

B. Tech. (Agricultural Engineering)

Curriculum and Syllabus

2018

Choice Base Credit System



SCHOOL OF AGRICULTURAL AND PROCESSING SCIENCES (SoAPS)

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

(To be a Kalasalingam University)

Krishnankoil - 626126, Virudhunagar District

SCHEME OF INSTRUCTION

COURSE CODE	Course Title	L	P	C
MAT18R105	Engineering Mathematics-I	2	1	3
PHY18R177	Engineering Physics	2	1	3
CHY18R178	Engineering Chemistry	2	1	3
AGE18R151	Principles of Soil Science	2	1	3
AGE18R152	Surveying and Levelling	1	2	3
AGE18R153	Engineering Mechanics	2	1	3
AGE18R181	Engineering Drawing	0	2	2
AGE18R101	Heat and Mass Transfer	2	0	2
NG18R1001/02	NCC/ NSS	0	1*	1*
NG18R1003	Physical Education	0	1*	1*
MAT18R106	Engineering Mathematics- II	2	0	2
AGE18R154	Environmental Science and Disaster Management	2	1	3
AGE18R155	Entrepreneurship Development and Business Management	2	1	3
AGE18R156	Fluid Mechanics and Open Channel Hydraulics	2	1	3
AGE18R157	Strength of Materials	1	1	2
AGE18R158	Workshop Technology and Practices	1	2	3
AGE18R102	Theory of Machines	2	0	2
CSE18R***	Web Designing and Internet Applications	1	1	2
AGE18R251	Principles of Horticultural Crops and Plant protection	1	1	2
AGE18R252	Principles of Agronomy	2	1	3
HSS18R***	Communication Skills and Personality Development	1	1	2
MAT18R210	Engineering Mathematics-III	2	1	3
AGE18R253	Soil Mechanics	1	1	2
AGE18R254	Design of Structures	1	1	2
AGE18R201	Machine Design	2	0	2
AGE18R255	Thermodynamics, Refrigeration and Air Conditioning	2	1	3
AGE18R256	Electrical Machines and Power Utilization	2	1	3
AGE18R202	Building construction and Cost Estimation	2	0	2
CSE18R***	Auto CAD Applications	0	2	2

AGE18R257	Applied Electronics and Instrumentation	2	1	3
AGE18R258	Tractor and Automotive Engines	2	1	3
AGE18R259	Engineering Properties of Agricultural Produce	1	1	2
AGE18R260	Watershed Hydrology	1	1	2
AGE18R261	Irrigation Engineering	2	1	3
AGE18R262	Sprinkler and Micro Irrigation Systems	1	1	2
AGE18R263	Fundamentals of Renewable Energy Sources	2	1	3
AGE18R351	Tractor Systems and Controls	2	1	3
AGE18R352	Farm Machinery and Equipment-I	2	1	3
AGE18R353	Agricultural Structures and Environmental Control	2	1	3
AGE18R354	Post Harvest Engineering of Cereals, Pulses and Oil Seeds	2	1	3
AGE18R355	Soil and Water Conservation Engineering	2	1	3
AGE18R356	Watershed Planning and Management	1	1	2
AGE18R357	Drainage Engineering	1	1	2
AGE18R358	Renewable Power Sources	2	1	3
NG18R3004	Skill Development Training-I	0	5*	5*
CSE18R***	Computer Programming and Data Structures	1	2	3
AGE18R359	Farm Machinery and Equipment-II	2	1	3
AGE18R360	Post Harvest Engineering of Horticultural Crops	1	1	2
AGE18R361	Water Harvesting and Soil Conservation Structures	2	1	3
AGE18R362	Groundwater, Wells and Pumps	2	1	3
AGE18R382	Tractor and Farm Machinery Operation and Maintenance	0	2	2
AGE18R363	Dairy and Food Engineering	2	1	3
AGE18R364	Bio-energy Systems: Design and Applications	2	1	3
AGE18R481	Industrial Attachment/Internship - STUDENT READY(Rural Entrepreneurship Awareness Development Yojana)	0	10	10
AGE18R482	Experiential Learning On campus - STUDENT READY(Rural Entrepreneurship Awareness Development Yojana)	0	10	10
NG18R4001	Educational Tour	0	2*	2*

NG18R4002	Skill Development Training-II	0	5*	5*
AGE18R485	Project Planning and Report Writing	0	10	10

Elective Courses - Any three courses only (each 2+1)		6	3	9
AGE18R451	Floods and Control Measures	2	1	3
AGE18R452	Wasteland Development	2	1	3
AGE18R453	Information Technology for Land and Water Management	2	1	3
AGE18R454	Remote Sensing and GIS Applications	2	1	3
AGE18R455	Minor Irrigation and Command Area Development	2	1	3
AGE18R456	Precision Farming Techniques for Protected Cultivation	2	1	3
AGE18R457	Water Quality and Management Measures	2	1	3
AGE18R458	Landscape Irrigation Design and Management	2	1	3
AGE18R459	Plastic Applications in Agriculture	2	1	3
AGE18R460	Mechanics of Tillage and Traction	2	1	3
AGE18R461	Farm Machinery Design and Production	2	1	3
AGE18R462	Human Engineering and Safety	2	1	3
AGE18R463	Tractor Design and Testing	2	1	3
AGE18R464	Hydraulic Drives and Controls	2	1	3
AGE18R465	Precision Agriculture and System Management	2	1	3
AGE18R466	Food Quality and Control	2	1	3
AGE18R467	Food Plant Design and Management	2	1	3
AGE18R468	Food Packaging Technology	2	1	3
AGE18R469	Development of Processed Products	2	1	3
AGE18R470	Process Equipment Design	2	1	3
AGE18R471	Photovoltaic Technology and Systems	2	1	3
AGE18R472	Waste and By-products Utilization	2	1	3
AGE18R473	Artificial Intelligence	3	0	3
AGE18R474	Mechatronics	2	1	3
AGE18R475	Management of Canal Irrigation System	2	1	3
Total		6	13	19

Total credits with Non Credit courses (14 credits) = 170+14* =184

MAT18R105	Engineering Mathematics-I	L	P	C
		2	1	3

UNIT I

Matrices Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordan method to find the inverse of a matrix, Eigenvalues, and Eigenvectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalization of matrices, quadratic forms.

UNIT II

PAQ form, Echelon form, Solution of linear equations, nature of rank, using Cayley-Hamilton theorem to find inverse of A. Differential calculus Taylors and Maclaurin 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.

UNIT III

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.

UNIT IV

Vector calculus Differentiation of vectors, scalar, and vector point functions, vector differential operator Del, Gradient of a scalar point function.

UNIT V

Divergence and Curl of a vector point function and their physical interpretations, identities involving Del, second order differential operator; line, surface and volume integrals, Stokes, divergence and Greens theorems (without proofs).

PRACTICAL SCHEDULE

1. Tutorials on the rank of a matrix, reduction to normal form, consistency, and solution of linear equations.
2. Eigenvalues and Eigenvectors, Cayley-Hamilton theorem.
3. Diagonalization of matrices, quadratic forms
4. Taylors and Maclaurin expansion
5. Indeterminate form, curvature, tracing of curves, partial differentiation
6. Maxima and minima, volume and surface of revolution
7. Multiple integrals, Beta and Gama functions
8. Differentiation of vectors, gradient, divergence, and curl of a vector point function
9. Line, surface and volume integrals, Stokes divergence and Greens Theorems.

TEXTBOOKS:

1. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
2. Shanti Narayan. 2004. Differential Calculus. S. Chand and Co. Ltd., New Delhi.
3. Shanti Narayan. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.
4. Shanti Narayan. 2004. A Textbook of Vector Calculus. S. Chand and Co. Ltd. New Delhi.

PHY18R177	Engineering Physics	L	P	C
		2	1	3

UNIT I

Elasticity – twisting of a cylinder – torsional pendulum - viscosity – viscosity of a fluid – Oswald’s viscometer. Surface tension– variation with temperature. Gravitation – gravitational constant– Seismic waves-detection and forewarning.

Ultrasonic –production, deduction and application –Industrial applications Drilling, welding, soldering, cleaning – Nondestructive testing. Acoustics –requisites of a good auditorium. Cryogenics– joule Kelvin effect– porous plug experiment– liquefaction of gases– adiabatic demagnetization –transmission of heat–thermal conductivity –Lee’s method thermal conductivity of rubber tubing.

UNIT II

Diffraction– principle of zone plate– diffraction at a single slit- resolving power– polarization- double refraction- quarter wave plates–elliptically and circularly polarizes light– Polarimeter and its applications–laser technology–He–Ne laser– Solid state Laser-Fiber optics– basic principles- classification of optical fibers based on materials-number of modes and refractive index profile-step index fiber and graded index fiber- doped fibers a amplifiers– optical communication using fibers – Waves and oscillations.

UNIT III

Dielectric properties-qualitative study of various types of polarization-effect of temperature and frequency on dielectric constant- dielectric loss-ferroelectric materials - classification of ferroelectric materials- applications of ferroelectric and piezoelectric materials- classification of insulating materials. Nanotechnology–basics–Nanomaterials– applications

UNIT IV

Electrical properties of metals - Drude Lorentz theory of electrical conduction - Thermal conductivity Weidmann Franz Law - band theory of solids - Distinction between conductors, semiconductor and insulator based on band theory- Factors affecting resistivity of metals temperature, alloying, magnetic field and strain. Applications of conductor strain gauges, transmission line contact materials, precision resistors, heating element, and resistance thermometers.

UNIT V

Atomic physics – De Broglie's matter waves – Electron microscope (Scanning) - solid state physics–crystal structure analysis by X-ray diffraction, Braggs Law. Laue and powder methods–the origin of X-rays–Characteristic X-Ray- Mosley’s law and applications.

Practical Schedule

1. To find the frequency of A.C. supply using an electrical vibrator
2. To find the low resistance using Carey Foster bridge without calibrating the bridge wire
3. To determine the dielectric constant of material using De Sautys bridge
4. To determine the value of a specific charge (e/m) for electrons by the helical method
5. To study the induced e.m.f. as a function of the velocity of the magnet
6. To obtain a hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities
7. To study the variation of the magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil
8. 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 a laser beam
9. To find the numerical aperture of optical fiber To set up the fiber optic analog and digital link
10. To study the phase relationships in L.R. circuit; To study LCR circuit
11. To study the variations of thermal emf of a copper-constantan thermocouple with temperature
12. To find the wavelength of light by a prism.

TEXTBOOKS

1. Theraja.B.L. 1996, Modern Physics. New Age International Limited
2. Nelkon & Parker, 1995, Advanced level Physics Longman International Education.

REFERENCE BOOKS

1. Brijlal and N. Subramanyam, 1995. Properties of matter. Eum Asia publishing house pvt. Ltd., Ram Nagar, New Delhi.
2. Brijlal and N. Subramanyam, 1995. Heat and Thermodynamics, Eum asia publishing house pvt. Ltd., Ram Nagar, New Delhi.
3. Brijlal and N. Subramanyam, 2001. Text book of optics. S. Chand and Co., Ram Nagar, New Delhi.
4. Gerd Keiser, 1997" Optical Fiber Communications", Mc Graw Hill Co.
5. Srivastava C.M and Srinivasan. C, 1998 "Science of Engineering Materials", New Age International (P)Ltd.
6. Chihtangah, Fundamentals of solid state electronics (1997), World scientific
7. Saxena, Guptha and Sexena, Solid State Physics (2004), Pragati Prakashan (India).
8. Brijlal and N. Subramanyam, 1990. Magnetism and electricity. S. Chand and Co., Ram Nagar, New Delhi.

CHY18R178	Engineering Chemistry	L	P	C
		2	1	3

UNIT I

Phase rule and its application to one and two component systems. Fuels: classification. calorific value. Colloids: classification. properties.

UNIT II

Corrosion: causes. types and method of prevention. Water: temporary and permanent hardness. Disadvantages of hard water, scale and sludge formation in boilers, boiler corrosion.

UNIT III

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.

UNIT IV

Principles of food chemistry. Introduction to lipids, proteins, carbohydrates, vitamins, food preservatives, coloring and flavoring reagents of food. Lubricants: properties. mechanism. classification and tests.

UNIT V

Polymers. types of polymerization. properties. uses and methods for the determination of molecular weight of polymers. Introduction to IR spectroscopy.

Practical Schedule

1. Determination of temporary and permanent hardness of water by EDTA method
2. Estimation of chloride in water
3. Estimation of dissolved oxygen in the water
4. Determination of BOD in a water sample
5. Determination of COD in a water sample
6. Estimation of available chlorine in bleaching powder
7. Determination of viscosity of oil Estimation of activity of water sample
8. Estimation of alkalinity of water sample Determination of carbonate and non-carbonate hardness by soda reagent
9. Determination of coagulation of water and chloride ion content
10. Determination of specific rotation of an optically active compound
11. Determination of Xanax and verification of Beer-Lambert Law
12. Determination of calorific value of fuel Identification of functional groups (alcohol, aldehyde, ketones, carboxylic acid, and amide) by IR
13. Chromatographic analysis
14. Determination of molar refraction of organic compounds.

TEXT BOOK

1. Kreshkov A.P. and Yaro slaves, 1977. The course of Analytical Chemistry Vol.II. Quantitative Analysis–Mir Publishers, Moscow.

REFERENCE BOOKS

1. Jain P L and Jain M. 1994. Engineering Chemistry. Danpat Rai publishing company Pvt. Ltd., Delhi.
2. Bahl BS, Arun Bahl and Tuli B D. 2007. Essentials of Physical Chemistry. S. Chand and Co. Ltd., Delhi.
3. Hesse, P.R. 1971.A Textbook of Soil Chemical Analysis. John Murray (Publishers) Ltd. London.
4. Jackson, M.L.1973.Soil Chemical Analysis.Prentice Hall Pvt. Ltd
5. Piper, C.S 1942.Soil and plant analysis Interscience *Publishers*, New York.

AGE18R151	Principles of Soil Science	L	P	C
		2	1	3

UNIT I

Soil - Pedological and edaphological concepts - Origin of the Earth - Composition of Earth's crust -Rocks and minerals - primary and secondary minerals.

UNIT II

Weathering of rocks & minerals - Physical, chemical and biological weathering - Soil formation - factors-active & passive. - Soil forming processes - Simenson's and specific - Soil profile.

UNIT III

Soil physical properties and their significance - Soil texture and textural classes - Soil structure and classification - Soil consistency. Bulk density, particle density, and porosity - Soil color - significance -causes and measurement. Soil temperature - Soil air - Soil water- Measurement - Soil water potentials -Soil moisture constants - Movement of soil water - saturated and unsaturated flow - infiltration, hydraulic conductivity, percolation, permeability, and drainage. **(Soil phases)**

UNIT IV

Soil colloids - Properties, types, and significance - Layer silicate clays - their genesis and sources of charges - Ion exchange - CEC, AEC and Base saturation - Factors influencing Ion exchange -significance. Soil reaction, Buffering capacity, and EC.

UNIT V

Soil organic matter - Composition - decomposition and mineralization, C: N ratio, Carbon cycle -Fractions of soil organic matter - Humus formation. Soil organisms - Beneficial and harmful effects.

