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints. Nomenclature, thread profiles, multi start threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts. Forms of screw threads, representation of threads, Bolts- headed centre, stud screws, set screws, butt, hexagonal and square; keys-types, taper, rank taper, hollow saddle etc.

## Suggested Readings

Bhat N D. 2010. Elementary Engineering Drawing. Charotar Publishing House Pvt. Ltd., Anand.

Bhatt N D and Panchal V M. 2013. Machine Drawing. Charotar Publishing House Pvt. Ltd., Anand.

Narayana K L and Kannaiah P. 2010. Machine Drawing. Scitech Publications (India) Pvt. Ltd., Chennai.

# AGRICULTURE ENGINEERING

## SEMESTER - II

### Engineering Mathematics – II

Ordinary differential equations: Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation, Differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel's and Legendre's differential equations. Functions of a Complex variable: Limit, continuity and analytic function, Cauchy-Riemann equations, Harmonic functions. Infinite series and its convergence, periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series, Harmonic analysis. Fourier Sine and Cosine Series, Fourier series for function having period  $2L$ , Elimination of one and two arbitrary function. Partial differential equations: Formation of partial differential equations Higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, application of partial differential equations (one dimensional wave and heat flow equations, Laplace Equation).

#### Suggested Readings

- Narayan Shanti. 2004. A Text Book of Matrices. S. Chand and Co. Ltd. New Delhi.
- Grewal B S. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
- Ramana B V. 2008. Engineering Mathematics. Tata McGraw-Hill. New Delhi.



# Engineering Chemistry

## Theory

Phase rule and its application to one and two component systems. Fuels: classification. calorific value. Colloids: classification. properties. Corrosion: causes. types and method of prevention. Water: temporary and permanent hardness. disadvantages of hard water, scale and sludge formation in boilers, boiler corrosion. Analytical methods like thermo-gravimetric. polarographic analysis. nuclear radiation. detectors and analytical applications of radioactive materials. Enzymes and their use in the manufacturing of ethanol and acetic acid by fermentation methods. Principles of food chemistry. Introduction to lipids, proteins, carbohydrates, vitamins, food preservatives, colouring and flavouring reagents of food. Lubricants: properties. mechanism. classification and tests. Polymers. types of polymerization. properties. uses and methods for the determination of molecular weight of polymers. Introduction to IR spectroscopy.

## Practical

Determination of temporary and permanent hardness of water by EDTA method: Estimation of chloride in water: Estimation of dissolved oxygen in water: Determination of BOD in water sample: Determination of COD in water sample: Estimation of available chlorine in bleaching powder: Determination of viscosity of oil: Estimation of activity of water sample: Estimation of alkalinity of water sample: Determination of carbonate and non-carbonate hardness by soda reagent: Determination of coagulation of water and chloride ion content: Determination of specific rotation of an optically active compound: Determination of  $X_{\text{max}}$  and verification of Beer Lambert Law: Determination of calorific value of fuel: Identification of functional groups (alcohol, aldehyde, ketones, carboxylic acid and amide) by IR: Chromatographic analysis: Determination of molar refraction of organic compounds.

## Suggested Readings

Jain P L and Jain M. 1994. Engineering Chemistry. Danpat Rai publishing company Pvt. Ltd., Delhi.  
Bahl B S, Arun Bahl and Tuli B D. 2007. Essentials of Physical Chemistry. S. Chand and Co. Ltd., Delhi.

# Engineering Mechanics

## Theory

Basic concepts of Engineering Mechanics. Force systems, Centroid, Moment of inertia, Free body diagram and equilibrium of forces. Frictional forces Analysis of simple framed structures using methods of joints, methods of sections and graphical method. Simple stresses. Shear force and bending moment diagrams. Stresses in beams. Torsion. Analysis of plane and complex stresses, Torsion of Shafts, Shear Stresses, Bending Stresses.

## Practical

Problems on composition and resolution of forces, moments of a force, couples, transmission of a couple, resolution of a force into a force & a couple; Problems relating to resultant of; Coplaner force system, collinear force system, concurrent force system, co-planer concurrent force system, co-planer non-concurrent force system, Non-coplaner concurrent force system, Non-coplaner non-concurrent force system, system of couples in space; Problems relating to centroids of composite areas; Problems on moment of inertia, polar moment of inertia, radius of gyration, polar radius of gyration of composite areas; Equilibrium of concurrent – co-planer and non concurrent – co-planer force systems; Problems involving frictional forces; Analysis of simple trusses by method of joints and method of sections; Analysis of simple trusses by graphical method; Problems relating to simple stresses and strains; Problems on shear force and bending moment diagrams; Problems relating to stresses in beams; Problems on torsion of shafts; Analysis of plane and complex stresses.

## References

Sundarajan V 2002. Engineering Mechanics and Dynamics. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Timoshenko S and Young D H 2003. Engineering Mechanics. McGraw Hill Book Co., New Delhi.

Prasad I B 2004. Applied Mechanics. Khanna Publishers, New Delhi.

Prasad I B 2004. Applied Mechanics and Strength of Materials. Khanna Publishers, New Delhi.

Bansal R K 2005. A Text Book of Engineering Mechanics. Laxmi Publishers, New Delhi.

# Surveying and Levelling

## Theory

Surveying: Introduction, classification and basic principles, Linear measurements. Chain surveying. Cross staff survey, Compass survey. Planimeter, Errors in measurements, their elimination and correction. Plane table surveying. Levelling, Leveling difficulties and error in leveling, Contouring, Computation of area and volume. Theodolite traversing. Introduction to setting of curves. Total station, Electronic Theodolite. Introduction to GPS survey

## Practical

Chain survey of an area and preparation of map; Compass survey of an area and plotting of compass survey; Plane table surveying; Levelling. L section and X sections and its plotting; Contour survey of an area and preparation of contour map; Introduction of software in drawing contour; Theodolite surveying; Ranging by Theodolite, Height of object by using Theodolite; Setting out curves by Theodolite; Minor instruments. Use of total station.

## References

Punmia, B C 1987. Surveying (Vol.I). Laxmi Publications, New Delhi.

Arora K R 1990. Surveying(Vol.I), Standard Book House, Delhi.

Kanetkar T P 1993. Surveying and Levelling. Pune Vidyarthi Griha, Prakashan, Pune.

# Thermodynamics, Refrigeration and Air Conditioning

## Theory

Thermodynamics properties, closed and open system, flow and non-flow processes, gas laws, laws of thermodynamics, internal energy. Application of first law in heating and expansion of gases in non-flow processes. First law applied to steady flow processes. Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, change of entropy of gases in thermodynamics process. Otto, diesel and dual cycles. Principles of refrigeration, - units, terminology, production of low temperatures, air refrigerators working on reverse Carnot cycle and Bell Coleman cycle. Vapour refrigeration-mechanism, P-V,P-S,P-H diagrams, vapor compression cycles, dry and wet compression, super cooling and sub cooling. Vapour absorption refrigeration system. Common refrigerants and their properties. Design calculations for refrigeration system. Cold storage plants. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process. Air conditioning – principles –Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods, fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling load calculations, types of air conditioners – applications.

## Practical

Tutorials on thermodynamic air cycles, Study and application of P V and T S chart in refrigeration, P H chart (or) Mollier diagram in refrigeration, Numerical on air refrigeration cycle systems, Numerical on vapour compression cycle refrigeration system, Study of domestic water cooler, Study of domestic household refrigerator, Study of absorption type solar refrigeration system, Study cold storage for fruit and vegetables, Freezing load and time calculations for food materials, Determination of refrigeration parameters using refrigeration tutor – II, Numerical on design of air conditioning systems, Study of window air conditioner, Study on repair and maintenance of refrigeration and air-conditioning systems. Visit to chilling or ice making and cold storage plants.

## Suggested Readings

- Kothandaraman C P Khajuria P R and Arora S C. 1992. A Course in Thermodynamics and Heat Engines. Dhanpat Rai and Sons, 1682 Nai Sarak, New Delhi.
- Khurmi R S. 1992. Engineering Thermodynamics. S Chand and Co. Ltd., Ram Nagar, New Delhi.
- Mathur M L and Mehta F S. 1992. Thermodynamics and Heat Power Engineering. Dhanpat Rai and Sons 1682 Nai Sarak, New Delhi.
- Ballney P. L. 1994. Thermal Engineering. Khanna Publishers, New Delhi.
- Nag P K. 1995. Engineering Thermodynamics. Tata McGraw Hill Publishing Co.Ltd., 12/4 Asaf Ali Raod, New Delhi.

# **Principles of Agronomy**

Introduction and scope of agronomy. Classification of crops, Effect of different weather parameters on crop growth and development. Principles of tillage, tith and its characteristics. Crop seasons. Methods, time and depth of sowing of major field crops. Methods and time of application of manures and fertilizers. Organic farming-Sustainable agriculture. Soil water plant relationship, crop coefficients, water requirement of crops and critical stages for irrigation, weeds and their control, crop rotation, cropping systems, Relay cropping and mixed cropping.

## **Suggested Readings**

William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York.

Arnon L. 1972. Crop Production in Dry Regions. Leonard Hill Publishing Co. London.

Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.

Gupta O P. 1984. Scientific Weed Management in the Tropics and Sub- Tropics. Today and Tomorrow's Printers and Publishers. New Delhi.

Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.

Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers Ludhiana.

# AGRICULTURE ENGINEERING

## SEMESTER - III

### Engineering Mathematics – III

Numerical analysis and Laplace transformation: finite difference, various difference operators and their relationships. factorial notation, interpolation with equal intervals. Newton's forward and backward interpolation formula. Bessel's and Stirling's difference interpolation formulae. Interpolation with unequal intervals. Newton's divided difference formula. Lagrange's interpolation formula. numerical differentiations, numerical integrations, difference equations and their solutions, numerical solutions of ordinary differential equations by Picard's method and Taylor's series. Fuller's and modified Fuller's methods. Runge-Kutta method; Laplace transformation and its applications to the solutions of ordinary and simultaneous differential equations. Testing of Hypothesis-Level of Significance-Degrees of freedom-Statistical errors, Large sample test (Z-test), Small sample test t-test (One tailed, two tailed and Paired tests), Testing of Significance through variance (F-test), Chi -Square test, contingency table, Correlation, Regression.

#### **Suggested Readings**

Chandel SRS. A Hand book of Agricultural Statistics. Achal Prakash Masndir, Kanpur.  
Agrawal B L. Basic Statistics. Wiley Eastern Ltd. New Age International Ltd.  
Nageswara Rao G. Statistics for Agricultural Sciences. BS Publications.  
Rangaswamy R. A Text Book of Agricultural Statistics. New Age Int. publications Ltd.  
Gupta S.C. Fundamental Applied Statistics.

# **Principles of Horticultural Crops and Plant Protection**

## **Theory**

Scope of horticultural. Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties, Criteria for site selection, layout and planting methods, nursery raising, commercial varieties/hybrids, sowing and planting times and methods, treatment for vegetable crops; macro and micro propagation methods, plant growing structures, pruning and training fertilizer application, fertigation, irrigation methods, harvesting, grading and packaging, post harvest practices, Garden tools, management of orchard, Extraction and storage of vegetables seeds. Layout of lawns and kitchen gardens. Preparation of different fruits and vegetable products.

## **Practical**

Judging maturity time for harvesting of crop; Study of seed viability and germination test; Identification and description of important fruits, flowers and vegetable crops; Study of different garden tools; Preparation of nursery bed; Practices of pruning and training in some important fruit crops, visit to commercial greenhouse/ polyhouse; cultural operations for vegetable crops (sowing, fertilizer application, mulching, irrigation and weed control); seed extraction techniques; identification of important pests and diseases and their control.

## **Suggested Readings**

Bansal. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi.  
Saraswathy, S., T.L. Preethi, S. Balasubramanyan, J. Suresh, N. Revathy and S. Natarajan. 2007. Postharvest management of Horticultural Crops. Agrobios Publishers, Jodhpur.  
Arjunan, G., Karthikeyan, G, Dinakaran, D. and Raguchander, T. 1999. Diseases of Horticultural Crops. AE Publications, Coimbatore.  
Sharma Neeta and Mashkoo Alam. 1997. Postharvest diseases of Horticultural crops. International Book publishing Co. UP.

# Web Designing and Internet Applications

## Theory

Basic principles in developing a web designing, Planning process, Five Golden rules of web designing, Designing navigation bar, Page design, Home Page Layout, Design Concept. Basics in Web Design, Brief History of Internet, World Wide Web , creation of a web site, Web Standards, Audience requirement. Introduction to Java Script, variables & functions, Working with alert, confirm and prompt, Connectivity of Web pages with databases; Project.

## Practical

FLASH: Animation concept FPS, Understanding animation for web, Flash interface, Working with tools, DREAM WEAVER :Exploring Dreamweaver Interface, Planning & Setting Web Site Structure, Working with panels, Understanding and switching views, Using property inspector, Formatting text, JAVA SCRIPT: Working with alert, confirm and prompt, Understanding loop, arrays, Creating rollover image, Working with operator, GIF ANIMATION: Learning to use FTP Setting FTP, Uploading of site, Using Control panel, FTP UPLOADING SITE: Understanding gif animation interface, Knowing Gif file format, Creating basic web banners, Creating web banners with effects, Creating animated web buttons.

## Suggested Readings

Jennifer Niederst Robbins. Developing web design latest edition.

Frain and Ben. Responsive Web Design with HTML5.

Nicholas c.Zakas. Java Script for Web Developers.

George Q. Huang, K. L Mak. Internet Applications in Product Design and Manufacturing.



# Strength of Materials

## Theory

Slope and deflection of beams using integration techniques, moment area theorems and conjugate beam method. Columns and Struts. Riveted and welded connections. Stability of masonry dams. Analysis of statically indeterminate beams. Propped beams. Fixed and continuous beam analysis using superposition, three moment equation and moment distribution methods.

## References

Khurmi R.S. 2001. Strength of Materials S. Chand & Co., Ltd., New Delhi.

Junarkar S.B. 2001. Mechanics of Structures (Vo-I). Choratar Publishing House, Anand.

Ramamrutham S. 2003. Strengths of Materials. Dhanpat Rai and Sons, Nai Sarak, New Delhi.

# Heat and Mass Transfer

Concept, modes of heat transfer, thermal conductivity of materials, measurement. General differential equation of conduction. One dimensional steady state conduction through plane and composite walls, tubes and spheres with and without heat generation. Electrical analogy. Insulation materials. Fins, Free and forced convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Useful non dimensional numbers. Equation of laminar boundary layer on flat plate and in a tube. Laminar forced convection on a flat plate and in a tube. Combined free and forced convection. Introduction. Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, grey bodies and emissive power, solid angle, intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection and radiation by networks. Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Flick's law, mass transfer coefficients. Reynold's analogy.