Practical Schedule

1. Identification of common rocks and minerals
2. Methods of soil sample collection
3. Visit soils of different terrains and study of soil profiles
4. Determination of bulk density, particle density and porosity - cylinder, wax coating, and core methods.
5. Soil textural analysis - feel method, International pipette method (part 1)
6. International pipette method (part 2)
7. International pipette method (part 3)
8. Determination of soil color and temperature.
9. Determination of soil moisture- Gravimetry and moisture probes
10. Determination of available soil moisture - Pressure Plate Apparatus
11. Determination of Infiltration rate - Double-Ring Infiltrometer
12. Determination of hydraulic conductivity - Constant head Hydraulic Conductivity unit
13. Determination of soil pH and EC
14. Estimation of soil organic carbon
15. Colloquium 1. - Chemical constituents of soil - Total elemental composition - relevance in soil properties and behavior
16. Colloquium 2. - Preparation of interpretative reports of soil analysis and assignments

TEXTBOOKS:

1. Brady Nyle C and Ray R Well. 2002. Nature and properties of soils. Pearson Education Inc., New Delhi.
2. Indian Society of Soil Science. 1998. Fundamentals of Soil Science. IARI, New Delhi.
3. Sehgal J.. A. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.

AGE18R152	Surveying and Levelling	L	P	C
		1	2	3

UNIT I

Principles and basic concepts, objective and uses of surveying - classification and basic methods of surveying- Types of chains - Ranging - Direct and Indirect methods –Method of Chaining on the level and sloping ground - Obstacles in chaining. Chain surveying - Principles - selection of survey stations and lines - Offsets - types, Measurement - cross-staff and optical square - Steps involved in Chain Survey - Reconnaissance, Index sketch, Reference sketch, Booking entries in field book - Plan and Map, Scale - Plain and Diagonal - Testing of Chain, Degree of accuracy in chaining, Errors and compensation - cumulative, mistakes - Determination of limiting length of offset and problems .

UNIT II

Area computation, Mid-Ordinate rule, Average ordinate rule, Trapezoidal rules, Simpson rule and Coordinate method of finding the area- Computation of volume by different methods.

UNIT III

Basic terminologies of traversing – Prismatic and Surveyors Compass – compass surveying methods-Checking the accuracy of the traverse - Errors and mistakes in Compass survey - Plane tabling - instruments and accessories - Radiation, Traversing, Orientation - Intersection and Resection.

UNIT IV

Levelling - definition - types of Benchmarks - different types of levels - optical principle - lenses - telescopes - Basic principles of leveling - different methods of reduction of levels - types of levelling - Theory of simple, compound, precision, profile, cross-sectional and reciprocal levelling - Minor instruments, Hand level - Clinometer - Abney level -- Planimeter .

UNIT-V

Theodolite types – adjustments – setting up – reading angles – measurements – Traversing – Plotting Correction of Errors Area and elevation determination. – Contouring - definition - contour characteristics - direct and indirect methods -gradient contour – uses. Contouring By Dumpy level & Tachometric contouring, Introduction about GPS and Total station.

Practical schedule

1. Use of different types of chaining and tapes - folding and unfolding - ranging - field recording.
2. Ranging and chaining - use of cross staff - optical square
3. Linear measurement and offset setting
4. Area computation by cross staff survey and Plotting
5. Chain traversing of cropped area and error correction.
6. Computation of Area from field notes and plotted plan, Mid-ordinate rule, Average ordinate rule, Trapezoidal rule- problems
7. Simpson rule and Coordinate method of finding area and problems
8. Compass Survey – radiation method.
9. Closed compass traversing, Plotting and correction of closing error
10. Open compass traversing
11. Problems on Compass traversing
12. Area computation by plane table survey - radiation method

13. Plane table survey - intersection
14. Plane table traversing resection methods
15. Use of Dumpy of level - limitation - handling - shifting. Simple levelling - temporary adjustments
16. Differential levelling in field
17. Differential levelling problems
18. Profile levelling - plotting
19. Cross-sectioning plotting
20. Finding Sensitiveness of Bubble tube
21. Contouring – Direct, Grid method. Plotting of contour - preparation of map - estimation of volume
22. Permanent adjustments in Dumpy Level
23. Computation of Volume – Problems
24. Use of Minor instruments
25. Finding area using Planimeter
26. Theodolite types – adjustments – setting up – reading angles
27. Measurement of horizontal angles by repetition and reiteration – reading magnetic bearings
28. Cross-sectioning with theodolite and plotting
29. Area and elevation determination by measuring horizontal and vertical angles
30. Traversing with a Theodolite - Plotting theodolite survey
31. The volume of earthwork computation

TEXTBOOKS

1. Basak. V.N, 2010, “Surveying and Levelling”, Tata McGraw Hill publications, New Delhi
2. Kanetkar, T.P. & Kulkarni, S.V., 2010. “Surveying & leveling”. Part –I, A.V.G. Prakashan, Poona.
3. Punmia. B.C 2010 “Surveying (Vol- I & Vol-II)” Laxmi publications, New Delhi

REFERENCE BOOK

1. Duggal, S.K. 2013 Surveying 4th edition, McGraw hill education (India) Pvt. Ltd. New Delhi
2. Kanetkar, T.P., and S.V. Kulkarni. Surveying and leveling Part II, Pune Vidyarthi Griha Prakashan
3. Bharihatti, S.S. 2013. Surveying Theory and Practice. I.K. international publishing house Pvt.Ltd. NewDelhi
4. Narinder Singh, 1992. Surveying. Tata McGraw Hill publishing company ltd, New Delhi
5. Michael, A.M., and T.P. Ojha. 2009. Principles of Agricultural Engineering, Vol. II, Jain Brothers, New Delhi

AGE18R153	Engineering Mechanics	L	P	C
		2	1	3

UNIT I

Six Fundamental principles and concepts - vector algebra- basics, external and internal forces, concurrent and non-concurrent coplanar forces - resultant and resolution static equilibrium of particles in 2-D and 3-D.

UNIT II

Moment about point and about an axis - Varignon's theorem - Static equilibrium of rigid body in 2-D and 3-D, free body diagram, supports, and reactions - Problem formulation concept in 2-D and 3-D.

UNIT III

Frictional forces- Types- laws of dry friction- simple contact friction - Sliding block, wedges, ladder friction - rolling resistance - belt friction - Axle friction, disk friction –Examples.

UNIT IV

Centroids of lines - areas, volumes, composite bodies, Centre of gravity- the center of mass - Area moment of Inertia - principal moment of inertia.

UNIT V

Introduction – Kinematics of particles – Displacements, velocity, and acceleration, their relationship - Equations of motions– Rectilinear motions - relative motion – Curvilinear motion –Kinetics of particles - Newton's second law – Equations of motion – rectangular components – Work Energy equation of particles.

PRACTICAL SCHEDULE:

1. Problems on composition and resolution of forces, moments of a force, couples, the transmission of a couple, resolution of a force into a force & a couple
2. Problems relating to resultant of Coplanar force system, collinear force system, concurrent force system, co-planer concurrent force system, co-planer non-concurrent force system, Non-coplanar concurrent force system, Non-coplanar non-concurrent force system, a system of couples in space
3. Problems relating to centroids of composite areas; Problems on the moment of inertia, polar moment of inertia, the radius of gyration, the polar radius of gyration of composite areas
4. Equilibrium of concurrent – co-planer and nonconcurrent – co-planer force systems
5. Problems involving frictional forces
6. Analysis of simple trusses by method of joints and method of sections
7. Analysis of simple trusses by graphical method
8. Problems relating to simple stresses and strains
9. Problems on shear force and bending moment diagrams
10. Problems relating to stresses in beams
11. Problems on torsion of shafts
12. Analysis of plane and complex stresses

TEXTBOOK

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, Tata Mc Graw Hill, 2007.

REFERENCE BOOKS

1. Bansal, R.K. 1992, Engineering Mechanics and Strength of Materials, Laxmi Publication, 7/21, Ansari Road, Daryaganj, New Delhi - 110 002.
2. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, 1998.
3. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall of India Pvt. Ltd., 2004.

AGE18R181	Engineering Drawing	L	P	C
		0	2	2

PRACTICAL SCHEDULE:

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

TEXT BOOK

1. Natarajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.

REFERENCE BOOKS

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson Education, New Delhi, 2005.
2. Bhatt, N.D., Engineering Drawing, Charotar Publishing House, New Delhi, 46th Edition, 2003.
3. Luzadder and Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt Ltd, New Delhi, XI Edition, 2001.
4. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2002.

AGE18R101	Heat and Mass Transfer	L	P	C
		2	0	2

UNIT I

Concept, modes of heat transfer, the 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.

UNIT II

Electrical analogy. Insulation materials. Fins, Free and forced convection. Newton's law of cooling, heat transfer coefficient convection. Dimensional analysis of free and forced convection. Useful nondimensional numbers.

UNIT III

Equation of laminar boundary layer on a 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-Boltzmann law, Kirchoff's law, grey bodies and emissive power, solid angle, the intensity of radiation.

UNIT IV

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

UNIT V

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. Reynolds analogy.

REFERENCE BOOKS

1. Geankoplis C.J. 1978. Transport Port Processes and Unit Operations. Allyn and Bacon Inc., Newton, Massachusetts.
2. Holman J P. 1989. Heat Transfer. McGraw Hill Book Co., New Delhi.
3. Incropera F P and De Witt D P. 1980. Fundamentals of Heat and Mass Transfer. John Wiley and Sons, New York.
4. Gupta C P and Prakash R. 1994. Engineering Heat Transfer. Nem Chand and Bros., Roorkee.

MAT18R106	Engineering Mathematics- II	L	P	C
		2	0	2

UNIT I

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.

UNIT II

Functions of a complex variable: Limit, continuity, and derivative of complex functions, analytic function. Cauchy-Reimann equations, conjugate functions, harmonic functions

UNIT III

Infinite series and its convergence, periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions. Functions having an arbitrary period, even and odd functions, half range series, harmonic analysis;

UNIT IV

Partial differential equations: Formation of partial differential equations, Lagrange's linear equation. Higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpits method

UNIT V

Application of partial differential equations (one-dimensional wave and heat flow equations, two-dimensional steady-state heat flow equation (Laplace equation)).

TEXTBOOKS

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

AGE18R154	Environmental Science and Disaster Management	L	P	C
		2	1	3

UNIT I

Scope and importance of environmental studies, Natural resources: Renewable and renewable resources, forest, water, food, energy and land resources, Ecosystems: Definition, concept, structure, and functions. Producers, consumers, and decomposers of an ecosystem, Energy flow in the ecosystem.

UNIT II

Types of ecosystems, Bio-diversity; Definition, classification, threats to biodiversity and its conservation, Environmental pollution; causes, effects, and control of air, water, soil, thermal, noise, and marine pollution.

UNIT III

Causes, effects, and management of soil nuclear hazards and industrial wastes, Disaster management, Floods, earthquakes, cyclones, and landslides. Social issues and the environment, unsustainable to sustainable development.

UNIT IV

Global warming - greenhouse gases and management. Biological oxygen demand and chemical oxygen demand; definition, determination in effluents. Noise pollution - Causes, effect, and management.

UNIT V

The environment protection Act. The Air Act. The water Act. The wildlife protection Act and the Forest Conservation Act. Woman and child welfare, HIV/AIDS and Role of information technology on the environment and human health.

PRACTICAL SCHEDULE

1. Collection, processing, and storage of effluent samples
2. Determination of Biological oxygen demand(BOD) in the effluent sample
3. Determination of Chemical oxygen demand (COD) in the effluent sample
4. Estimation of dissolved oxygen in effluent samples
Determination of sound level meter
5. Estimation of respirable and non-respirable dust in the air by using portable dust sampler
6. Determination of total dissolved
7. Pollution case studies. Case Studies - Fieldwork
8. Visit a local area to document environmental assets river and forest.
9. Visit a local area to document environmental assets grassland, hill/ mountain
10. Visit a local polluted site-Urban/Rural - Visit a local polluted site- Industrial/ Agricultural
11. Study of common plants
12. Study of common insects
13. Study of common birds
14. Study of simple ecosystems- pond
15. Study of simple ecosystems- river
16. Study of simple ecosystems- hill slopes

REFERENCE BOOKS

1. The perspective of Environmental Sciences – Kaushik & Kaushik
2. Air Environment and Pollution – S.S. Purohit
3. Water Pollution causes, effects, and control – P.K. Goel
4. Biodiversity and Forest genetic resource – D.N. Tiwari
5. Biodiversity: Planning for sustainable Development – J. Singh
6. Text Book of Ecology and Environment – S.C. Joshi
7. Environmental Engineering – G. Kiely
8. Environmental Engineering – B.K. Nanda and T. Biswal

AGE18R155	Entrepreneurship Development and Business Management	L	P	C
		2	1	3

UNIT I

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.

UNIT II

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.

UNIT III

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 phytosanitary (SPS) measures, Trade-related intellectual property rights (TRIPS).

UNIT IV

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 the 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.

UNIT V

Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for the 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 the agricultural engineering industry, characteristics of Indian farm machinery industry.

PRACTICAL SCHEDULE

1. Preparation of business plan
2. Strengths Weaknesses Opportunities and Threats (SWOT) analysis
3. Analysis of financial statements (Balance Sheet, Profit loss statement)
4. Compounding and discounting
5. Break-even analysis
6. Visit agro-based industries – I
7. Visit agro-based industries – II
8. Study of Agro-industries Development Corporation

9. Ratio analysis – I
10. Ratio analysis – II
11. Application of project appraisal technique – I(Undiscounted measures)
12. Application of project appraisal technique – II(Discounted Measures)
13. Formulation of project feasibility reports
14. Farm Machinery Project proposals as an entrepreneur - individual
15. Farm Machinery Project proposals as entrepreneur - group
16. Presentation of project proposals in the class.

REFERENCE BOOKS

1. Harsh, S.B., Conner, U.J. and Schwab, G.D. 1981. Management of the Farm Business. Prentice Hall Inc., New Jersey.
2. Joseph, L. Massie. 1995. Essentials of Management. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Omri Rawlins, N. 1980. Introduction to Agribusiness. Prentice Hall Inc., New Jersey
4. Gittinger Price, J. 1989. Economic Analysis of Agricultural Projects. John Hopkins University, Press, London.
5. Thomas W Zimmer and Norman M Scarborough. 1996. Entrepreneurship. Prentice-Hall, New Jersey.
6. Mark J Dollinger. 1999. Entrepreneurship Strategies and Resources. Prentice-Hall, Upper Saddle River, New Jersey.
7. Khanka S S. 1999. Entrepreneurial Development. S. Chand and Co. New Delhi.
8. Mohanty S K. 2007. Fundamentals of Entrepreneurship. Prentice Hall India Ltd., New Delhi.

AGE18R156	Fluid Mechanics and Open Channel Hydraulics	L	P	C
		2	1	3

UNIT I

Properties of fluids–definition–units of measurement- Mass density–specific weight, specific volume–specific gravity equation of state–perfect gas-Viscosity– vapor pressure–compressibility and elasticity of surface tension – capillarity. Fluid pressure and measurement –simple, differential and micro mano meters-Mechanical gages–calibration.