## Suggested Readings

Geankoplis C.J. 1978. Transport Port Processes and Unit Operations. Allyn and Bacon Inc., Newton, Massachusetts.

Holman J P. 1989. Heat Transfer. McGraw Hill Book Co., New Delhi.

Incropera F P and De Witt D P. 1980. Fundamentals of Heat and Mass Transfer. John Wiley and Sons, New York.

Gupta C P and Prakash R. 1994. Engineering Heat Transfer. Nem Chand and Bros., Roorkee.

## Electrical Machines and Power Utilization

## **Theory**

Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses, Transformer: principle of working, construction of single phase transformer, EMF equation, phasor diagram on load, leakage reactance, voltage regulation, power and energy efficiency, open circuit and short circuit tests, principles, operation and performance of DC machine (generator and motor), EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics, DC motor characteristics, starting of shunt and series motor, starters, speed control methods-field and armature control, polyphase induction motor: construction, operation, phasor diagram, effect of rotor resistance, torque equation, starting and speed control methods, single phase induction motor: double field revolving theory, equivalent circuit, characteristics, phase split, shaded pole motors, various methods of three phase power measurement; power factor, reactive and apparent power, Concept and analysis of balanced poly-phase circuits; Series and parallel resonance.

## **Practical**

To obtain load characteristics of d.c. shunt/series /compound generator; To study characteristics of DC shunt/ series motors; To study d.c. motor starters; To Perform load-test on 3 ph. induction motor & to plot torque V/S speed characteristics; To perform no-load & blocked –rotor tests on 3 ph. Induction motor to obtain equivalent ckt. parameters & to draw circle diagram; To study the speed control of 3 ph. induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor; To study star- delta starters physically and (a) to draw electrical connection diagram (b) to start the 3 ph. induction motor using it. (c) to reverse the direction of 3 ph. I.M.; To start a 3-phase slip –ring induction motor by inserting different levels of resistance in the rotor ckt. and to plot torque –speed characteristics; To perform no load & blocked –rotor test on 1 ph. induction motor & to determine the parameters of equivalent ckt. drawn on the basis of double revolving field theory; To perform load –test on 1 ph. induction motor & plot torque –speed characteristics; To study power consumed in a three-phase circuit; Two lights in series controlled by one switch; Two lights in parallel controlled by one switch.

## **Suggested Readings**

Thareja B L & Theraja AK. 2005. A text book of Electrical Technology. Vol. I S. Chand & Company LTD., New Delhi.

Theraja B L & Theraja AK 2005. A text book of Electrical Technology. Vol. II S.Chand & Company LTD., New Delhi.

Vincent Del Toro. 2000. Electrical Engineering Fundamentals. Prentice-Hall of India Private LTD., New Delhi.

Anwani M L. 1997. Basic Electrical Engineering. Dhanpat Rai & Co.(P) LTD. New Delhi.

# AGRICULTURE ENGINEERING

## SEMESTER - IV

### Entrepreneurship Development and Business Management

Entrepreneurship, management – Management functions – planning- Organizing -Directing – motivation – ordering – leading – supervision-Communication and control – Capital – Financial management – importance of financial statements – balance sheet – profit and loss statement, Analysis of financial statements – liquidity ratios – leverage ratios, Coverage ratios – turnover ratios – profitability ratios, Agro-based industries – Project – project cycle – Project appraisal and evaluation techniques – undiscounted measures – payback period – proceeds per rupee of outlay, Discounted measures – Net Present Value (NPV) – Benefit-Cost Ratio (BCR) – Internal Rate of Return (IRR) – Net benefit investment ratio (N / K ratio) – sensitivity analysis-Importance of agribusiness in Indian economy International trade-WTO agreements – Provisions related to agreements in agricultural and food commodities. Agreements on agriculture (AOA) – Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS). Development (ED): Concept of entrepreneur and entrepreneurship Assessing overall business environment in Indian economy– Entrepreneurial and managerial characteristics- Entrepreneurship development Programmes (EDP)- Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment- Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political systems and their implications for decision making by individual entrepreneurs- Economic system and its implications for decision making by individual entrepreneurs- Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotion of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract farming (CF) and joint ventures (JV), public-private partnerships (PPP)- Overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

#### Suggested Readings

Harsh, S.B., Conner, U.J. and Schwab, G.D. 1981. Management of the Farm Business. Prentice Hall Inc., New Jersey.

Joseph, L. Massie. 1995. Essentials of Management. Prentice Hall of India Pvt. Ltd., New Delhi.

Omri Rawlins, N. 1980. Introduction to Agribusiness. Prentice Hall Inc., New Jersey

Gittenger Price, J. 1989. Economic Analysis of Agricultural Projects. John Hopkins University, Press, London.

Thomas W Zimmer and Norman M Scarborough. 1996. Entrepreneurship. Prentice-Hall, New Jersey.

Mark J Dollinger. 1999. Entrepreneurship Strategies and Resources. Prentice-Hall, Upper Saddal Rover, New Jersey.

Khanka S S. 1999. Entrepreneurial Development. S. Chand and Co. New Delhi.

Mohanty S K. 2007. Fundamentals of Entrepreneurship. Prentice Hall India Ltd., New Delhi.

# Fluid Mechanics and Open Channel Hydraulics

## Theory

Properties of fluids: Ideal and real fluid. Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, centre of pressure, buoyancy, meta centre and meta centric height, condition of floatation and stability of submerged and floating bodies; Kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flow net. Types of fluid flow, translation, rotation, circulation and vorticity, Vortex motion; Dynamics of fluid flow, Bernoulli's theorem, venturimeter, orifice meter and nozzle, siphon; Laminar flow: Stress strain relationships, flow between infinite parallel plates both plates fixed, one plate moving, discharge, average velocity; Laminar and turbulent flow in pipes, general equation for head loss Darcy, Equation, Moody's diagram, Minor and major hydraulic losses through pipes and fittings, flow through network of pipes, hydraulic gradient and energy gradient; Flow through orifices (Measurement of Discharge, Measurement of Time), Flow through Mouthpieces, Flow over Notches, Flow over weirs, Chezy's formula for loss of head in pipes, Flow through simple and compound pipes, Open channel design and hydraulics: Chezy's formula, Bazin's formula, Kutter's Manning's formula, Velocity and Pressure profiles in open channels, Hydraulic jump; Dimensional analysis and similitude: Rayleigh's method and Buckingham's 'Pi' theorem, types of similarities, dimensional analysis, dimensionless numbers. Introduction to fluid machinery.

## Practical

Study of manometers and pressure gauges; Verification of Bernoulli's theorem; Determination of coefficient of discharge of venturi-meter and orifice meter; Determination of coefficient of friction in pipeline; Determination of coefficient of discharge for rectangular and triangular notch; Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice; Determination of coefficient of discharge for mouth piece; Measurement of force exerted by water jets on flat and hemispherical vanes; Determination of meta-centric height; Determination of efficiency of hydraulic ram; Performance evaluation of Pelton and Francis turbine; Study of current meter; Velocity distribution in open channels and determination of Manning's coefficient of rugosity.

## Suggested Readings

Khurmi, R .S. 1970. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines S. Chand & Company Limited, New Delhi.  
Modi P M and Seth S.M.1973. Hydraulics and Fluid Mechanics. Standard Book House, Delhi.  
Chow V T 1983. Open Channel Hydraulics. McGraw Hill Book Co., New Delhi.  
LalJagadish 1985. Fluid Mechanics and Hydraulics. Metropolitan Book Co.Pvt. Ltd., New Delhi.

# Soil Mechanics

## Theory

Introduction of soil mechanics, field of soil mechanics, phase diagram, physical and index properties of soil, classification of soils, effective and neutral stress, elementary concept of Boussinesq and Westergaard's analysis, Seepage Analysis; Shear strength, Mohr stress circle, theoretical relationship between principal stress circle, theoretical relationship between principal stress, Mohr-Coulomb failure theory, effective stress principle. Determination of shear parameters by direct shear test, triaxial test & vane shear test. simple Numerical exercise . Compaction, composition of soils standard and modified proctor test, abbot compaction and Jodhpur mini compaction test field compaction method and control. Consolidation of soil: Consolidation of soils, one dimensional consolidation spring analogy, Terzaghi's theory, Laboratory consolidation test, calculation of void ratio and coefficient of volume change, Taylor's test. determination of coefficient of consolidation. Earth pressure: plastic equilibrium in soils, active and passive states, Rankine's theory of earth pressure, active and passive earth pressure for cohesive soils, simple numerical exercises. Stability of slopes: introduction to stability analysis of infinite and finite slopes friction circle method, Taylor's stability number.

## Practical

Determination of water content of soil; Determination of specific gravity of soil; Determination of field density of soil by core cutter method; Determination of field density by sand replacement method; Grain size analysis by sieving (Dry sieve analysis); Grain size analysis by hydrometer method; Determination of liquid limit by Casagrande's method; Determination of liquid limit by cone penetrometer and plastic limit; Determination of shrinkage limit; Determination of permeability by constant head method; Determination of permeability by variable head method; Determination of compaction properties by standard proctor test; Determination of shear parameters by Direct shear test; Determination of unconfined compressive strength of soil; Determination of shear parameters by Tri-axial test; Determination of consolidation properties of soils.

## Suggested Readings

Punmia B C, Jain A K and Jain A K. 2005. Soil Mechanics and Foundations. Laxmi Publications (P) Ltd. New Delhi.

Ranjan Gopal and Rao A S R. 1993. Basic and Applied Soil Mechanics. Welley Easters Ltd., New Delhi.

Singh Alam. 1994. Soil Engineering Vol. I. CBS Publishers and Distributions, Delhi.

# Auto CAD Applications

## Practical

Application of computers for design. CAD- Overview of CAD window – Explanation of various options on drawing screen. Study of draw and dimension tool bar. Practice on draw and dimension tool bar. Study of OSNAP, line thickness and format tool bar. Practice on OSNAP, line thickness and format tool bar. Practice on mirror, offset and array commands. Practice on trim, extend, chamfer and fillet commands. Practice on copy, move, scale and rotate commands. Drawing of 2 D- drawing using draw tool bar. Practice on creating boundary, region, hatch and gradient commands. Practice on Editing polyline- PEDIT and Explode commands. Setting of view ports for sketched drawings. Printing of selected view ports in various paper sizes. 2D drawing of machine parts with all dimensions and allowances- Foot step bearing and knuckle joint. Sectioning of foot step bearing and stuffing box. Drawing of hexagonal, nut and bolt and other machine parts. Practice on 3-D commands- Extrusion and loft. Practice on 3-D commands on sweep and press pull. Practice on 3-D Commands- revolving and joining. Demonstration on CNC machine and simple problems.

## Suggested Readings

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

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

Zeid Ibrahim. 2011. Mastering CAD/CAM with Engineering. McGraw-Hill Education Pvt. Ltd., New Delhi.

Lee Kunwoo. 1999. Principles of CAD/CAM/CAE Systems. Addison Wesley Longman, Inc.

# Theory of Machines

## Theory

Elements, link, pairs, kinematic chain and mechanism, classification of pairs, lower and higher pairs, four bar chain, slider crank chain and inversions, Degree of Freedom, Determination of velocity and acceleration using graphical ( relative velocity and acceleration) method.

Introduction to belt drive, types of belt material, belt materials, length of belt, power transmitted, velocity ratio, Effects of centrifugal tension, Creep and slip of power transmission.

Cam, Types of Cam, Terminology used in cam and follower, Cam profile, Toothed gear.

Gear train, Simple, compound, reverted and epicyclic gear trains, Determination of velocity ratio and train value by tabular method. Introduction to governor, Types of Governor.

## Suggested Readings

Bevan Thomas. 1984. Theory of Machines. CBS Publishers and Distributors, Delhi.

Ballaney P L. 1985. Theory of Machines. Khanna Publishers, 2-B Nath Market, Nai Sarak, New Delhi.

Rao J S and Dukkipatti R V. 1990. Mechanisms and Machine Theory. Wiley astern Ltd., New Delhi.

Lal Jagdish. 1991. Theory of Mechanisms and Machines. Metropolitan Book Co. Pvt.Ltd., 1 Netaji Subash Marg, New Delhi..

Rattan S B. 1993. Theory of Machines. Tata McGraw Hill Publishing Co. Ltd., 12/4 Asaf Ali Road, New Delhi.

Khurmi R S and Gupta J K. 1994. Theory of Machines. Eurasia Publishing House Pvt. Ltd., Ram Nagar, New Delhi.

## Suggested Readings

Bevan Thomas. 1984. Theory of Machines. CBS Publishers and Distributors, Delhi.

Ballaney P L. 1985. Theory of Machines. Khanna Publishers, 2-B Nath Market, Nai Sarak, New Delhi.

Rao J S and Dukkipatti R V. 1990. Mechanisms and Machine Theory. Wiley astern Ltd., New Delhi.

Lal Jagdish. 1991. Theory of Mechanisms and Machines. Metropolitan Book Co. Pvt.Ltd., 1 Netaji Subash Marg, New Delhi..

Rattan S B. 1993. Theory of Machines. Tata McGraw Hill Publishing Co. Ltd., 12/4 Asaf Ali Road, New Delhi.

Khurmi R S and Gupta J K. 1994. Theory of Machines. Eurasia Publishing House Pvt. Ltd., Ram Nagar, New Delhi.



## Applied Electronics and Instrumentation

Semiconductors. p—n junction. V—I characteristics of p—n junction. diode as a circuit element. rectifier. clipper. damper, voltage multiplier, capacitive filter. diode circuits for OR & AND (both positive and negative logic), bipolar junction transistor: operating point. classification (A, B & C) of amplifier. various biasing methods (fixed. self potential divider). h-parameter model of a transistor. analysis of small signal. CE amplifier. phase shift oscillator, analysis of differential amplifier using transistor. ideal OP-AMP characteristics. linear and non-linear applications of OP-AMP (adder. subtractor. integrator, active rectifier. comparator. differentiator. differential, instrumentation amplifier and oscillator). zener diode voltage regulator. transistor series regulator. current limiting. OP-AMP voltage regulators. Basic theorem of Boolean algebra. Combinational logic circuits(basic gates. SOP rule and Kmap). binary ladder D/A converter, successive approximation A/D converter, generalized instrumentation, measurement of displacement. temperature. velocity, force and pressure using potentiometer. resistance thermometer. thermocouples. Bourclen tube. LVDT. strain gauge and tacho-generator.