UNIT II

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

UNIT III

Bernoulli's equation – applications – Venturimeter – orifice meter – nozzle meter rotameter–elbow meter pitot tube–Orifice–sharp-edged orifice discharging free–submerged orifice–mouthpiece-Flow through an orifice under the variable head– a time of emptying the 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-Williams 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

Types of flow in the 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, Cippollette and triangular– float method-Flow measurement in rivers/streams/canals–weirs–free and submerged flow–current meter–Parshall flume.

UNIT V

Dimensional analysis– the 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 horsepower – a selection of pump capacity. Centrifugal pumps–components–working– types of pumps and impellers- Priming–cavitation–specific speed– characteristics curves. Turbine and submersible pumps –Jet pump– jet assembly- Other pumps–Airlift pump-reciprocating pump-sludge pump and vacuum pump-Hydraulic ram.

PRACTICAL SCHEDULE

1. Study of manometers and pressure gauges; Verification of Bernoulli's theorem
2. Determination of coefficient of discharge of venturi-meter and orifice meter
3. Determination of coefficient of friction in the pipeline
4. Determination of coefficient of discharge for rectangular and triangular notch
5. Determination of coefficient of discharge, the coefficient of velocity and coefficient of contraction for flow through the orifice
6. Determination of coefficient of discharge for the mouthpiece
7. Measurement of force exerted by water jets on flat and hemispherical vanes
8. Determination of meta-centric height
9. Determination of the efficiency of the hydraulic ram
10. Performance evaluation of Pelton and Francis turbine
11. Study of current meter
12. Velocity distribution in open channels and determination of Mannings coefficient of rugosity.

TEXTBOOK

1. Modi, P.N. and Seth S.M., 2010. Hydraulics and fluid mechanics, Standard Publishers Distributors, New Delhi.

REFERENCE BOOKS

1. Bansal, R.K., 2002. A textbook of fluid mechanics and hydraulic machinery, Laxmi publications (P)Ltd., New Delhi.
2. Grade, R.J., 2002. Fluid mechanics through problems. Wiley Eastern Ltd., Madras.
3. Micheal A.M. and S.D. Khepar, 2005. Water well and pump engineering. Tata Mc Graw Hil lCo., New Delhi.
4. Jagdish Lal, 2000. Hydraulic machines. Metropolitan book house, New Delhi.
5. Michael, A.M. 2008. Irrigation Theory and practice, Vikas publishing house, New Delhi.

AGE18R157	Strength of Materials	L	P	C
		1	1	2

UNIT I

Simple Stresses and Strains – Hooke’s Law – Modulus of Elasticity – Principle of Superposition – bars of varying sections – thermal stresses and strains – Elastic Constants – Poisson’s Ratio – Bulk Modulus – Shear Modulus – interrelationships – Strain Energy and Impact Loading – Proof Resilience – Modulus of Resilience – Principal Stresses and Strains – Oblique sections – Analytical method – Graphical method (Mohr’s Circle method).

UNIT II

Centroid and Centre of Gravity – geometrical considerations – method of moments – Plane (laminae) sections - symmetrical sections – unsymmetrical sections – solid bodies and sections with cut out holes –Moment of Inertia – Routh’s rule – method of integration – Theorem of Parallel axes – Theorem of Perpendicular axes – geometric sections - solid and hollow sections – composite and built-up sections.

UNIT III

Structures built of Frames - Types of Frames –Perfect and imperfect frames – deficient and redundant frames – Loads and stresses – Method of Joints – Method of sections – Graphical method – Bow’s notations – polar diagram – funicular polygon – vector diagram – cantilever trusses – freely supported trusses –King Post and Queen Post Trusses.

UNIT IV

Cantilever beams and simply supported beams – continuous beams and overhanging beams –Uniformly distributed load and gradually varying load – Shear Force and Bending Moment distributions – Theory of Simple Bending - Bending stress – modulus of the section – deflection in beams and cantilevers – Double integration method – Macaulay’s method.

UNIT V

Columns and struts – Slenderness ratio – Buckling and crushing - Euler’s Column theory – applications – Rankine’s formula – Johnson’s formula – Indian Standards – Shells – Cylindrical and spherical shells – thin and thick shells – Shafts – torsion in circular shafts – Polar Moment of Inertia – strain energy due to torsion.

Practical Schedule

1. Calculations of simple stresses, strains and Young’s Modulus of Elasticity in bars of uniform sections, varying sections and uniformly tapering sections
2. Determination of Elastic Constants using their inter-relationships
3. Calculation of thermal stresses and strains in uniform and composite sections
4. Determination of Principal Stresses in Oblique sections: Analytical solutions
5. Determination of Principal Stresses in Oblique sections: Graphical (Mohr’s Circle) solutions
6. Centre of Gravity and Moment of Inertia calculations solid, plane and cutout sections
7. Analysis of Framed Structures: Method of joints and method of sections (analytical)
8. Analysis of Framed Structures: Graphical solution (Bow’s notations and Vector diagram)

9. Drawing Shear Force and Bending Moment distribution along cantilever beams point load and uniformly distributed loads
10. Drawing Shear Force and Bending Moment distribution along cantilever beams: Gradually varying loads (triangular and trapezoidal pattern)
11. Drawing Shear Force and Bending Moment distribution along simply supported beams point load and uniformly distributed loads
12. Drawing Shear Force and Bending Moment distribution along simply supported beams Gradually varying loads (triangular and trapezoidal pattern)
13. Drawing Shear Force and Bending Moment distribution along overhanging beams point load and uniformly distributed loads
14. Drawing Shear Force and Bending Moment distribution along overhanging beams Gradually varying loads (triangular and trapezoidal pattern)
15. Calculations on Deflection of beams: double integration and Macaulay's methods
16. Calculations on Bending Stresses and Shearing stresses in beams

TEXT BOOK

1. Khurmi, R.S. (2013). The strength of Materials (Mechanics of Solids). 24th Edition. S.Chand & Company Ltd, India

REFERENCE BOOKS

1. Rajput, R.K. (2010). The strength of Materials (Mechanics of Solids). 4th edition. S.Chand & Company Ltd. India
2. Ramamrutham, S. (2008). The strength of Materials. 16th edition. Dhanpat Rai Publishing Co., India

AGE18R158	Workshop Technology and Practices	L	P	C
		1	2	3

UNIT I

Introduction to various carpentry tools, materials, types of wood and their characteristics and Processes or operations in woodworking; Introduction to Smithy tools and operations.

UNIT II

Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. The principle of arc welding, equipment, and tools.

UNIT III

Casting processes. Classification, constructional details of the center lathe, Main accessories, and attachments. Main operations and tools used on center lathes. Types of shapers, Constructional details of the standard shaper. Work holding devices, shaper tools, and main operations.

UNIT IV

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.

UNIT V

Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on a milling machine.

PRACTICAL SCHEDULE:

1. Preparation of simple joints: Cross half Lap joint and T-Halving joint.
2. Preparation of Dovetail joint, Mortise, and tenon joint; Jobs on Bending, shaping, etc.
3. Jobs on Drawing, Punching, Rivetting.
4. Introduction to tools and measuring instruments for fitting; Jobs on sawing, filing and right angle fitting of MS Flat.
5. Practical in the more complex fitting job.
6. Operations of drilling, reaming, and threading with tap and dies; Introduction to tools and operations in sheet metal work
7. Making different types of sheet metal joints using G.I. sheets.
8. 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.
9. Gas welding Practice – Lab, butt, and T-Joints.
10. Introduction to metal casting equipment, tools, and their use
11. Mould making using a one-piece pattern and two pieces pattern.
12. Demonstration of mould making using sweep pattern, and match plate patterns.
13. Introduction to machine shop machines and tools.
14. Demonstration on Processes in machining and use of measuring instruments; Practical jobs on simple turning, step turning.
15. Practical job on taper turning, drilling and threading.

16. Operations on shaper and planer, changing around MS rod into the square section on a shaper.
17. Demonstration of important operations on a milling machine, making a plot, gear tooth forming and indexing. Any additional job.

TEXTBOOKS

1. Hazra, Choudari S K and Bose S K. 1982. Elements of Workshop technology (Vol. I and II). Media Promoters and Publishers Pvt. Ltd., Mumbai.
2. Chapman W A J. 1989. Workshop Technology (Part I and II). Arnold Publishers (India) Pvt. Ltd., AB/9 Safdarjung Enclave, New Delhi.
3. Raghuwamsi B S. 1996. A Course in Workshop Technology (Vol. I and II). Dhanpat Rai and Sons, 1682 Nai Darak, New Delhi

AGE18R102	Theory of Machines	L	P	C
		2	0	2

UNIT I

Mechanism- definitions - kinematic links,-types of constrained motion - Kinetic pairs – classification. Kinematic chain- machine and mechanism – equations and criterion. Four bar chain –slider crank chain-double slider crank chain and their inversions. Straight line mechanisms and their applications. Different techniques of obtaining velocity and acceleration in different mechanisms

UNIT II

Kinetics of motion-principles of conservation of energy and momentum- drive torque in the geared system. Friction – concepts sliding of the body on the horizontal and inclined plane. Friction in a screw- screw jack. Pivot and collar friction. Brakes-types, and calculation of braking effort for simple braking systems

UNIT III

Friction clutches-principle-torque transmitted. Power transmission by belt-expression for tension ratio – belt tension belt drive - the ratio of driving tensions. Chain drives –terminology - chain classification - chain length determination- sprocket terminology

UNIT IV

Toothed gears - advantages-classification- terminology. Law of gearing-velocity of sliding-gear teeth profiles -minimum number of teeth techniques of reducing interference. Gear trains- simple compound and reverted - Cams – application- classification - followers – classification- Radial cam terminology Procedure for obtaining cam profile for uniform velocity, acceleration, and deceleration. Simple harmonic and cycloidal motions

UNIT V

Governors – Watt and Porter – the principle of operation Sensitivity and hunting - power and effort. Turning moment diagram and flywheel – fluctuations of speed and energy Balancing - static and dynamic - balancing of rotating masses in single and multiple planes

TEXTBOOKS

1. Khurmi, R.S. and Gupta, J. K. 2007. S Chand & Co Ltd;
2. Ballaney, P.L. 1994. Theory of machines. Khanna publishers. New Delhi.

REFERENCE BOOKS

- 1.Jagdish Lal. 1992. Theory and mechanisms and machines. Metropolitan Book Pvt. Ltd. New Delhi
- 2.Rao, J.S. and Dukkipatti, R.V. 1990. Mechanisms and machine theory, Wiley Eastern. New Delhi.
- 3.Rattan, S.S. 1993. Theory of machines, Tata McGraw Hill Publishing Co. New Delhi.
- 4.Thomas Beven. 1984. Theory of machines, CBS Publishers and Distributors, New Delhi.

CSE18R***	Web Designing and Internet Applications	L	P	C
		1	1	2

UNIT I

Basic principles in developing a web designing, Planning process, Five Golden rules of web designing.

UNIT II

The designing navigation bar, Page design, Home Page Layout, Design Concept. Basics in Web Design.

UNIT III

Brief History of the Internet, World Wide Web, the creation of a website, Web Standards, Audience requirement.

UNIT IV

Introduction to Java Script, variables & functions.

UNIT V

Working with alert, confirm and prompt, Connectivity of Web pages with databases. Project.

PRACTICAL SCHEDULE:

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

TEXTBOOKS:

1. Jennifer Niederst Robbins. Developing web design latest edition.
2. Frain and Ben. Responsive Web Design with HTML5.
3. Nicholas c.Zakas. Java Script for Web Developers.
4. George Q. Huang, K. L Mak. Internet Applications in Product Design and Manufacturing.

AGE18R251	Principles of Horticultural Crops and Plant protection	L	P	C
		1	1	2

UNIT I

Horticulture - Definition – scope and importance – nutritive value and global scenario of horticultural crops-Division and classification of horticultural crops–Horticultural zones in India.

UNIT II

Propagation – definition – propagation methods – seed propagation-vegetative propagation - cutting, layering, grafting and budding methods – specialized plant parts for propagation – micropropagation.

UNIT III

Planting systems including HDP and UHDP – Cropping systems - Protected cultivation- principles and structures used–shade net houses, poly houses-Special structures used for propagation– mist chambers, hotbeds. Weed management – irrigation and moisture conservation.

UNIT IV

Nutrient application methods in horticultural crops – Root architecture – Special practices - training, pruning, ringing, notching, disbudding and pinching-Canopy management and crop regulation–physical and chemical regulation. Maturity indices— harvesting methods, precooling– packaging, packing methods– storage of horticultural crops.

UNIT V

Major pests and diseases and their management in horticulture crops.

PRACTICAL SCHEDULE:

1. Visit Orchard and study of different components
2. Horticultural tools and implements used for various operations.
3. Preparation of pot mixture, potting and reporting.
4. Commercial propagation techniques in horticultural crops- practicing layering and cutting.
5. Practicing propagation method-budding and grafting
6. Practices training and pruning in horticultural crops
7. Study of major fruit crops and important varieties
8. Study of major vegetable crops and important varieties
9. Study of major flower crops and important varieties
10. Study of major spices and plantation crops
11. Study of major medicinal and aromatic crops.
12. Irrigation, fertilizer application and weed management practices
13. Maturity indices for the harvesting of horticultural crops
14. Maintenance of lawn, hedges, and edges through machinery
15. Plant propagation structures
16. Visit private orchards to identify different features of an orchard.

TEXTBOOKS

1. George Acquaah.2002.Horticulture-principles and practices. Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Kumar, N. 2010. Introduction to Horticulture, Oxford and IBH Publication, New Delhi.

REFERENCE BOOKS

1. Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, NewDelhi.
2. Edmond,J.B.T.L.Senn,F.S.Andrews and P.G.Halfacre, 1975.Fundamentals of Horticulture, Tata Mc. Graw Hill Publishing Co.New Delhi.
3. Hartman, H.T. and Kester, D.E.1986. Plant Propagation–Principles and Practices–Prentice Hall of India Ltd., New Delhi.
4. Veeraragavathatham, D., M. Jawaharlal, S. Jeeva, Rabindran, and Umapathi. 2004. Scientific fruit culture. Suri Associates, Coimbatore.

AGE18R252	Principles of Agronomy	L	P	C
		2	1	3

UNIT I

Agriculture - Definition - Importance and scope - Branches of agriculture - Evolution of man and agriculture - History of agricultural development in the World and India.

UNIT II

Agriculture heritage - Agriculture in ancient India - Stages of agriculture development - Era of civilization - Importance of Neolithic civilization - Chronological agricultural technology development in India - Kautilya's Arthashastra - Sangam literature - Kambar Eazhupathu - ITK - Development of scientific Agriculture - National and International Agricultural Research Institutes in India - Indian agriculture.

UNIT III

Agronomy - Definition - Importance - Meaning and scope - Agro-climatic zones of Tamil Nadu - Agro-ecological zones of India - Crops and their classification - Economic and agronomic - Major crops of India and Tamil Nadu - Major soils of Tamil Nadu - Factors affecting crop production - climatic - edaphic - biotic - physiographic and socio-economic factors.

UNIT IV

Tillage - Definition - Types - Objectives - Modern concepts of tillage - Main field preparations - Seeds - seed rate - sowing methods - Crop establishment methods - Planting geometry and its effect on growth and yield - After cultivation - Thinning - Gap filling - Weeds - Definition - Weed control methods.

UNIT V

Manures and fertilizers (organic, inorganic, green manure) - time and method of application - Irrigation - Principles and concepts - Cropping patterns and cropping systems - Sustainable agriculture - integrated farming systems - Organic agriculture - Principles and concepts - Dry farming - Principles and concepts.

PRACTICAL SCHEDULE

1. Visit college farm
2. Study of farm features and measurements
3. Identification of crops and seeds
4. Working out seed rate: Different methods of sowing and effect of sowing depth on germination and seedling vigor
5. Study of seed treatment practices
6. Study of tillage implements; practicing ploughing, puddling operations, practicing seeding different methods of sowing and planting
7. Study and practicing inter-cultivation implements; Practicing fertilizer applications - Participation in ongoing field operations.
8. Identification of manures and fertilizers
9. Fertilizer recommendation and calculations
10. Methods of fertilizer applications- broadcasting, placement, foliar application and fertigation

11. Computation of seed rate, plant population
12. Yield contributing characters and yield estimation of crops
13. Seed testing – germination test, viability test.
14. Identification of weeds in crops: Techniques of weed collection and preservation
15. Different methods of sowing and effect of sowing depth on germination and seedling vigour
16. Herbicide formulation and identification- Herbicide label information

REFERENCE BOOKS

1. Yellamananda Reddy, T. and G.H. Sankara Reddi. 1997. Principles of Agronomy. Kalyani Publishers, New Delhi.
2. Sankaran, S. and V.T. Subbiah Mudaliar. 1997. Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
3. ICAR. 2011. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.

HSS18R***	Communication Skills and Personality Development	L	P	C
		1	1	2

UNIT I

Communication skills: Structural and functional grammar; Meaning and process of communication; Verbal and nonverbal communication; Listening and note taking; Writing skills;

UNIT II

Oral presentation skills; Field diary and lab record; Indexing, footnote and bibliographic procedures; Reading and comprehension of general and technical articles; Precise writing, summarizing, abstracting.

UNIT III

Individual and group presentations; Impromptu presentation; Public speaking; Group discussion and interviews; Organizing seminars and conferences.

UNIT IV

Voice modulation basics and their usage for a meaningful impact on people. Attributes of an effective leader; Stress and conflict management.

UNIT V

Time management: Personal organization, prioritizing and balancing; Cosmopolitan culture; Impact of nonverbal communication; Science of body language; Role of teamwork.

PRACTICAL SCHEDULE:

1. Listening and note-taking.
2. Writing skills.
3. Oral presentation skills.
4. Field diary and lab record.
5. Indexing, footnote, and bibliographic procedures.
6. Reading and comprehension of general and technical articles.
7. Precise writing, summarizing, abstracting.
8. Individual and group presentations.
9. Video recorded mock group discussions and interviews.
10. Attitude management.
11. Setting and achieving a short-term goal.
12. Creating a personal vision statement of life.
13. Voice modulation
14. Practicing conscious body postures and movements.
15. Rapport building.
16. Video recorded practically to evaluate the change in confidence level.
17. Teamwork exercises.
18. Time management.

TEXTBOOKS:

1. Carroll, B.J. 1986. English for college, Macmillan India Ltd. New Delhi
2. Hahn, "The Internet complete reference", TMH
3. Hornby, A.S. 1975. Guide to patterns and usage in English. Oxford University, NewDelhi.
4. Quirk, R and Green baum, S 2002. University grammar

MAT18R210	Engineering Mathematics-III	L	P	C
		2	1	3

UNIT I

Numerical analysis and Laplace transformation: finite difference, various difference operators, and their relationships. factorial notation, interpolation with equal intervals. Newtons forward and backward interpolation formula.

UNIT II

Bessels and Stirlings difference interpolation formulae. Interpolation with unequal intervals. Newtons divided difference formula. Lagrange's interpolation formula.

UNIT III

Numerical differentiation, numerical integrations, difference equations and their solutions, numerical solutions of ordinary differential equations by Picards Taylors series. Fullers and modified Fullers methods.

UNIT IV

Runga-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).

UNIT V

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.

PRACTICAL SCHEDULE:

1. Interpolation.
2. Numerical differentiation and integration solutions of difference equations
3. Numerical solution of ordinary differential equations of first order and first degree
4. Laplace and inverse Laplace transformations and their application to the solution of ordinary and simultaneous differential equations.
5. Problems on One Sample, Two-sample Z-tests when Population S.D. is known and unknown
6. Problems on one sample, Two sample and paired t-test Chi-Square test -2×2 and $m \times n$. Calculation of Correlation coefficient and its testing.
7. Contingency Table and F-test.

TEXTBOOKS:

1. Chandel SRS. A Handbook of Agricultural Statistics. Achal Prakasam Masndir, Kanpur.
2. Agrawal B L. Basic Statistics. Wiley Eastern Ltd. New Age International Ltd.
3. Nageswara Rao G. Statistics for Agricultural Sciences. BS Publications.
4. Rangaswamy R. A Text Book of Agricultural Statistics. New Age Int. publications Ltd.
5. Gupta S.C. Fundamental Applied Statistics.

AGE18R253	Soil Mechanics	L	P	C
		1	1	2

UNIT I

Introduction of soil mechanics, the field of soil mechanics, phase diagram, physical and index properties of soil, classification of soils, effective and neutral stress, the elementary concept of Boussinesq and Westergaard's analysis, new mark influence chart

UNIT II

Seepage Analysis; Quick condition-two dimensional flow-Laplace equation, Velocity potential and stream function, Flow net construction. Shear strength, Mohr stress circle, theoretical relationship between principal stress circle, theoretical relationship between principal stress, Mohr-Coulomb failure theory, effective stress principle.

UNIT III

Determination of shear parameters by direct shear test, triangle test & vane shear test. Numerical exercise based on various types of tests. Compaction, composition of soils standard and modified proctor test, abbot compaction and Jodhpur mini compaction test field compaction method and control.

UNIT IV

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 and Casagrande method, determination of the coefficient of consolidation

UNIT V

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: an introduction to stability analysis of infinite and finite slopes friction circle method, Taylor's stability number

PRACTICAL SCHEDULE:

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

TEXTBOOKS:

1. Punmia BC, Jain A K and Jain A K. 2005. Soil Mechanics and Foundations. Laxmi Publications (P) Ltd. New Delhi.
2. Ranjan Gopal and Rao A S R. 1993. Basic and Applied Soil Mechanics. Welley Easters Ltd., New Delhi.
3. Singh Alam. 1994. Soil Engineering Vol. I. CBS Publishers and Distributions, Delhi.

AGE18R254	Design of Structures	L	P	C
		1	1	2

UNIT I

Loads and use of BIS Codes.

UNIT II

Design of connections.

UNIT III

Design of structural steel members in tension, compression and bending.

UNIT IV

Design of steel roof truss

UNIT V

Analysis and design of singly and doubly reinforced sections, Shear, Bond and Torsion. Design of Flanged Beams, Slabs, Columns, Foundations, Retaining walls and Silos.

PRACTICAL SCHEDULE:

1. Design and drawing of single reinforced beam, double reinforced beam.
2. Design and drawing of steel roof truss.
3. Design and drawing of one way, two way slabs.
4. Design and drawing of RCC building.
5. Design and drawing of Retaining wall.
6. To measure workability of cement by slump test.

TEXT BOOKS:

1. Junarkar, S.B. 2001. Mechanics of Structures Vol. I Charotar Publishing Home, Anand.
2. Khurmi R. S. 2001. The strength of materials. S. Chand & Company Ltd., 7361, Ram Nagar, New Delhi – 110055.
3. Kumar Sushil 2003. Treasure of R.C.C. Design. R.K. Jain. 1705-A, Nai Sarak, Delhi-110006, P.B.1074.

AGE18R201	Machine Design	L	P	C
		2	0	2

UNIT I

General considerations in machine design – strength properties of engineering materials. Limits and tolerances – Types of Fits – simple stresses in machine elements – tension – compression – shear and bearing stresses. Torsional and bending stresses in machine parts- torsional stresses in shafts, bending stresses in beams – combined stresses. Theories of failure – Rankine’s and Guest theory.

UNIT II

Design of permanent joints – Welded joints – comparison of welded and riveted joints – types of welded joints – transverse and parallel strength of fillet welds – design of butt joints – Rivets and riveted joints – failure modes of riveted joints – design of non-permanent joints – threaded fasteners – stresses in screwed fastening due to static loading.

UNIT III

Keys and couplings – the strength of sunk keys-Shaft couplings – design of sleeve coupling and flange coupling. Design of cotter and knuckle joints – Design of shafts – shafts subjected to torsion, bending and combined stresses. Power screws – design of screw jack.

UNIT IV

Belt drives - flat belts – Euler’s formula – V-belt design – power calculation and selection – chain drive – design. Springs – types of springs – properties of spring material – terminology – design of helical springs.

UNIT V

Bearings – types of bearings - rolling contact bearings– principles behind the selection of bearings. Spur gear – classification – gear terminology – law of gearing – Strength of gear teeth – Lewis equation – Buckingham equation – bevel gear – terminology – design of gear teeth.

TEXTBOOKS

1. Khurmi, R.S. and Gupta, J.S. 2006. Reprint. A textbook of Machine design. Eurasia Publishing House Pvt Ltd., New Delhi
2. Narayana, K.L., and P.Kannaiah. 1992. Engineering graphics. Tata McGraw-Hill pub.

REFERENCE BOOKS

1. Gill, P.S. 1992. A textbook of machine drawing. S.K. Kataria and sons, New Delhi.
2. Siddeswar, N, P.Kannaiah and V.V.S Sastry. 1993. Machine drawing. Tata McGraw-Hill pub.
3. Kannaiah, P.2003. Machine Design Scitech Publishers (India) Pvt Ltd. Chennai.

AGE18R255	Thermodynamics, Refrigeration and Air Conditioning	L	P	C
		2	1	3

UNIT -I

Thermodynamics- Basic concepts of system and its properties. Temperature-scales. Thermodynamic equilibrium. Pressure units and conversion. Energy - heat and thermal capacity- Mechanical equivalent of heat, Heat and work, Point function and path function Zeroth law. First law of thermodynamics – energy balance of closed system. Gas laws – characteristic equation - Avogadro's law – universal gas constant. Specific heat of gas – internal energy, enthalpy, Regnault's law – relation between specific heats.

UNIT-II

Thermodynamic Process- classification – work done and application of first law of thermodynamics to a non-flow process. Work done and heat transferred during constant volume and constant pressure isothermal adiabatic and polytropic non-flow processes. Application of first law of thermodynamics to a steady flow process and work done for constant volume and pressure process. Work done for steady flow process – constant temperature, adiabatic and polytropic - applications-boiler-condenser-compressor

UNIT-III

Limitation of first law - Second law of thermodynamics – Kelvin Planck and Clausius statement – equivalence. COP of refrigerator and heat pump. Relation between heat and entropy – importance of entropy – Clausius inequality – principle of increase of entropy. Expression for change of entropy of a perfect gas in terms of V-T, P-T and P-V. Change of entropy of a perfect gas during constant volume and constant pressure process, isothermal, adiabatic and polytropic process

UNIT IV

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, supercooling and subcooling. Vapor absorption refrigeration system. Common refrigerants and their properties. Design calculations for a refrigeration system

UNIT V

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 the design of complete air conditioning systems – humidifiers and dehumidifiers – cooling load calculations, types of air conditioners – applications.

PRACTICAL SCHEDULE:

1. Tutorials on thermodynamic air cycles
2. Study and application of P V and T S chart in refrigeration, P H chart (or) Mollier diagram in refrigeration
3. Numerical on-air refrigeration cycle systems
4. Numerical on vapor compression cycle refrigeration system

5. Study of domestic water cooler
6. Study of the domestic household refrigerator
7. Study of absorption type solar refrigeration system
8. Study cold storage for fruit and vegetables
9. Freezing load and time calculations for food materials
10. Determination of refrigeration parameters using refrigeration tutor – II
11. Numerical on the design of air conditioning systems
12. Study of window air conditioner
13. Study on repair and maintenance of refrigeration and air-conditioning systems.
14. Visit chilling or ice making and cold storage plants.

TEXTBOOKS

1. Arora, C. P. 1981. Refrigeration and Air conditioning. Tata-McGraw-Hill Publishing Co., New Delhi.
2. Kurmi.R.S and J.K.Gupta 2002. A Textbook of Refrigeration and Air conditioning. Eurasia Publishing House (P) Ltd, Ram Nagar, New Delhi.
3. Khurmi.R.S.and J.K. Gupta, 2012. A Textbook of Thermal Engineering, S.Chand and Co. Ltd. New Delhi

AGE18R256	Electrical Machines and Power Utilization	L	P	C
		2	1	3

UNIT I

Electromotive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses, Transformer: the principle of working, construction of single phase transformer,

UNIT II

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).

UNIT III

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.

UNIT IV

Polyphase induction motor: construction, operation, phasor diagram, the effect of rotor resistance, torque equation, starting and speed control methods. Single phase induction motor: double field revolving theory, equivalent circuit, characteristics.

UNIT V

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 SCHEDULE:

1. To obtain load characteristics of d.c. shunt/series /compound generator
2. To study characteristics of DC shunt/ series motors
3. To study d.c. motor starters; To Perform load-test on 3 pHS. Induction motor & to plot torque V/S speed characteristics
4. To perform no-load & blocked –rotor tests on 3ph. Induction motor to obtain equivalent ckt. parameters & to draw circle diagram.
5. To study the speed control of 3 pHS. induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
6. To study star- delta starters physically and (a) to draw electrical connection diagram (b) to start the 3 pHS. induction motor using it. (c) to reverse the direction of 3 pHS. I.M.
7. 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.
8. 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.
9. To perform load –test on 1 ph. Induction motor & plot torque-speed characteristics.
10. To study power consumed in a three-phase circuit
11. Two lights in series controlled by one switch
12. Two lights in parallel controlled by one switch.

TEXT BOOKS:

1. Thareja B L & Theraja AK. 2005. A text book of Electrical Technology. Vol. I S. Chand & Company LTD., New Delhi.
2. Theraja B L & Theraja AK 2005. A text book of Electrical Technology. Vol. II S.Chand & Company LTD., New Delhi.
3. Vincent Del Toro. 2000. Electrical Engineering Fundamentals. Prentice-Hall of India Private LTD., New Delhi.
4. Anwani M L. 1997. Basic Electrical Engineering. Dhanpat Rai & Co.(P) LTD. New Delhi.

AGE18R202	Building construction and Cost Estimation	L	P	C
		2	0	2

UNIT I

Building Materials: Rocks, Stones, Bricks Properties and varieties of Tiles, Lime, Cement, Concrete, Sand. Glass, Rubber, Plastics, iron, Steel, Aluminium, Copper, Nickel. Timber. Building components: Lintels, Arches, staircases

UNIT II

Different types of floors, Finishing: Damp Proofing and waterproofing, Plastering, pointing, whitewashing and distempering – Painting, Building design, Design procedures, Technology, building construction.

UNIT III

Types of agricultural buildings and related needs, application of design theory and practice to the conservation, sloped and flat roof buildings, construction economics: Preliminary estimates, Detailed Estimates of Buildings source of cost information, use of cost analyses for controlling design.

UNIT IV

Factors affecting building costs; cost evaluation of design and planning alternatives for building and estate development, Measurement and pricing.

UNIT V

Economic methods for evaluating investments in buildings and building systems: cost-in-use, benefit-to-costs and savings-to-investment ratios, rate of return, net benefits, payback.