### Practical

To study V-I characteristics of p-n junction diode: To study half wave. full wave and bridge rectifier: To study transistor characteristics in CE configurations: To design and study fixed and self bias transistor: To design and study potential divider bias transistor: To study a diode as clipper and clamper: To study a OP-AMP IC 741 as inverting and non- inverting amplifier: To study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor: To study a OP-AMP IC 741 as differential amplifier: To study a zener regulator circuit: To study a OP-AMP IC 741 as a active rectifier: To study a OP-AMP IC 741 as a comparator: To familiarize with various types of transducers.

### Suggested Readings

Mehta V K. Principles of Electronics. S. Chand and Co., New Delhi.

Shaney A K. Measurement of Electronics and Electronic Instrumentation. Khanna

Publications.

Roy Chowdary. Integrated Electronics. John Wiley International.

Kumar Anand. Digital Electronics. A. PHI.

Gupta Sanjeev, Sonthosh Gupta. Electronic Devices and Circuits. Danapath Rai Publications.

## **Sprinkler and Micro irrigation Systems**

### **Theory**

Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation systems; design of sprinkler irrigation system: layout selection, hydraulic design of lateral, submain and main pipe line, design steps; selection of pump and power unit for sprinkler irrigation system; performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency; Micro Irrigation Systems: types-drip, spray, & bubbler systems, merits and demerits, different components; Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection, hydraulics of drip irrigation system, design steps; necessary steps for proper operation of a drip irrigation system; maintenance of micro irrigation system: clogging problems, filter cleaning, flushing and chemical treatment; fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation.

### **Practical**

Study of different components of sprinkler irrigation system; design and installation of sprinkler irrigation system; determination of precipitation pattern, discharge and uniformity coefficient; cost economics of sprinkler irrigation system; study of different components of drip irrigation; design and installation of drip irrigation system; determination of pressure discharge relationship and emission uniformity for given emitter; study of different types of filters and determination of filtration efficiency; determination of rate of injection and calibration for chemigation/fertigation; design of irrigation and fertigation schedule for crops; field visit to micro irrigation system and evaluation of drip system; cost economics of drip irrigation system.

### **Suggested Readings**

Keller Jack and Bliesner Ron D. 2001. Sprinkle and Trickle Irrigation. Springer Science+ business Media, New York .

Mane M.S. and Ayare B.L.2007. Principles of Sprinkler Irrigation systems, Jain Brothers, New Delhi.

Mane M.S and Ayare B.L. and MagarS.S.2006.Principles of Drip Irrigation systems, Jain Brothers, New Delhi.

Michael AM, Shrimohan and KR Swaminathan. Design and evaluation of irrigation methods, (IARI Monograph No.1). Water Technology Centre, IARI New Delhi.

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

Choudhary M.L and Kadam U.S 2006. Micro irrigation for cash crops Westville Publishing House.

# **AGRICULTURE ENGINEERING SEMESTER - V**

## **SYSTEM ENGINEERING**

### **UNIT-I**

System concepts, System approach to Agricultural Engg., Linear programming problems, Mathematical formulation, Graphical solution; Simplex method;

### **UNIT-II**

Degeneracy and Duality in linear programming; transportation problems; Assignment problems; Decision analysis; Waiting line problems.

### **UNIT-III**

Project Management by PERT/CPM; Inventory control. Mathematical models of physical systems

### **UNIT-IV**

Modelling of agriculture systems and operations. Response of systems. Simulation.

### **UNIT-V**

Computer as a tool in system analysis.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	4

## **HYDROLOGY**

### **UNIT-I**

Hydrologic cycle and its comport; meteorological parameters and their measurement,

### **UNIT-II**

Interpretation of precipitation data; runoff- factors affecting rainfall-runoff relationship, runoff measurement computation and analysis.

### **UNIT-III**

Hydrograph analysis, unit hydrograph and synthetic hydrograph

### **UNIT-IV**

Stream flow measurement, flood routing, probability analysis of hydrological data; ground-water in hydrologic cycle; occurrence, distribution and movement of groundwater.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

## **FARM MACHINERY**

### **UNIT-I**

Status and scope of farm mechanization; principles of construction, operation and selection of farm machinery used for crop production,

### **UNIT-II**

Primary and secondary tillage equipment,

### **UNIT-III**

Sowing and planting equipment, inter-cultivation tools, plant protection equipment,

### **UNIT-IV**

Crop harvesting and threshing equipment; chaff cutters and silage filling equipment,

### **UNIT-V**

Land development machinery; performance and cost analysis; special farm machines for sugarcane, cotton, potato, and horticultural crops operation; human engineering and safety in farm machinery.

# **POST-HARVEST ENGINEERING OF CEREALS, PULSES AND OIL SEEDS**

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

## **UNIT-I**

Unit operation in processing of cereals, oilseeds and pulses.

## **UNIT-II**

Working principles of equipment for milling, mixing; cleaning; grading

## **UNIT-III**

Drying; and storage for cereals, pulses and oilseeds.

## **UNIT-IV**

Moisture content determination; physical properties

## **UNIT-V**

Psychrometry; Energy and material balance; Solvent extraction; Process flow charts

## **AGRI-BUSINESS MANAGEMENT**

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

### **UNIT-I**

Basics of agri-business management; Planning; Organising, Controlling.

### **UNIT-II**

Leading; Forecasting for Agri-Business; Location and layout of Facilities.

### **UNIT-III**

Work force management, Quality Management; Maintenance Management

### **UNIT-IV**

Financial Analysis of Agri-Business, Process Strategy; Inventory Management.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

## **IRRIGATION AND DRAINAGE ENGINEERING**

### **UNIT-I**

Water resource development and utilization in India; importance of irrigation; soil-water plant relationship; measurement of soil moisture, irrigation

### **UNIT-II**

Water and infiltration; water requirement of crops, consumptive use and evapotranspiration; land grading and land preparation for irrigation and drainage; design of irrigation channels; water conveyance and control structures, irrigation efficiencies

### **UNIT-III**

Irrigation scheduling; methods of irrigation water application-flood, border, furrow, check basin, sprinkler and drip, evaluation of irrigation methods.

### **UNIT-IV**

Drainage problems, causes and effect of waterlogging, prevention and control; drainage requirements of various crops; drainage investigations; types of drainage systems; planning, design and layout of surface and sub surface drainage systems; irrigation and drainage

### **UNIT-V**

water quality, recycling of drainage water for irrigation.



**AGRICULTURE ENGINEERING  
SEMESTER - VI**

<b>L</b>	<b>T</b>	<b>P</b>
3	1	0

**BUILDING MATERIAL AND STRUCTURAL DESIGN**

**UNIT-I**

Bricks and tiles, stones

**UNIT-II**

Pozzolanas, mortars, cement concrete

**UNIT-III**

Timber and plywood, asbestos and A.C. sheets; metallic products

**UNIT-IV**

Foundations; stone and brick masonry; D. P. C.; floors and roofs; windows

**UNIT-V**

Plasting and pointing; ventilation; plumbing and drainage

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

## **FARM POWER**

### **UNIT-I**

Power availability on the farms from animate and inanimate sources of energy, their capacities and efficiencies

### **UNIT-II**

Tractor engine components and their construction

### **UNIT-III**

Operating principles and function of engine systems, valve and valve mechanism, fuel and air supply, cooling, lubrication, ignition, starting and electrical systems

### **UNIT-IV**

Engine governing; transmission systems of wheel and track type tractors, clutch and brake, gearbox, differential, PTO, belt pulley and draw-bars and final drive mechanisms

### **UNIT-V**

Power tillers and small engines for farm operations; performance and cost analysis of farm tractors and power tillers.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **MACHINE DESIGN**

### **UNIT-I**

Basic principles; materials and manufacturing considerations in designing; marking stresses, fatigue and endurance limit; ISI and ISO codes

### **UNIT-II**

Design of basic machine parts like shafts, keys, splines, couplings, levers, etc

### **UNIT-III**

Design of joints, design and selection of machine components like gears, bearings and belts; complete analysis.