TEXT BOOKS:

1. Punmia B.C. Ashok Kumar Jain and Arun Kumar Jain. Building Construction. Laxmi Publications (P) Ltd., New Delhi.
2. Duggal S K. Building material. New Age International Publishers.
3. Sane Y.S. Planning and Designing of Buildings.
4. Rangwala S C. 1994. Engineering Materials. Charotar Publishing House, Anand.
5. Dutta B.N. 2000. Estimating and Costing. UBS publishers.

CSE18R***	Auto CAD Applications	L	P	C
		0	2	2

1. Application of computers for design. CAD- Overview of CAD window – Explanation of various options on drawing screen.
2. Study of draw and dimension tool bar. Practice on draw and dimension tool bar.
3. Study of OSNAP, line thickness and format tool bar. Practice on OSNAP, line thickness and format tool bar.
4. Practice on mirror, offset and array commands.
5. Practice on trim, extend, chamfer and fillet commands.
6. Practice on copy, move, scale and rotate commands.
7. Drawing of 2 D- drawing using draw tool bar.
8. Practice on creating boundary, region, hatch and gradient commands.
9. Practice on Editing polyline- PEDIT and Explode commands.
10. Setting of view ports for sketched drawings.
11. Printing of selected view ports in various paper sizes.
12. 2Ddrawing of machine parts with all dimensions and allowances- Foot step bearing and knuckle joint.
13. Sectioning of foot step bearing and stuffing box.
14. Drawing of hexagonal, nut and bolt and other machine parts.
15. Practice on 3-D commands- Extrusion and loft.
16. Practice on 3-D commands on sweep and press pull.
17. Practice on 3-D Commands- revolving and joining.
18. Demonstration on CNC machine and simple problems.

TEXT BOOKS:

1. Rao P.N.. 2002. CAD/CAM Principles and Applications. McGraw-Hill Education Pvt. Ltd., New Delhi.
2. Sareen Kuldeep and Chandan Deep Grewal. 2010. CAD/CAM Theory and Practice. S.Chand & Company Ltd., New Delhi.
3. Zeid Ibrahim. 2011. Mastering CAD/CAM with Engineering. McGraw-Hill Education Pvt. Ltd., New Delhi.
4. Lee Kunwoo. 1999. Principles of CAD/CAM/CAE Systems. Addison Wesley Longman, Inc.

AGE18R257	Applied Electronics and Instrumentation	L	P	C
		2	1	3

UNIT I

Semiconductors. p—n junction. V—I characteristics of p—n junction. diode as a circuit element. rectifier. clipper. damper, voltage multiplier, a capacitive filter. diode circuits for OR & AND (both positive and negative logic).

UNIT II

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 the small signal. CE amplifier. phase shift oscillator.

UNIT III

Analysis of differential amplifier using a 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).

UNIT IV

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.

UNIT V

Generalized instrumentation, measurement of displacement. temperature. velocity, force, and pressure using a potentiometer. resistance thermometer. thermocouples. Bourclen tube. LVDT. strain gauge and tacho-generator.

PRACTICAL SCHEDULE:

1. Study V-I characteristics of the p-n junction diode.
2. Study half wave. a full wave and bridge rectifier.
3. Study transistor characteristics in CE configurations
4. Design and study fixed and self-bias transistor
5. Design and study potential divider bias transistor
6. Study a diode as clipper and clamper
7. Study an OP-AMP IC 741 as inverting and non- inverting amplifier
8. Study an OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor
9. Study a OP-AMP IC 741 as differential amplifier
10. Study a zener regulator circuit
11. Study a OP-AMP IC 741 as a active rectifier
12. Study a OP-AMP IC 741 as a comparator
13. Familiarize with various types of transducers.

TEXT BOOKS:

1. Mehta V K. Principles of Electronics. S. Chand and Co., New Delhi.
2. Shaney A K. Measurement of Electronics and Electronic Instrumentation. Khanna Publications.
3. Roy Chowdary. Integrated Electronics. John Wiley International.
4. Kumar Anand. Digital Electronics. A. PHI.
5. Gupta Sanjeev, Sonthosh Gupta. Electronic Devices and Circuits. Danapath Rai Publications

AGE18R258	Tractor and Automotive Engines	L	P	C
		2	1	3

UNIT I

Study of sources of farm power –conventional & non-conventional energy sources. Classification of tractors and IC engines. Review of thermodynamic principles of IC (CI & SI) engines and deviation from the ideal cycle. General energy equation and heat balance sheet. Study of mechanical, thermal and volumetric efficiencies.

UNIT II

Study of engine components their construction, operating principles and functions. Study of engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines. Study of Engine Valve systems, valve mechanism, Valve timing diagram, and valve clearance adjustment. Study of Cam profile, valve lift, and valve opening area.

UNIT III

Study of the importance of air cleaning system. Study of types of air cleaners and performance characteristics of various air cleaners. Study of the fuel supply system. Study of fuels, properties of fuels, calculation of air-fuel ratio. Study of tests on fuel for SI and CI engines. Study of detonation and knocking in IC engines.

UNIT IV

Study of a carburetion system, carburetors, and their main functional components. Study of fuel injection system – Injection pump, their types, working principles. Fuel injector nozzles – their types and working principle. Engine governing – need of governors, governor types, and governor characteristics. Study of lubrication system – need, types, functional components. Study of lubricants – physical properties, additives and their application.

UNIT V

Engine cooling system – need, cooling methods, and main functional components. Study of need and type of thermostat valves. Additives in the coolant. Study of radiator efficiency. Study of the ignition system of SI engines. Study of the electrical system including a battery, starting the motor, battery charging, cut-out, etc. Comparison of dynamo and alternator. Familiarization with the basics of engine testing.

PRACTICAL SCHEDULE:

1. Introduction to different systems of CI engines
2. Engine parts and functions, working principles etc.
3. Valve system – study, construction, and adjustments
4. Oil & Fuel – determination of physical properties; Air cleaning system
5. Fuel supply system of SI engine
6. Diesel injection system & timing
7. Cooling system, and fan performance, thermostat and radiator performance evaluation
8. Part load efficiencies & governing
9. Lubricating system & adjustments
10. Starting and electrical system
11. Ignition system
12. Tractor engine heat balance and engine performance curves
13. Visit to engine manufacturer/ assembler/ spare parts agency.

TEXTBOOKS:

1. Liljedahl J B and Others. Tractors and Their Power Units.
2. Rodichev V and G Rodicheva. Tractors and Automobiles.
3. Mathur ML and RP Sharma. A course in Internal Combustion Engines.
4. Singh Kirpal. Automobile Engineering – Vol II.
5. Heitner Joseph. Automotive Mechanics: Principles and Practices.

AGE18R259	Engineering Properties of Agricultural Produce	L	P	C
		1	1	2

UNIT I

Classification and importance of engineering properties of Agricultural Produce, shape, size, roundness, sphericity, volume, density, porosity, specific gravity, the surface area of grains, fruits, and vegetables.

UNIT II

Thermal properties, Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion, Friction in agricultural materials; Static friction, Kinetic friction, rolling resistance, the angle of internal friction, the angle of repose.

UNIT III

The flow of bulk granular materials, Aerodynamics of agricultural products, drag coefficients, terminal velocity. Rheological properties; force, deformation, stress, strain, elastic, plastic and viscous behavior.

UNIT IV

Newtonian and Non-Newtonian liquid, Visco-elasticity, Newtonian and Non-Newtonian fluid, Pseudo-plastic, Dilatant, Thixotropic, Rheopectic and Bingham Plastic Foods, Flow curves.

UNIT V

Electrical properties; dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination. Application of engineering properties in handling processing machines and storage structures.

PRACTICAL SCHEDULE:

1. Determination of the shape and size of grains, fruits and vegetables.
2. Determination of bulk density and angle of repose of grains.
3. Determination of the particle density/true density and porosity of solid grains.
4. Finding the co-efficient of external and internal friction of different crops.
5. Finding out the terminal velocity of grain sample and study the separating behaviour in a vertical wind tunnel.
6. Finding the thermal conductivity of different grains.
7. Determination of specific heat of some food grains.
8. Determination of hardness of food material and determination of viscosity of liquid foods.

REFERENCE BOOKS

1. Mohesin, N.N. 1980. Physical Properties of Plants & Animals. Gordon & Breach Science Publishers, New York.
2. Mohesin, N.N. 1980. Thermal Properties of Foods and Agricultural Materials. Gordon & Breach Science Publishers, New York.
3. Prentice, J.H. 1984. Measurement in Rheological Properties of Food Stuffs. Elsevier Applied science Pub. Co. Inc. New York.
4. Rao, M.A. and Rizvi, S.H., 1995. Engineering Properties of Foods. Marcel Dekker Inc. New York.
5. Singhal OP & Samuel DVK. 2003. Engineering Properties of Biological Materials. Saroj Prakashan.

AGE18R260	Watershed Hydrology	L	P	C
		1	1	2

UNIT I

Hydrologic cycle, precipitation and its forms, rainfall measurement and estimation of mean rainfall, frequency analysis of point rainfall. Mass curve, hyetograph, depth-area-duration curves and intensity-duration-frequency relationship.

UNIT II

Hydrologic processes-Interception, infiltration –factors influencing, measurement and indices. Evaporation - Estimation and measurement. Runoff - Factors affecting, measurement, stage - discharge rating curve, estimation of peak runoff rate and volume.

UNIT III

Rational method, Cook’s method and SCS curve number method. Geomorphology of watersheds – Linear, aerial and relief aspects of watersheds- stream order, drainage density and stream frequency.

UNIT IV

Hydrograph - Components, base flow separation, unit hydrograph theory, S-curve, synthetic hydrograph, applications, and limitations. Stream gauging - discharge rating curves, flood peak.

UNIT V

Design flood and computation of probable flood. Flood routing – channel and reservoir routing. Drought – classification, causes and impacts, drought management strategy.

PRACTICAL SCHEDULE

1. Visit meteorological observatory and study of different instruments.
2. Design of rain gauge network.
3. Exercise on intensity - frequency - duration curves.
4. Exercise on depth - area – duration and double mass curves.
5. Analysis of rainfall data and estimation of mean rainfall by different methods.
6. Exercise on frequency analysis of hydrologic data and estimation of missing data, test for consistency of rainfall records.
7. Exercise on computation of infiltration indices.
8. Computation of peak runoff and runoff volume by Cooks method and rational formula.
9. Computation of runoff volume by SCS curve number method.
10. Study of stream gauging instruments - current meter and stage level recorder.
11. Exercise on geomorphic parameters of watersheds.
12. Exercise on runoff hydrograph.
13. Exercise on unit hydrograph.
14. Exercise on synthetic hydrograph.
15. Exercise on flood routing.

TEXTBOOKS:

1. Chow, V.T., D.R. Maidment and L.W. Mays. 2010. Applied Hydrology, McGraw Hill Publishing Co., New York.
2. Jaya Rami Reddy, P. 2011. A Text Book of Hydrology. University Science Press, New Delhi.
3. Linsley, R.K., M.A. Kohler, and J.L.H. Paulhus. 1984. Hydrology for Engineers. McGraw-Hill Publishing Co., Japan.
4. Mutreja, K.N. 1990. Applied Hydrology. Tata McGraw-Hill Publishing Co., New Delhi.
5. Raghunath, H.M. 2006. Hydrology: Principles Analysis and Design. Revised 2nd Edition, New Age International (P) Limited Publishers, New Delhi.
6. Subramanya, K. 2008. Engineering Hydrology. 3rd Edition, Tata McGraw-Hill Publishing Co., New Delhi.
7. Suresh, R. 2005. Watershed Hydrology. Standard Publishers Distributors, Delhi.
8. Varshney, R.S. 1986. Engineering Hydrology. Nem Chand and Brothers, Roorkee, U.P.

AGE18R261	Irrigation Engineering	L	P	C
		2	1	3

UNIT I

Major and medium irrigation schemes of India, purpose of irrigation, environmental impact of irrigation projects, source of irrigation water, present status of development and utilization of different water resources of the country.

UNIT II

Measurement of irrigation water: weir, flumes and orifices and other methods; open channel water conveyance system : design and lining of irrigation field channels, on farm structures for water conveyance, control & distribution.

UNIT III

Underground pipe conveyance system: components and design; land grading: criteria for land levelling, land levelling design methods, estimation of earth work.

UNIT IV

Soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil water potential, soil moisture characteristics, soil moisture constants, measurement of soil moisture, moisture stress and plant response.

UNIT V

Water requirement of crops: concept of evapotranspiration (ET), measurement and estimation of ET, water and irrigation requirement of crops, depth of irrigation, frequency of irrigation, irrigation efficiencies; surface methods of water application: border, check basin and furrow irrigation- adaptability, specification and design considerations.

PRACTICAL SCHEDULE:

1. Measurement of soil moisture by different soil moisture measuring instruments.
2. Measurement of irrigation water.
3. Measurement of infiltration characteristics.
4. Determination of bulk density, field capacity and wilting point.
5. Estimation of evapotranspiration.
6. Land grading methods.
7. Design of underground pipeline system.
8. Estimation of irrigation efficiency.
9. Study of advance, recession and computation of infiltration opportunity time.
10. Infiltration by inflow-outflow method.
11. Evaluation of border irrigation method.
12. Evaluation of furrow irrigation method.
13. Evaluation of check basin irrigation method.

TEXT BOOKS:

1. Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing House New Delhi.
2. Majumdar D. K. 2013. Irrigation Water Management Principles. PHI learning Private Limited New Delhi 2nd Edition.
3. Allen R. G., L. S. Pereira, D. Raes, M. Smith. 1998. Crop Evapotranspiration guidelines for computing crop water requirement. Irrigation and drainage Paper 56, FAO of United Nations, Rome.
4. Murthy VVN. 2013. Land and Water Management Engineering. Kalyani Publishers, New Delhi.
5. Israelsen O W. and Hansen V. E and Stringham G. E. 1980. Irrigation Principles and Practice, John Wiley & Sons, Inc. USA.

AGE18R262	Sprinkler and Micro Irrigation Systems	L	P	C
		1	1	2

UNIT –I

Indigenous water lifts -Pumps - Positive displacement and variable displacement pumps, hydraulic ram -Reciprocating pump - Work done - coefficient of discharge – slip

UNIT-II

Centrifugal pump-Volute-vortex-radial-mixed-axial-self priming, Installation-Troubles-Remedies Types- Multistage-Submersible-Turbine-Propeller-Jet-Air lift pumps, centrifugal pump-Work done -Head-static-dynamic-manometric, the Minimum speed of impeller-Diameter of suction & delivery, Limitation of suction lift, NPSH, Characteristics- efficiencies- Specific speed

UNIT-III

Micro irrigation-classification, Irrigation scheduling, Water Budgeting with micro irrigation, Hydraulics of micro irrigation- components-Valves- planning factors-Wetting pattern-crop geometries

UNIT-IV

Drip - design – Evaluation -Operation-maintenance, Sprinkler - design – Evaluation

UNIT V

Greenhouse irrigation system- design, Lift irrigation system – Design, Subsurface drip irrigation, Soilless culture, Fertigation, Automation.

Practical schedule

1. Performance Evaluation of Reciprocating pump
2. Performance Evaluation of Centrifugal pump
3. Performance Evaluation of Multistage pump
4. Problems on water Budgeting at a farm level for micro irrigation systems
5. Wetting pattern study of drippers
6. Determination of Drinker discharge coefficient and flow exponent
7. Design of drip sub mains
8. Design of drip main and pump capacity
9. Evaluation of uniformity of Drip system
10. Design of Drip system for a typical field
11. The wetting pattern of sprinklers
12. Sprinkler lateral and main design
13. Evaluation of sprinkler uniformity
14. Design of Sprinkler System for a typical field.
15. Greenhouse irrigation system design.
16. Lift irrigation and design of pipe network for many areal units

TEXTBOOKS

1. A.M.Michael, 2010. Irrigation - Theory and practice, Vikas Publishers, New Delhi.
2. Ravikumar. V, M.V.Ranghaswami, K.Appavu and S.Chellamuthu, 2011, Microirrigation & Irrigation Pumps, Kalyani Publishers, Ludhiana.
3. Michael Raviv and Heinrich Lieth. J., 2013, Soilless culture, Theory, and Practice, Elsevier

REFERENCE BOOKS

1. Jack Keller and Rond. Bleisner 1990. Sprinkler and Trickle irrigation, Van Nostrand Reinhold, New York.
2. Modi, P.N. and Seth, S.M. 2010, Hydraulics and fluid mechanics, Standard book house, New Delhi

AGE18R263	Fundamentals of Renewable Energy Sources	L	P	C
		2	1	3

UNIT I

Concept and limitation of Renewable Energy Sources (RES), Criteria for assessing the potential of RES, Classification of RES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of renewable energy sources with non renewable sources.

UNIT II

Solar Energy: Energy available from Sun, Solar radiation data, solar energy conversion into heat through, Flat plate and Concentrating collectors, different solar thermal devices, Principle of natural and forced convection drying system

UNIT III

Solar Photo voltaics: p-n junctions. Solar cells, PV systems, Stand alone, Grid connected solar power station, Calculation of energy through photovoltaic power generation and cost economics

UNIT IV

Wind Energy: Energy available from wind, General formula, Lift and drag. The basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Types of Windmill rotors, Determination of torque coefficient, Induction type generators, Working principle of wind power plant.

UNIT V

Bio-energy: Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification, Types of the gasifier, various types of biomass cookstoves for rural energy needs. Biogas: types of biogas plants, biogas generation, factors affecting biogas generation and usages, design consideration, advantages and disadvantages of biogas spent slurry.

PRACTICAL SCHEDULE:

1. Study of different types of solar cookers.
2. Solar water heating system.
3. Natural convection solar dryer.
4. Forced convection solar dryer.
5. Solar desalination unit.
6. Solar greenhouse for agriculture production.
7. Study on Biogas plants.
8. Study on Biomass gasifiers.
9. Study on Biomass improved cook-stoves.
10. Solar photovoltaic system

TEXTBOOKS:

1. Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.
2. Rai, G.D., Solar Energy Utilization, Khanna Publishers, Delhi.
3. Khandelwal, K.C. & S. S. Mahdi. 1990. Biogas Technology- A Practical Handbook.
4. Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Non-Conventional Energy Sources, Himanshu Publications.
5. Tiwari, G.N. and Ghoshal, M.K. 2005. Renewable Energy Resources: Basic Principles and Applications. Narosa Pub. House. Delhi.
6. Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Renewable Energy, Theory and Practice, Himanshu Publications.

AGE18R351	Tractor Systems and Controls	L	P	C
		2	1	3

UNIT I

Study of the need for the transmission system in a tractor. Transmission system – types, major functional systems. Study of the clutch – need, types, functional requirements, construction, and principle of operation. Familiarization with a single plate, multi-plate, centrifugal and dual clutch systems. Study of Gear Box – Gearing theory, the principle of operation, gearbox types, functional requirements, and calculation for speed ratio.

UNIT II

Study of the differential system – need, functional components, construction, the calculation for speed reduction. Study of the need for a final drive. Study of Brake system – types, the principle of operation, construction, the calculation for braking torque. Study of steering system – requirements, steering geometry characteristics, functional components, the calculation for turning radius.

UNIT III

Familiarization with Ackerman steering. Steering systems in track-type tractors. Study of the Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements. Familiarization with the Hydraulic system adjustments and ADDC. Study of tractor power outlets – PTO. PTO standards, types and functional requirements.

UNIT IV

Introduction to traction. Traction terminology. Theoretical calculation of shear force and rolling resistance on traction device. Study of wheels and tires – Solid tires and pneumatic tyres, tire construction, and tire specifications. Study of traction aids. Study of tractor mechanics – forces acting on the tractor. Determination of CG of a tractor.

UNIT V

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

PRACTICAL SCHEDULE:

1. Introduction to transmission systems and components.
2. Study of clutch functioning, parts and design problem on the clutch system.
3. Study of different types of gearbox, calculation of speed ratios, design problems on gearbox; Study on differential and final drive and planetary gears.
4. Study of brake systems and some design problems.
5. Steering geometry and adjustments.
6. Study of hydraulic systems in a tractor, hydraulic trainer and some design problems.
7. Appraisal of various controls in different makes tractors in relation to anthropometric measurements.
8. Determination of the location of CG of a tractor.
9. Moment of Inertia of a tractor.
10. Traction performance of a traction wheel.

TEXTBOOKS:

1. Liljedahl J B and Others. Tractors and Their Power Units.
2. Rodichev V and G Rodicheva. Tractors and Automobiles.
3. Singh Kirpal. Automobile Engineering – Vol I.
4. Heitner Joseph. Automotive Mechanics: Principles and Practices.
5. C.B.Richey. Agricultural Engineering Handbook.
6. John Deere. Fundamentals of Service Hydraulics.

AGE18R352	Farm Machinery and Equipment-I	L	P	C
		2	1	3

UNIT I

Introduction to farm mechanization. Classification of farm machines. Unit operations in crop production. Identification and selection of machines for various operations on the farm. Hitching systems and controls of farm machinery. Calculation of field capacities and field efficiency.

UNIT II

Calculations for the economics of machinery usage, comparison of ownership with the hiring of machines. Introduction to the seed-bed preparation and its classification. Familiarization with land reclamation and earth moving equipment. Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of the draft of tillage tools and calculations for power requirement for the tillage machines.

UNIT III

Introduction to tillage machines like a mould-board plough, disc plough, chisel plough, sub-soiler, harrows, cultivators, Identification of major functional components. Attachments with tillage machinery. Introduction to sowing, planting & transplanting equipment. Introduction to seed drills, no-till drills, and strip-till drills.

UNIT IV

Introduction to planters, bed-planters, and other planting equipment. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/ planters. Adjustments during operation. Introduction to materials used in the construction of farm machines.

UNIT V

Heat treatment processes and their requirement in farm machines. Properties of materials used for critical and functional components of agricultural machines. Introduction to steels and alloys for agricultural application. Identification of heat treatment processes especially for the agricultural machinery components.

PRACTICAL SCHEDULE:

1. Familiarization with different farm implements and tools.
2. Study of hitching systems.
3. Problems in machinery management.
4. Study of primary and secondary tillage machinery – construction, operation, adjustments and calculations of power and draft requirements.
5. Study of sowing and planting equipment – construction, types, the calculation for calibration and adjustments.
6. Study of transplanters – paddy, vegetable, etc.
7. Identification of materials of construction in agricultural machinery and study of material properties.
8. Study of heat treatment processes subjected to critical components of agricultural machinery.

TEXT BOOKS:

1. Kepner RA, Roy Bainer & EL Barger. Principles of Farm Machinery.
2. Smith HP and LH Wilkey. Farm Machinery and Equipment.
3. Culpin Claude. Farm Machinery.
4. Srivastava AC. Elements of Farm Machinery.
5. Lal Radhey and AC Datta. Agricultural Engineering.

AGE18R353	Agricultural Structures and Environmental Control	L	P	C
		2	1	3

UNIT I

Planning and layout of the farmstead. Scope, importance, and need for environmental control, physiological reaction of livestock environmental factors, environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods, Livestock production facilities.

UNIT II

BIS Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc. Storage of grains Causes of spoilage, Water activity for low and high moisture food and its limits for storage.

UNIT III

Moisture and temperature changes in grain bins; Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins), Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin.

UNIT IV

Calculation of pressure in bins, Storage of seeds. Rural living and development, rural roads, their construction cost and repair and maintenance. Sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to the rural community.

UNIT V

Site and orientation of building in regard to sanitation, community sanitation system; sewage system and its design, cost and maintenance, the design of septic tank for a small family. Estimation of domestic power requirement, the source of power supply and electrification of rural housing.

PRACTICAL SCHEDULE:

1. Measurements for environmental parameters and cooling load of a farm building.
2. Design and layout of a dairy farm, Design, and layout of a poultry house.
3. Design and layout of a goat house/ sheep house.
4. Design of a farm fencing system.
5. Design of a feed/fodder storage structures
6. Design of grain storage structures
7. Design and layout of the commercial bag and bulk storage facilities
8. Study and performance evaluation of different domestic storage structure
9. Estimation of a Farm building.

TEXTBOOKS:

1. Pandey, P.H. Principles, and practices of Agricultural Structures and Environmental Control, Kalyani Publishers, Ludhiana.
2. Ojha, T.P and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers, Karol Bag, New Delhi.
3. Nathanson, J.A. Basic Environmental Technology, Prentice Hall of India, New Delhi.
4. Venugopal Rao, P. Text Book of Environmental Engineering, Prentice Hall of India, New Delhi.
5. Garg, S.K. Water Supply Engineering, Khanna Publishers, New Delhi-6.
6. Dutta, B.N. Estimating and Costing in Civil Engineering, Dutta & CO, Lucknow.
7. Khanna, P.N. Indian Practical Civil Engineer's Hand Book, Engineer's Publishers, New Delhi.
8. Sahay, K.M., and Singh, K.K. Unit Operations of Agricultural Processing, Vikas publishing Pvt. Ltd, Noida.
9. Banerjee, G.C. A Text Book of Animal Husbandry, Oxford IBH Publishing Co, New Delhi.

AGE18R354	Post Harvest Engineering of Cereals, Pulses and Oil Seeds	L	P	C
		2	1	3

UNIT I

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

UNIT II

Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill. Material handling equipment. Types of conveyors: Belt, roller, chain and screw. Elevators: bucket, Cranes & hoists. Trucks (refrigerated/ unrefrigerated), Pneumatic conveying. Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination.

UNIT III

Psychrometric chart and its use in drying, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Mass and energy balance, Shedd's equation, Dryer performance, Different methods of drying, batch-continuous; mixing-non-mixing, Sunmechanical, conduction, convection, radiation, superheated steam, tempering during drying.

UNIT IV

Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray. Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes. Milling of rice: Conditioning and parboiling, advantages and disadvantages, traditional methods, CFTRI and Jadavpur methods, Pressure parboiling method, Types of rice mills, Modern rice milling, different unit operations, and equipment.

UNIT V

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

PRACTICAL SCHEDULE:

1. Performance evaluation of different types of cleaners and separators.
2. Determination of separation efficiency.
3. Study of different size reduction machines and performance evaluation.
4. Determination of fineness modulus and uniformity index.
5. Study of different types of conveying and elevating equipment.
6. Study of different types of mixers.
7. Measurement of moisture content: dry basis and wet basis.
8. Study on drying characteristics of grains and determination of drying constant.

9. Determination of EMC (Static and dynamic method).
10. Study of various types of dryers.
11. Study of different types of equipment in rice mills and their performance evaluation.
12. Study of different types of equipment in pulse mills and their performance evaluation.
13. Study of different types of equipment in oil mills and their performance evaluation.
14. Type of process flow charts with examples relating to the processing of cereals pulses and oilseeds.
15. Visit grain processing industries.

TEXTBOOKS:

1. Chakraverty, A. Post Harvest Technology of cereals, pulses, and oilseeds. Oxford & IBH Publishing Co. Ltd., New Delhi.
2. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.
3. Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.
4. Geankoplis C. J. Transport processes and unit operations, Prentice Hall of India Pvt Ltd, New Delhi
5. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
6. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman, and Hall, London
7. McCabe, W.L., Smith J.C. and Harriott, P. Unit Operations of Chemical Engineering. McGraw Hill.
8. Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.

AGE18R355	Soil and Water Conservation Engineering	L	P	C
		2	1	3

UNIT I

Soil erosion - Introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion. Water erosion - Mechanics and forms - splash, sheet, rill, gully, ravine and stream bank erosion. Gullies - Classification, stages of development.

UNIT II

Soil loss estimation – Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity - estimation by KE>25 and EI30 methods. Soil erodibility - topography, crop management and conservation practice factors. Measurement of soil erosion - Runoff plots, soil samples.

UNIT III

Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching. Engineering measures– Bunds and terraces. Bunds - contour and graded bunds - design and surplussing arrangements.

UNIT IV

Terraces - level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stonewall and trenching. Gully and ravine reclamation - principles of gully control - vegetative measures, temporary structures and diversion drains. Grassed waterways and design.

UNIT V

Wind erosion- Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, windbreaks and shelter belts and stabilization of sand dunes. Land capability classification. The rate of sedimentation, silt monitoring and storage loss in tanks.

PRACTICAL SCHEDULE:

1. Study of different types and forms of water erosion.
2. Exercises on the computation of rainfall erosivity index.
3. Computation of soil erodibility index in soil loss estimation.
4. Determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE and MUSCLE.
5. Exercises on soil loss estimation/measuring techniques.
6. Study of rainfall simulator for erosion assessment.
7. Estimation of sediment rate using Coshocton wheel sampler and multislot devisor.
8. Determination of sediment concentration through oven dry method.
9. Design and layout of contour bunds.
10. Design and layout of graded bunds.
11. Design and layout of broad base terraces.
12. Design and layout of bench terraces.
13. Design of vegetative waterways.
14. Exercises on the rate of sedimentation and storage loss in tanks.
15. Computation of soil loss by wind erosion.
16. Design of shelterbelts and windbreaks for wind erosion control.
17. Visit soil erosion sites and watershed project areas for studying erosion control and water conservation measures.

TEXTBOOKS:

1. Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management International Books and Periodicals Supply Service, New Delhi.
3. Mal, B.C. 2014. Introduction to Soil and Water Conservation Engineering. 2014. Kalyani Publishers.
4. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
5. Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
6. Norman Hudson. 1985. Soil Conservation. Cornell University Press, Ithaca, New York, USA.
7. Frevert, R.K., G.O. Schwab, T.W. Edminster and K.K. Barnes. 2009. Soil and Water Conservation Engineering, 4th Edition, John Wiley and Sons, New York.
8. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.

AGE18R356	Watershed Planning and Management	L	P	C
		1	1	2

UNIT I

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

UNIT II

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

UNIT III

Water budgeting in a watershed. Management measures - rainwater conservation technologies - *in-situ* and *ex-situ* storage, water harvesting and recycling. Dry farming techniques - inter-terrace and inter-bund land management

UNIT IV

Integrated watershed management - concept, components, arable lands - agriculture and horticulture, non-arable lands - forestry, fishery and animal husbandry. Effect of cropping systems, land management and cultural practices on watershed hydrology.