### **UNIT-IV**

Design and drawing of simple machine units.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

## **SOIL AND WATER CONSERVATION ENGINEERING**

### **UNIT-I**

Soil erosion- types, wind and water erosion, factors affecting erosion, classification of water erosion- splash, sheet, rill, gully and stream bank erosion; mechanics of erosion,

### **UNIT-II**

Estimation of soil loss; wind erosion control- windbreak and shelter belts

### **UNIT-III**

Biological and engineering measures, contour farming, strip cropping, contour bunds, graded bunds and terraces; design principles of bunds and terraces

### **UNIT-IV**

Design of vegetative and grassed waterways; gully control structures- temporary and permanent;

### **UNIT-V**

Watershed characteristics watershed management.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	4

**Code No.**

**:- BT – 634 (N)**

**Max. Marks :- 50**

**Duration :- 2 Hours**

## **REFRIGERATION AND AIR-CONDITIONING**

### **UNIT-I**

Principles- refrigeration effect - Carnot cycle, Bell coleman cycle- vapour compression cycle, temperature-entropy diagram, pressure-enthalpy charts, effect of dry compression wet compression- under cooling- superheating-actual vapour compression cycle.

### **UNIT-II**

Electrolux refrigerator. Centrifugal and steam jet refrigeration systems. Thermoelectric refrigeration systems. Vortex tube and other refrigeration systems. Ultra low temperature refrigeration.

### **UNIT-III**

Types and functions of air conditioning Physiological principles in air-conditioning, humidification and dehumidification- room dehumidifiers.

### **UNIT-IV**

Calculation of cooling and heating loads Air distribution and duct design methods, fundamentals of design of complete air-conditioning systems.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

**Code No. :- BT – 632 (N)**

**Max. Marks :- 100**

**Duration :- 3 Hours**

## **POST HARVEST ENGINEERING OF HORTICULTURAL CROPS**

### **UNIT-I**

Properties of fruits and vegetables; Food texture and rheology.

### **UNIT-II**

Process, parameters and equipment for sorting, washing, handling, peeling, slicing, blanching, mixing and handling, chilling.

### **UNIT-III**

packaging, transportation, storage and preservation technology.

### **UNIT-IV**

Flow charts for manufacture of finished products.

### **UNIT-V**

Application of quality control techniques.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	0

## **AGRICULTURE ENGINEERING SEMESTER - VII**

### **FARM MACHINERY DESIGN**

#### **UNIT-I**

Materials of construction of farm machinery and their properties.

#### **UNIT-II**

design of power transmission components and systems in agricultural machines; fits and tolerances.

#### **UNIT-III**

Design parameters of agricultural implements; force analysis of primary tillage tools and their hitching systems.

#### **UNIT-IV**

Design considerations of reapers, mowers, harvesters and threshing equipment.

#### **UNIT-V**

application of design methods to the systems of selected farm machinery; bill of materials and construction cost in project design.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

## **DAIRY AND FOOD ENGINEERING**

### **UNIT-I**

Properties of dairy food products.

### **UNIT-II**

Unit operation of various dairy and food processing Systems.

### **UNIT-III**

Process flow charts for product manufacture.

### **UNIT-IV**

Working principles of equipment for receiving, pasteurisation, sterilisation, homogenisation,

### **UNIT-V**

Filling and packaging, butter manufacture, evaporation, drying, freezing, juice extraction, filtration, membrane' separation, thermal processing, plant utilities requirement.



<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

## **GROUND WATER WELL & PUMP ENGG.**

### **UNIT-I**

Occurrence of groundwater - confined and unconfined aquifers, groundwater movement.

### **UNIT-II**

Hydraulics of wells - Equilibrium and Non-equilibrium flow conditions - surface and subsurface investigations of groundwater.

### **UNIT-III**

Darcy's Law-Aquifer characteristics - Jacobs, Dupits and other methods - Specific yield - safe yield - qualities - artificial recharge of ground water - seawater intrusion.

### **UNIT-IV**

Type of wells - Dug, bore, filter, point wells and deep wells - well logging and analysis - well screen - casing pipes - Development of wells - well testing - well design and yield - protection of wells.

### **UNIT-V**

Selection of wells - geological features - Dip strike - folds and joints - geological condition for artesian wells.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **RENEWABLE ENERGY**

### **UNIT-I**

Introduction to conventional and non-conventional energy sources, Patterns of fuel consumption, potential of solar, wind, biogas, biomass, geothermal and other renewable energy sources.

### **UNIT-II**

Characteristics of the sun, the solar constant. Heat transfer for solar energy utilization, solar refrigeration, Heat conduction through plate, typical fin problem. Radiative heat transfer coefficient, beam and diffuse radiation, Determination of solar time and problems related to it. Introduction to solar energy measuring instruments. Introduction to solar gadgets viz., Solar Cooker, Water Heater, Drier, Still, PV system.

### **UNIT-III**

Aerobic and anaerobic bio-conversion process, principles and raw materials, properties of biogas, Benefits of biogas viz., Manure, domestic fuel, sanitation and health, motive power, numerical problems on selection of size of biogas plants. Biogas appliances

### **UNIT-IV**

Production of Biomass, broad classification, conversion of solid, liquid and gaseous fuels. Pyrolysis, gasification and their economics. Wind energy potential, study of various types of wind machines

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **SOIL & WATER CONSERVATION STRUCTURES**

### **UNIT-I**

Introduction, Classification of structure & their functional requirements, types of open channel flow, energy equation, momentum principles, specific energy, specific force.

### **UNIT-II**

Hydraulic jump, its types and applications, energy dissipation, jump efficiency, relative loss of energy, runoff measuring structure, H – Flume, Parshall Flume, weirs.

### **UNIT-III**

Drop spillway-its functional use etc. drop spillway - hydrologic design, drop spillway - hydraulic design, drop spillway - structural design, free board & wave freeboard.

### **UNIT-IV**

Chute spillway, drop inlet spillway Farm ponds.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	0

## **AGRICULTURE ENGINEERING SEMESTER - VIII**

### **ADVANCED FARM POWER**

#### **UNIT-I**

Tractor performance characteristics; torque, speed, power and specific fuel consumption;

#### **UNIT-II**

Traction theory; chassis mechanics stability; steering and turning, Ackerman's steering geometry.

#### **UNIT-III**

Tractor hitches and hydraulic systems; tractor testing and controls.

#### **UNIT-IV**

Human factors in tractor design and operational safety.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

**Code No. :- BT – 832 (N)**  
**Max. Marks :- 100**  
**Duration :- 3 Hours**

## **PROCESS EQUIPMENT DESIGN**

### **UNIT-I**

Application of design engineering for processing equipments

### **UNIT-II**

Design parameters, codes and materials selection.

### **UNIT-III**

Design of handling and milling equipments, dryers.

### **UNIT-IV**

Heat exchangers, Pressure vessels, Optimisation of design with respect to process efficiency, energy and cost; Application of computer techniques in design optimization.