UNIT V

Watershed programme - execution, follow-up practices, maintenance, monitoring, and evaluation. Participatory watershed management - the role of watershed associations, user groups, and self-help groups. Planning and formulation of a project proposal for watershed management programme including a cost-benefit analysis.

PRACTICAL SCHEDULE:

1. Exercises on the delineation of watersheds using toposheets.
2. Surveying and preparation of watershed map.
3. Quantitative analysis of watershed characteristics and parameters.
4. Watershed investigations for planning and development.
5. Analysis of hydrologic data for planning watershed management.
6. Water budgeting of watersheds.
7. Prioritization of watersheds based on sediment yield index.
8. Study of the functional requirement of watershed development structures.
9. Study of watershed management technologies.
10. Practice on software for analysis of hydrologic parameters of the watershed.
11. Study of the role of various functionaries in watershed development programmes.
12. Techno-economic viability analysis of watershed projects.
13. Visit watershed development project areas.

TEXTBOOKS:

1. Ghanshyam Das. 2008. Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
2. Katyal, J.C., R.P. Singh, Shrinivas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra. 1995. Field Manual on Watershed Management. CRIDA, Hyderabad.
3. Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi.
4. Sharda, V.N., A.K. Sikka and G.P. Juyal. 2006. Participatory Integrated Watershed Management: A Field Manual. Central Soil and Water Conservation Research and Training Institute, Dehradun.
5. Singh, G.D., and T.C. Poonia. 2003. Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.
6. Singh, P.K. 2000. Watershed Management: Design and Practices. E-media Publications, Udaipur.
7. Singh, R.V. 2000. Watershed Planning and Management. Yash Publishing House, Bikaner.
8. Tideman, E.M. 1999. Watershed Management: Guidelines for Indian Conditions. Omega Scientific Publishers, New Delhi.

AGE18R357	Drainage Engineering	L	P	C
		1	1	2

UNIT I

Waterlogging- causes and impacts; drainage, objectives of drainage, familiarization with the drainage problems of the state; surface drainage coefficient, types of surface drainage.

UNIT II

Design of surface drains; sub-surface drainage: purpose and benefits, investigations of design parameters hydraulic conductivity, drainable porosity.

UNIT III

Water table; derivation of Hooghoudt's and Ernst's drain spacing equations; design of subsurface drainage system; drainage materials, drainage pipes, drain envelope; layout.

UNIT IV

Construction and installation of drains; drainage structures; vertical drainage; bio-drainage; mole drains; salt balance.

UNIT V

Reclamation of saline and alkaline soils, leaching requirements, conjunctive use of fresh and saline water.

PRACTICAL SCHEDULE:

1. *In-situ* measurement of hydraulic conductivity by single auger hole and inverse auger hole method.
2. Estimation of drainage coefficients.
3. Installation of piezometer and observation wells.
4. Preparation of iso-bath and isobar maps.
5. Determination of drainable porosity.
6. Design of surface drainage systems.
7. Design of gravel envelop.
8. Design of subsurface drainage systems.
9. Determination of chemical properties of soil and water.
10. Study of drainage tiles and pipes.
11. Installation of the sub-surface drainage system.
12. Cost analysis of surface and sub-surface drainage system.

TEXTBOOKS:

1. Bhattacharya AK and Michael AM. 2013. Land Drainage, Principles, Methods, and Applications. Vikas Publication House, Noida (UP).
2. Ritzema H.P.1994 Drainage Principles and Applications, ILRI Publication 16, Second Edition (Completely Revised).
3. Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II 5th Edition. Jain Brothers Publication, New Delhi.
4. Kadam U.S., Thokal R.T., Gorantiwar S.D. and Powar A.G. 2007. Agricultural Drainage-Principles and Practices, Westville Publishing House. FAO Irrigation and Drainage Paper No. 6, 9, 15, 16, 28 and 38. Rome, Italy.

AGE18R358	Renewable Power Sources	L	P	C
		2	1	3

UNIT I

Energy consumption pattern & energy resources in India. Renewable energy options, potential, and utilization. Biogas technology and mechanisms.

UNIT II

Generation of power from biogas, Power generation from urban, municipal and industrial waste. Design & use of different commercial sized biogas plant.

UNIT III

Solar thermal and photovoltaic Systems for power generation. Central receiver (Chimney) and distributed type solar power plant, OTEC, MHD, hydrogen, and fuel cell technology.

UNIT IV

Wind farms. Aero-generators. Wind power generation system. Power generation from biomass (gasification & Dendro thermal).

UNIT V

Mini and micro small hydel plants. Fuel cells and its associated parameters.

PRACTICAL SCHEDULE:

1. Performance evaluation of solar water heater.
2. Performance evaluation of a solar cooker.
3. Characteristics of solar photovoltaic panel.
4. Evaluation of solar air heater/dryer.
5. Performance evaluation of biomass gasifier engine system (throatless & downdraft).
6. Performance evaluation of a fixed dome type biogas plant.
7. Performance evaluation of the floating drum type biogas plant.
8. Estimation of calorific value of biogas & producer gas.
9. Testing of diesel engine operation using dual fuel and gas alone.

TEXTBOOKS:

1. Garg H.P. 1990. Advances in Solar Energy Technology; D. Publishing Company, Tokyo.
2. Alan L: Farredbruch & R.H. Buse. 1983. Fundamentals of Solar Academic Press, London.
3. Bansal N.K., Kleemann M. & Melissa Michael. 1990. Renewable Energy Sources & Conversion Technology; Tata Mcgraw Publishing Company, New Delhi.
4. Rathore N. S., Kurchania A. K. & N.L. Panwar. 2007. Non-Conventional Energy Sources, Himanshu Publications.
5. Mathur, A.N. & N.S. Rathore. 1992. Biogas Production Management & Utilization. Himanshu Publications, Udaipur.
6. Khandelwal, K.C. & S.S. Mahdi. 1990. Biogas Technology.
7. Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.

CSE18R***	Computer Programming and Data Structures	L	P	C
		1	2	3

UNIT I

Introduction and historical background: Review of computer technology; Processor, memory, secondary storage, display devices and other peripheral devices; Basic computer organization, future trends; Brief review of present-day applications, programming; Introduction to systems software, applications software, and programming language.

UNIT II

Algorithms and flow-charts: Input processing- output model of a computer program; Role of the compiler and the integrated development environment; Introduction to C: Structure of a C program, simple data types, declarations, operators, and expressions.

UNIT III

The assignment statement; Library functions; Control Structures: Conditional and iterative execution of statements; Importance of documentation; Nesting of control structures and the use of indentation to indicate nesting levels; Labels and the “go to” statement; Arrays; Single and multi-dimensional arrays: Character strings and string functions.

UNIT IV

Functions: Scope rules; Argument passing by reference and by value; Storage classes; Use of function prototypes; Structures, unions and user-defined types; Operations on files: Concept of standard input and output files; Formatting of data on input and output; Use of include files; Introduction to high level languages; Primary data types and user-defined data types, variables, typecasting, operators, building and evaluating expressions,

UNIT V

Standard library functions, managing input, and output, decision making, branching. Looping, arrays, user-defined functions, passing arguments and returning values, recursion, scope and visibility of a variable, string functions, structures and union, pointers, stacks, push/pop operations, queues, insertion and deletion operations, linked lists.

PRACTICAL SCHEDULE:

1. Familiarizing with Turbo C IDE.
2. Building an executable version of C program.
3. Debugging a C program.
4. Developing and executing simple programs.
5. Creating programs using decision-making statements such as if, go to and switch.
6. Developing a program using loop statements while do and for.
7. Using nested control structure.
8. Familiarizing with one and two-dimensional arrays.
9. Using string functions.
10. Developing structures and union.
11. Creating user-defined functions.
12. Using local, global and external variables.
13. Using pointers, Implementing stacks.
14. Implementing push/ pop functions.
15. Creating queues.

16. Developing linked lists in C language.
17. Insertion/deletion in data structures.

TEXTBOOKS:

1. Mark Allen Weiss. 2014. Data Structures and Algorithm Analysis in C++, 4th Ed. Pearson Education, Boston, USA.
2. Svetlin Nakov & Co. 2013. Fundamentals of Computer Programming with c#. Sofia, Bulgaria.
3. F. Balagurusamy. 2008. Object Oriented Programming with C++, 4th Ed. Tata McGraw-Hill Publishing Company Limited, New Delhi.

AGE18R359	Farm Machinery and Equipment-II	L	P	C
		2	1	3

UNIT I

Introduction to plant protection equipment – sprayers and dusters. Classification of sprayers and sprays. Types of nozzles. Calculations for calibration of sprayers and chemical application rates. Introduction to intercultural equipment. Use of weeders – manual and powered. Study of functional requirements of weeders and main components. Familiarization of fertilizer application equipment. Study of harvesting operation – harvesting methods, harvesting terminology.

UNIT II

Study of mowers – types, constructional details, working, and adjustments. Study of shear type harvesting devices – cutter bar, inertial forces, counterbalancing, terminology, cutting pattern. Study of reapers, binders and windrowers – the principle of operation and constructional details. Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay. Introduction to threshing systems – manual and mechanical systems.

UNIT III

Types of threshing drums and their applications. Types of threshers- tangential and axial, their constructional details and cleaning systems. Study of factors affecting thresher performance. Study of grain combines, combine terminology, classification of grain combines.

UNIT IV

Study of material flow in combines. Computation of combined losses, the study of combine troubles and troubleshooting. Study of chaff cutters and capacity calculations. Study of straw combines – working principle and constructional details. Study of root crop diggers – the principle of operation, blade adjustment and approach angle, and calculation of material handled. Study of potato and groundnut diggers.

UNIT V

Study of Cotton harvesting – Cotton harvesting mechanisms, the study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Introduction to vegetables and fruit harvesting equipment and tools.

PRACTICAL SCHEDULE:

1. Familiarization with plant protection and intercultural equipment.
2. Study of sprayers, types.
3. Functional components of sprayers.
4. Study of dusters, types and functional components.
5. Calculations for chemical application rates.
6. Study of nozzle types and spread pattern using alternator.
7. Familiarization with manual and powered weeding equipment and identification of functional components.
8. Study of fertilizer application equipment including manure spreaders and fertilizer broadcasters. Study of various types of mowers, reaper, reaper binder.
9. Study of functional components of mowers and reapers.
10. Familiarization with threshing systems, cleaning systems in threshers.
11. Calculations of losses in threshers.
12. Familiarization with functional units of Grain combines and their types.

13. Calculations for grain losses in a combine.
14. Study of root crop diggers and familiarization with the functional units and attachments.
Familiarization with the working of cotton and maize harvesters.
15. Familiarization with vegetable and fruit harvesters.

TEXTBOOKS:

1. Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery.
2. Smith HP and LH Wilkey. Farm Machinery and Equipment.
3. Culpin Claude. Farm Machinery.
4. Srivastava AC. Elements of Farm Machinery.
5. Lal Radhey and AC Datta. Agricultural Engineering Principles of Farm Machinery.

AGE18R360	Post-Harvest Engineering of Horticultural Crops	L	P	C
		1	1	2

UNIT I

Importance of processing of fruits and vegetables, spices, condiments, and flowers. Characteristics and properties of horticultural crops important for processing, Peeling: Different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling, and thermal peeling).

UNIT II

Slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction, etc., Blanching: Importance and objectives; blanching methods, effects on food (nutrition, colour, pigment, texture), Chilling and freezing: Application of refrigeration in different perishable food products, Thermophilic, mesophilic & Psychrophilic micro-organisms, Chilling requirements of different fruits and vegetables, Freezing of food, freezing time calculations, slow and fast freezing.

UNIT III

Equipment for chilling and freezing (mechanical & cryogenic), Effect on food during chilling and freezing, Cold storage heat load calculations and cold storage design, refrigerated vehicle and cold chain system, Dryers for fruits and vegetables, Osmo-dehydration, Packaging of horticultural commodities, Packaging requirements (in terms of light transmittance, heat, moisture and gas proof, microorganisms, mechanical strength).

UNIT IV

Different types of packaging materials commonly used for raw and processed fruits and vegetable products, bulk and retail packages and packaging machines, handling, and transportation of fruits and vegetables, Packhouse technology, Minimal processing, Common methods of storage, Low-temperature storage, evaporative cooled storage, Controlled atmospheric storage, Modified atmospheric packaging.

UNIT V

Preservation Technology, General methods of preservation of fruits and vegetables, Brief description and advantages and disadvantages of different physical/ chemical and other methods of preservation, Flowcharts for preparation of different finished products, Important parameters and equipment used for different unit operations, Post-harvest management and equipment for spices and flowers, Quality control in fruit and vegetable processing industry. Food supply chain.

PRACTICAL SCHEDULE:

1. Performance evaluation of peeler and slicer.
2. Performance evaluation of juicer and pulper.
3. Performance evaluation of blanching equipment.
4. Testing adequacy of blanching.
5. Study of cold storage and its design.
6. Study of CAP and MAP storage.
7. Minimal processing of vegetables.
8. Preparation of value-added products.
9. Visit fruit and vegetable processing industry.
10. Visit spice processing plant.

TEXTBOOKS:

1. Arthey, D. and Ashurst, P. R. 1966. Fruit Processing. Chapman and Hall, New York.
2. Pantastico, E.C.B. 1975. Postharvest physiology, handling, and utilization of tropical and subtropical fruits and vegetables AVI Pub. Co., New Delhi.
3. Pandey, R.H. 1997. Postharvest Technology of fruits and vegetables (Principles and practices). Saroj Prakashan, Allahabad.
4. Sudheer, K P., and Indira, V. 2007. Post-Harvest Engineering of horticultural crops. New India Publishing House.

AGE18R361	Water Harvesting and Soil Conservation Structures	L	P	C
		2	1	3

UNIT I

Water harvesting -principles, importance, and issues. Water harvesting techniques – a classification based on source, storage, and use. Runoff harvesting – short-term and long-term techniques. Short-term harvesting techniques - terracing and bunding, rock and ground catchments. Long-term harvesting techniques - purpose and design criteria.

UNIT II

Structures - farm ponds - dug-out and embankment reservoir types, tanks and subsurface dikes. Farm pond - components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation, and construction. Percolation pond - site selection, design and construction details.

UNIT III

Design considerations of *Nala* bunds. Soil erosion control structures - introduction, classification and functional requirements. Permanent structures for soil conservation and gully control – check dams, drop, chute and drop inlet spillways - design requirements, planning for design, design procedures - hydrologic, hydraulic and structural design and stability analysis.

UNIT IV

Hydraulic jump and its application. Drop spillway - applicability, types - straight drop, box-type inlet spillways - description, functional use, advantages and disadvantages, straight apron and stilling basin outlet, structural components, and functions. Loads on head wall, variables affecting equivalent fluid pressure, triangular load diagram for various flow conditions.

UNIT V

Creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension. Chute spillway - description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations. Drop inlet spillway - description, functional use, and design criteria.

PRACTICAL SCHEDULE:

1. Study of different types of farm ponds.
2. Computation of storage capacity of embankment type of farm ponds.
3. Design of dugout farm ponds.
4. Design of percolation pond and *Nala* bunds.
5. Runoff measurement using H-flume.
6. Exercise on the hydraulic jump.
7. Exercise on energy dissipation in water flow.
8. Hydrologic, hydraulic and structural design of drop spillway and stability analysis.
9. Design of SAF stilling basins in chute spillway.
10. Hydrologic, hydraulic and structural design of drop inlet spillway.
11. Design of small earthen embankment structures.
12. Practice on software for the design of soil and water conservation structures.
13. Field visit to watershed project areas treated with soil and water conservation measures/structures.