<b>L</b>	<b>T</b>	<b>P</b>
3	1	4

**Code No. :- BT – 831 (N)**  
**Max. Marks :- 100**  
**Duration :- 3 Hours**

## **IRRIGATION AND DRAINAGE EQUIPMENT DESIGN**

### **UNIT-I**

Design of irrigation wells - open well and tube wells - well diameter , thickness of casing, pipe and screens , openings of well screen, gravel packing design;

### **UNIT-II**

Centrifugal pumps - design of components, power requirement, pump characteristics, pump selection

### **UNIT-III**

Design of sprinkler irrigation - components, size of pipes, nozzles and matching pumping system.

### **UNIT-IV**

Design of drip irrigation - components, size of pipes, emitters.

### **UNIT-V**

Design of sub surface drainage system - tube diameter and perforation, filter design, outlet design.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **ELECTIVES-I**

### **RURAL WATER SUPPLY AND SANITATION**

#### **UNIT -I**

Water supply - Domestic industrial and commercial demand, total water requirement of a town, per capital demand - variation in demand. Population estimation - Design period - Population forecasting methods - surface and sub surface sources of water – Rainfall measurement, runoff estimation - Surface sources - lakes, rivers, reservoirs.

#### **UNIT -II**

Various types of conduits including gravity conduits such as canals, flumes, aqueducts, pressure conduits - design of pressure pipes as gravity mains - Darcy Wesbach manning, and Hazen Willeam formula. Flow in pipe system - Forces acting on pressure conduits - cast iron pipes steel, RCC, PVC, Asbestos and concrete pipes - Laying of pipes and testing of pipes.

#### **UNIT -III**

Selection of pumps - Efficiency of pumps, economical diameter of pumping mains. Purification of water supply sedimentation, filtration - coagulation, water softening

#### **UNIT -IV**

Water treatment methods, standards for potable water, sewerage system, Domestic and industrial wastes - Storm sewage - Flow through sewers - Design of sewers, Manhole, sewage characteristics BOD, COD Solids - Dissolved oxygen, nitrogen, solid waste collection and disposal.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **WATERSHED MANAGEMENT**

### **UNIT-I**

Watershed, concept, objectives of watershed management, selection of priority areas

### **UNIT-II**

Aerial photography and remote sensing, Planning Principles, Components of study, soil and moisture conservation

### **UNIT-III**

Groundwater recharge, Water harvesting, storage and recycling, farm pond, supplemental irrigation pond, Evaporation suppression, seepage reduction, water balance studies

### **UNIT-IV**

Dry farming techniques, River valley projects, runoff and sedimentation, Hill area development, Watershed based rural development



<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **FARM MACHINERY PRODUCTION**

### **UNIT-I**

Review of workshop practice in welding – drilling, tapping, turning material selection, Specifications, standard of fabrication techniques

### **UNIT-II**

Sequence of operations. Selection of tool implements for fabrication, preparation of detailed drawing, mechanical estimation. Planning of sequence for production – setting up jigs and fixtures, fabrication process, finishing and assembly. Testing for quality inspection cost analysis

### **UNIT-III**

Product design – capacity planning, make or buy decision, process plant layout, production planning and control, routing, estimating loading scheduling dispatching

### **UNIT-IV**

Expediting – inspection and control, PERT and CPM techniques, basics of materials. Management maintenance of machinery- EOQ and ABC analysis. Time study – work study – cost analysis.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **FOOD ENGINEERING**

### **UNIT-I**

Heat processing – methods of applying heat to food, sterilization, thermo bacteriology, evaporation, evaporator capacity, overall heat transfer – co efficient evaporator economy, capacity, Extrusion cooking.

### **UNIT-II**

Multiple effect system dehydration and drying, free moisture, equilibrium moisture content and water activity. Estimation – BETequation.

### **UNIT-III**

Classification of dryers, tray drum and spray drier for liquids and pastes, freeze drying, vacuum drying, concentration, freeze concentration, membrane concentration, freezing frozen products.

### **UNIT-IV**

Preservation techniques, low temperature preservation, irradiation- of foods, microwave heating, dielectric heating of foods.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **SEED PROCESSING**

### **UNIT-I**

Seed • types - breeder seed - foundation, certified seeds - factors affecting seed germination vigour- viability.

### **UNIT-I**

Introduction - methods of harvest and post harvest operations of crop for seed production merits and limitations - processing of seed - pre - cleaning cleaner-cum - grader special type of seed processing equipment - gravity separator, indented cylinder sorter, spiral separator - inclined belt drapper.

### **UNIT-I**

Dodder mill - colour sorter - Buck horn machine drying moisture content and measurements thin layer and deepbed drying, material handling equipment, seed treatment - seed treating equipment - cotton seed delinting machine - seed extractors for different crops bagging .

### **UNIT-I**

quality control measurements -storage - container, bulk storage - chemical and non-toxic chemical protectants during storage - general layout of seed processing plants.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

**Code No. :- BT – 833 (N)**  
**Max. Marks :- 100**  
**Duration :- 3 Hours**

## **ELECTIVES-II**

### **MINOR IRRIGATION AND COMMAND AREA DEVELOPMENT**

#### **UNIT-I**

Minor irrigation - definition, necessity, advantages and disadvantages, storage and diversion works, duty of water requirement of various crops, computation, conveyance, storage and application efficiencies.

#### **UNIT-II**

Design of border strip and furrows and other irrigation methods- design and layout of sprinkler irrigation – Design and layout of drip irrigation- Evapotranspiration irrigation scheduling.

#### **UNIT-III**

Command area development – components of CADA, various CADA programmers in India- Land consolidation- infrastructure development, organization and maintenance, on farm development works.

#### **UNIT-IV**

Development- organization and application losses- remedial measures, farmer's role in system in system operation – farmer's committee for water distribution, strategic outlet command- stream size for efficiency, rotational irrigation system.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **RURAL WATER SUPPLY AND SANITATION**

### **UNIT-I**

Water supply – Domestic industrial and commercial demand total water requirement of a town, per capital demand- variation in demand, population –estimation- Design period-population forecasting methods

### **UNIT-II**

Surface and sub surface sources of water – Rainfall measurement, runoff estimation- surface sources- lakes rivers, reservoirs.

### **UNIT-III**

Various types of conduits including gravity conduits such as canals, flumes , aqueducts pressure conduits design of pressure pipes as gravity mains- Darcy wesbach manning , and Hazed William formula Flow in pipe system- Forces acting on pressure conduits- cast iron popes steel, RCC, PVC, Asbestos and concrete pipes- Lying of pipes and testing of pipes. Selection of pumas – Efficiency of pumps, economical diameter of pumping mains.

### **UNIT-IV**

Purification of water supply sedimentation, filtration – coagulation, water softening- water treatment methods, standards for potable water , sewerage system- Domestic and industrial wastes-storm sewage – Flow through sewers- Design of sewers- manhole- sewage characteristics BOD, COD, Solids- Dissolved oxygen, nitrogen, solid waste collection and disposal

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **SMALL DAMS AND RESERVOIRS**

### **UNIT-I**

Small storage structures- Objectives and data required investigation and planning- source of supply- runoff estimations- Artificial catchments- Estimation of flood flows – water quality- water requirements - Types of Dams – Hillside dams- Ring tanks – site Turkey, s Nest tanks – Excavated tanks off creek storage's- spread bank tanks- site investigations Reservoir sites- Foundation of dams – Dam building materials – subsurface exploration- classification of soils- Dispersion Test- unfilled soil classification

### **UNIT-II**

Design considerations- Homogeneous Dams- Zoned dams- Diaphragm dams – crest – cut off excavation- Borrow pits- spillway- free board- upstream slope protection- settlement – outlet pipes- valves- siphons- Top soil cover Estimation of earthwork volumes and storage capacities – plan and specification

### **UNIT-III**

Sand Dams- Drought- farm pond- pond – nala bundling – Losses of stored water- Developed Groundwater percolation ponds- Design considerations- check dams

### **UNIT-IV**

Construction aspects – construction equipment – Denaturing Foundations- Maintenance – spillways- outlet pipes – Reservoir problems- silting- seepage- Toxic algae- Reservoir safety.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **TESTING OF AGRICULTURAL MACHINERY AND TRACTORS**

### **UNIT-I**

General guidelines on use of test codes, preparation for tests, accuracy of data, Field test –cost calculation of operation using test data

### **UNIT-II**

Test code and procedure for ploughs, rotary tillers, disc harrows, seeding equipment without fertilizing attachment, rice transplanters, row crop cultivators, weepers, sprayers dusters and harvesting machines, scope of the tests, definition of terms, specification of the implements, laboratory tests, tests conditions, performance test practical field test, criteria for the evaluation- preparation of test report format

### **UNIT -III**

Tractor performance criteria, criteria power measurement methods, absorption dynamometers. Transmission dynamometers, hydraulic dynamometer selected direct current dynamometers, shoe type dynamometers, spring dynamometers. strain gauge dynamometer, power estimating , engine test apparatus, air supply measurement ,engine pressure indicators, fuel flow meter ,

### **UNIT-IV**

ISI test code, Budhni testing centre, correction for atmospheric conditions torque engine performance, efficiency of Tractor engine , actual power output and fuel consumption.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

**Code No. :- BT – 835 (N)**

**Max. Marks :- 50**

**Duration :- 2 Hours**

## **FOOD INDUSTRY MANAGEMENT**

### **UNIT-I**

Definition and classification of food industries- responsibilities qualities of management, characteristics and labor efficiency ,wages and incentives decision making and production management

### **UNIT-II**

Production planning- production control manufacturing systems ,job production ,batch ,mass production and process charts, routing and scheduling ,time and motion study, line of balance technique.

### **UNIT-III**

Inventory control- types of inventory ,economic lot size ,raw materials management- economic order quantity ,ABC Analysis ,plant location ,factors- plant layout- types ,advantages- characteristics of an efficient layout-techniques of plant layout

### **UNIT-IV**

Product selection and development - Introduction of new product, stages of product development, specialization, diversification sales forecasting techniques, investment and replacement, concept of present value future worth and internal rate of return, quality control and inspection, acceptance sampling, control charts, variable and attributes, optimization techniques in transportation,



<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **LAND DEVELOPMENT MACHINERY**

### **UNIT-I**

Land clearing, Logging, stump, stump pulling, rock blasting, Bulldozers –General description, blade, arms, pitch arms, hydraulic lip, montages, mechanical tilt, power tilt, control valve, use of float control

### **UNIT-II**

Cable bulldozers Power control units, blade, control lever, down pressure. special features of engine, tracks and suspension steering, operations using bulldozers,

### **UNIT-III**

Digging breaking piles, suck, road cuts, side slopes, and transporting, pilling, spreading, turning, scalloping back, balding, rocks in cuts, rocks in fills, pitching, and rear power control

### **UNIT-IV**

Gears, dozing cycle, hill work, cable operation, cutting hard ground, comparison of hydraulic and cable out put special constructions, U blade, angle dozens, stumpers, tree dozers, root or rock blades, brush cutters, bull clam.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **STORAGE ENGINEERING**

### **UNIT-I**

Introduction, Requirement of storage, Physical properties of food material - shape & size density, hydrodynamic property, angle of internal and external friction, angle of repose, moisture contents - EMC, Hysteresis effect, Determination of EMC

### **UNIT-II**

Factors for food deterioration- biological agents – microbial spoilage, food enzymes, insects, parasites, rodents. Physical factors – temperature, moisture, oxygen, light, time. Losses control and food safety.

### **UNIT-III**

Storage systems, bag storage, shed, warehouses, methods of stacking, functional design of warehouse, bulk storage- bins silos- type of silos, functional design of silo, grain pressure theories- Airy thereon, Janssen equation, accretion, fumigation, CAP storage, silage storage

### **UNIT-IV**

Cold storage – design, cooling load calculations, equipments used, design, insulations, management of cold rooms, controlled atmosphere storage- effect of nitrogen oxygen and carbon dioxide on storage of durable and perishable commodities- modified atmospheric storage- methods- quality evaluation.

### **UNIT-V**

Packaging – Introduction, basic packaging materials, types of packaging, effects of packaging on the nutritive value of foods, packaging of bakery products, use of plastics in storage and packaging

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **REMOTE SENSING AND GIS**

### **UNIT-I**

Definition: History of Remote Sensing, Abroad \ India: Multi concepts, Concepts of scale, Resolution; Merits V Demerits between conventional and remote sensing approaches. Electromagnetic Spectrum: Optical\Microwave - Visible region: Blue, Green and Red wavelength portion; Non-visible region: B. UV, TIR, MW wavelength portion.

### **UNIT-II**

Radiation sources: Active and Passive; Natural \ Stimulated luminescence; Photon; Energy transmission; Maxwell's formulation; Wavelength and frequency: their relation and units of measurement; Polarisation; Coherent & Incoherent radiation; Doppler effect; Radiation quantities - Radiant energy, radiant energy density, radiation flux, irradiation, radiance, emissivity. Atmospheric characteristics: atmospheric gas composition, pressure, temperature, number and mass densities; scale height; Clouds; Solar radiant energy.

### **UNIT-III**

Flight planning - Crab and drift - Computation of flight plan - Specification for Aerial Photography, Basic horizontal and vertical control - Pre-pointing and post-pointing - Planning for Ground Control - Cost Estimates. Basic characteristics of Photographic Images Interpretation keys - Visual and Digital

### **UNIT-IV**

Interpretation - Basic Elements in Photographic Interpretation for Terrain Analysis - Equipments for Interpretation. Imagery Interpretation for Land Use -Geology - Soil – Forestry. Introduction: Map - Definitions - Representations - Point line polygon common coordinate systems - Map projects Transformation, - Map analysis.

### **UNIT-V**

History of development of GIS, - Definition - Basic components - standard GIS packages. Data - Entry, storage and maintenance: Data types - spatia- - Non-Spatial (attribute data) Data structure, data format - point line vector - Raster - Pol gon - object structural model - files and files organization - Data base management system (DBMS), Entering data in computer - digitizer - scanner - data compression.

<b>L</b>	<b>T</b>	<b>P</b>
2	1	0

## **FARM POWER AND MACHINERY MANAGEMENT**

### **UNIT-I**

Economic performance - machine performance - capacities - Time efficiencies – Machine utility - Field patterns.

### **UNIT-II**

Field shape, size and soil conditions as factors of performance - Drawbar pull power requirements - Operator performance - value of labour - amount and capacity - safety - Economics - investment decisions -undiscounted measure –

### **UNIT-III**

Break even point payback period Discounted measures - Changing value of money – Compounding and discounting - Net present value of benefit - cost ratio - Internal rate of return – Cost determination Depreciation Depreciation methods Renting and leasing - variable cost - replacement cost –

### **UNIT-IV**

Determination of least cost. Cost determinations for tillage operation, seedbed preparation - cultivation seeding machines - chemical applications – Grain harvesting - Forage harvesting - Special crop machines - Equipment selection – machinery selection - power selection.