TEXTBOOKS:

1. Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
3. Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
4. Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1993. Soil and Water Conservation Engineering. 4th Edition, John Wiley and Sons Inc. New York.
5. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
6. Samra, J.S., V.N. Sharda and A.K. Sikka. 2002. Water Harvesting and Recycling: Indian Experiences. CSWCR&TI, Dehradun, Allied Printers, Dehradun.
7. The Y. Oweis, Dieter Prinz, and Ahmed Y. Hachum. 2012. Rainwater Harvesting for Agriculture in the Dry Areas. CRC Press, Taylor and Francis Group, London.
8. Studer Rima Mekdaschi and Hanspeter Liniger. 2013. Water Harvesting - Guidelines to Good Practice. Centre for Development and Environment, University of Bern, Switzerland.

AGE18R362	Groundwater, Wells, and Pumps	L	P	C
		2	1	3

UNIT I

Occurrence and movement of groundwater; aquifer and its types; classification of wells, fully penetrating tube wells and open wells, familiarization of various types of bore wells; design of open wells; groundwater exploration techniques.

UNIT II

Methods of drilling of wells: percussion, rotary, reverse rotary; design of tube well and gravel pack, installation of the well screen, completion and development of well; groundwater hydraulics-determination of aquifer parameters by a different method such as Theis, Jacob and Chows.

UNIT III

Theis recovery method; well interference, multiple well systems, estimation of groundwater potential, quality of groundwater; artificial groundwater recharge techniques; pumping systems: water lifting devices.

UNIT IV

Different types of pumps, classification of pumps, component parts of centrifugal pumps, priming, pump selection, installation and troubleshooting, performance curves, the effect of speed on capacity, head, and power.

UNIT V

Effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics; deep well turbine pump and submersible pump.

PRACTICAL SCHEDULE:

1. Verification of Darcy's Law.
2. Study of different drilling equipment.
3. Sieve analysis for gravel and well screens design.
4. Estimation of specific yield and specific retention.
5. Testing of the well screen.
6. Estimation of aquifer parameters by Theis method, Coopers-Jacob method, Chow Method.
7. Theis Recovery method.
8. Well design under confined and unconfined conditions.
9. Well, losses and well efficiency; estimating groundwater balance.
10. Study of artificial groundwater recharge structures.
11. Study of radial flow and mixed flow centrifugal pumps.
12. Multistage centrifugal pumps, turbine, propeller and other pumps; installation of the centrifugal pump.
13. Testing of centrifugal pump and study of cavitations.
14. Study of the hydraulic ram.
15. Study and testing of the submersible pump.

TEXTBOOKS:

1. Michael AM, Khepar SD., and SK Sondhi. 2008. Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill.
2. Todd David Keith and Larry W. Mays. 2004. Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow).
3. Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II, 5th Edition. Jain Brothers Publication, New Delhi.

AGE18R382	Tractor and Farm Machinery Operation and Maintenance	L	P	C
		0	2	2

PRACTICAL SCHEDULE:

1. Familiarization with different makes and models of agricultural tractors.
2. Identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems.
3. Study of maintenance points to be checked before starting a tractor.
4. Familiarization with controls on a tractor.
5. Safety rules and precautions to be observed while driving a tractor.
6. The driving practice of tractor. The practice of operating a tillage tool (mold-board plough/ disc plough) and their adjustment in the field.
7. Study of field patterns while operating a tillage implement.
8. Hitching & De-hitching of mounted and trail type implement to the tractor.
9. Driving practice with a trail type trolley – forward and in reverse direction.
10. Introduction to tractor maintenance – precautionary and break-down maintenance.
11. Tractor starting with a low battery charge.
12. Introduction to troubleshooting in tractors.
13. Familiarization with tools for general and special maintenance.
14. Introduction to the scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation. Safety hints. Top end overhauling.
15. Fuel saving tips.
16. Preparing the tractor for storage.
17. Care and maintenance procedure of agricultural machinery during operation and offseason.
18. Repair and maintenance of implements – adjustment of functional parameters in tillage implements.
19. Replacement of broken components in tillage implements.
20. Replacement of furrow openers and change of blades of rotavators.
21. Maintenance of cutter bar in a reaper.
22. Adjustments in a thresher for different crops.
23. Replacement of V-belts on implements.
24. The setting of agricultural machinery workshop.

TEXTBOOKS:

1. Ghosh RK and S Swan. Practical Agricultural Engineering.
2. Black PO and WE Scahill. Diesel Engine Manual.
3. Southern N. Tractor operation and maintenance.
4. Jain SC and CR Rai. Farm Tractor Maintenance and Repair.
5. Operators manuals of tractors.
6. Service manuals provided by manufacturers.

AGE18R363	Dairy and Food Engineering	L	P	C
		2	1	3

UNIT I

Deterioration in food products and their controls, Physical, chemical and biological methods of food preservation. Nanotechnology: History, fundamental concepts, tools and techniques nanomaterials, applications in food packaging and products, implications. Environmental impact of nanomaterials and their potential effects on global economics, regulation of nanotechnology.

UNIT II

Dairy development in India, Engineering, thermal and chemical properties of milk and milk products. Process flow charts for product manufacture, the Unit operation of various dairy and food processing systems. Principles and equipment related to receiving of milk, pasteurization, sterilization, homogenization, centrifugation and cream separation.

UNIT III

Preparation methods and equipment for the manufacture of cheese, *paneer*, butter and ice cream, Filling and packaging of milk and milk products; Dairy plant design and layout, Plant utilities; Principles of operation and equipment for thermal processing, Canning.

UNIT IV

Aseptic processing, Evaporation of food products: principle, types of evaporators, steam economy, multiple effect evaporation, vapor recompression, Drying of liquid and perishable foods: principles of drying, spray drying, drum drying, freeze drying.

UNIT V

Filtration: principle, types of filters; Membrane separation, RO, Nano-filtration, Ultrafiltration and Macro-filtration, equipment and applications, Non-thermal and other alternate thermal processing in Food processing.

PRACTICAL SCHEDULE:

1. Study of pasteurizers.
2. Study of sterilizers.
3. Study of homogenizers.
4. Study of separators.
5. Study of butter churns.
6. Study of evaporators.
7. Study of milk dryers.
8. Study of the freezer.
9. Study of filtration.
10. Design of food processing plants & preparation of layout.
11. Visit multi-product dairy plant.
12. Estimation of steam requirements.
13. Estimation of refrigeration requirements in dairy & food plant.
14. Visit Food industry.

TEXTBOOKS:

1. Ahmed, T. 1997. Dairy Plant Engineering and Management. 4th Ed. Kitab Mahal.
2. McCabe, W.L. and Smith, J. C. 1999. Unit Operations of Chemical Engineering. McGraw Hill.
3. Rao, D.G. Fundamentals of Food Engineering. PHI Learning Pvt. Ltd. New Delhi.
4. Singh, R.P. & Heldman, D.R. 1993. Introduction to Food Engineering. Academic Press.
5. Toledo, R. T. 1997. Fundamentals of Food Process Engineering. CBS Publisher.

AGE18R364	Bio-energy Systems: Design and Applications	L	P	C
		2	1	3

UNIT I

Fermentation processes and its general requirements, an overview of aerobic and anaerobic fermentation processes and their industrial application. Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential.

UNIT II

Biomass Production: Wastelands, classification and their use through energy plantation, selection of species, methods of field preparation and transplanting. Harvesting of biomass and coppicing characteristics.

UNIT III

Biomass preparation techniques for harnessing (size reduction, densification and drying). Thermochemical degradation. History of small gas producer engine system. Chemistry of gasification. Gas producer – type, operating principle.

UNIT IV

Gasifier fuels, properties, preparation, conditioning of producer gas. Application, shaft power generation, thermal application and economics. Transesterification for biodiesel production.

UNIT V

A range of bio-hydrogen production routes. The environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.

PRACTICAL SCHEDULE:

1. Study of anaerobic fermentation system for the industrial application.
2. Study of gasification for industrial process heat.
3. Study of biodiesel production unit.
4. Study of biomass densification technique (briquetting, pelletization, and cubing).
5. Integral bio energy system for industrial application.
6. Study of bioenergy efficiency in industry and commercial buildings.
7. Study and demonstration of energy efficiency in building.
8. Measuring efficiency of different insulation technique.
9. Study of Brayton.
10. Stirling and Rankine cycles.
11. Study of modern greenhouse technologies.

TEXTBOOKS:

1. British BioGen. 1997, Anaerobic digestion of farm and food processing practices- Good practice guidelines, London, available on www.britishbiogen.co.uk.
2. Butler, S. 2005. Renewable Energy Academy: Training wood energy professionals.
3. Centre for biomass energy. 1998. Straw for energy production; Technology-Environment- Ecology. Available: www.ens.dk.

AGE18R481	Industrial attachment/ internship STUDENT READY(Rural Entrepreneurship Awareness Development Yojana)	L	P	C
		0	10	10

Inventory survey – land, water, machinery, equipment and cropping pattern – availability of power – animal, mechanical and electrical, pump – selection and maintenance.

Observation of existing cultural practices – improvement – cost benefits – observation of erosion spots – remedial measures – observation of land preparation – tools used – a suggestion of improved tools, machinery and post-harvest equipment – use of non-conventional energy sources – biogas plant, smokeless Chula, solar cooker, water heater – preparation of the report.

Students allotted to various industries as below to get on hand, in-plant training in the industrial environment – farm Machinery and Implements Tractors / Power Tillers/earth moving Machinery – Manufacture and Testing Crop/Seed/Food /Dairy-Processing/Machinery manufacture and testing – soil / Water conservation techniques/Design and implementation-pumping industry-Equipment-manufacture and Testing – Renewable energy gadgets – manufacture and Testing – Renewable energy installations – maintenance and management – Farm structures – materials – manufacture and Testing – Govt. Testing and Training Institute etc., like Soil conservation – design, layout and execution – water management – measurement of flow – equity distribution in the field – efficiency computation – assessment of consumptive use ratio – irrigation – design and layout of drip, and sprinkler. Operation and maintenance of farm equipment – tractors, bulldozers rigs, power tillers and plant protection equipment’s – land cultivation tools – design – manufacture – testing and marketing – bore wells – prospecting groundwater – sinking of bore wells – yield testing, hiring – tractor, bulldozer and rigs – energy consumption – a real coverage – bill preparation, tie up with Encoded and TAI – interaction and appraisal of marketing strategy.

Industries-modern rice mills – operation and maintenance – quality control – extraction of by-products – bran, oil, briquetting of husk – solvent extraction plants – operation – extraction of oil- quality control – pump manufacture – design – fabrication – selection and testing, preparation of the report.

AGE18R482	Experiential Learning On campus	L	P	C
	STUDENT READY(Rural Entrepreneurship Awareness Development Yojana)	0	10	10

Student READY Experiential Learning Module of 10 weeks with a credit load of 0+10 credit hours. The module will run concurrently in the final semester along with the regular courses. This shall include the development of Detailed Project Report on setting up of enterprise in the selected areas of product manufacture and Evaluation of the Module.

AGE18R485	Project planning and Report Writing	L	P	C
		0	10	10

This will include project planning students in planning, development, formulation, monitoring and evaluation of project for entrepreneurial proficiency. Project planning will have 0+10 credit hours and include analysis of inculcation and sensitization of students.

ELECTIVE COURSES

AGEI8R451	Floods and Control Measures	L	P	C
		2	1	3

UNIT I

Floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, flood estimation - methods of estimation; estimation of flood peak - rational method, empirical methods, unit hydrograph method.

UNIT II

Statistics in hydrology, flood frequency methods - log normal, Gumbel's extreme value, log-Pearson type-III distribution; depth-area-duration analysis. Flood forecasting. Flood routing - channel routing, Muskingum method, reservoir routing, modified Pul's method.

UNIT III

Flood control - history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement. Gully erosion and its control structures - design and implementation. Ravine control measures. River training works, planning of flood control projects and their economics.

UNIT IV

Earthen embankments - functions, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type, foundation requirements, grouting, seepage through dams, flow net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes.

UNIT V

Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc., stability of slopes - analysis of failure by different methods. Subsurface dams - site selection and constructional features. Check dam - Small earthen embankments - types and design criteria. Subsurface dams - site selection and constructional features.

PRACTICAL SCHEDULE:

1. Determination of flood stage-discharge relationship in a watershed.
2. Determination of flood peak-area relationships.
3. Determination of frequency distribution functions for extreme flood values using Gumbel's method.
4. Determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution.
5. Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution.
6. Determination of probable maximum flood, standard project flood and spillway design flood. Design of levees for flood control.
7. Design of jetties.
8. Study of vegetative and structural measures for gully stabilization.
9. Design of gully/ravine control structures and cost estimation.

10. Designing, planning and cost-benefit analysis of a flood control project.
11. Study of different types, materials and design considerations of earthen dams.
12. Determination of the position of the phreatic line in earth dams for various conditions, stability analysis of earthen dams against head water pressure, foundation shear, sudden drawdown condition etc.
13. Stability of slopes of earth dams by friction circle and other methods.
14. Construction of flow net for isotropic and anisotropic media.
15. Computation of seepage by different methods.
16. Determination of settlement of earth dam.
17. Input-output-storage relationships by reservoir routing.
18. Visit sites of an earthen dam and water harvesting structures.

TEXTBOOKS:

1. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
2. Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
3. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
4. Mutreja, K.N. 1990. Applied Hydrology. Tata McGraw-Hill Publishing Co., Delhi.
5. Subramanya, K. 2008. Engineering Hydrology. 3rd Edition, Tata McGraw-Hill Publishing Co., New Delhi.
6. Bureau of Reclamation. 1987. Design of Small Dams. US Department of Interior, Washington DC, USA.
7. Arora, K.R. 2014. Soil Mechanics and Foundation Engineering (Geotechnical Engineering). Standard Publishers Distributors, Delhi.

AGEI8R452	Waste land Development	L	P	C
		2	1	3

UNIT I

Land degradation – concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands. Wastelands - factors causing, classification and mapping of wastelands.

UNIT II

Planning of wastelands development - constraints, agroclimatic conditions, development options, contingency plans. Conservation structures – gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods.

UNIT III

Afforestation - agro-Horti-forestry-silvopasture methods, forage, and fuel crops - socioeconomic constraints. Shifting cultivation, optimal land use options. Wasteland development – hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands.

UNIT IV

Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and my environment management. Micro-irrigation in wastelands development. Sustainable wasteland development - drought situations, socio-economic perspectives.

UNIT V

Government policies. Participatory approach. Preparation of proposal for wasteland development and benefit-cost analysis.

PRACTICAL SCHEDULE

1. Mapping and classification of wastelands.
2. Identification of factors causing wastelands.
3. Estimation of vegetation density and classification.
4. Planning and design of engineering measures for reclamation of wastelands.
5. Design and estimation of different soil and water conservation structures under arid, semiarid and humid conditions.
6. Planning and design of micro-irrigation in wasteland development.
7. Cost estimation of the above measures/structures.
8. Visit wasteland development project sites.

TEXTBOOKS:

1. Abrol, I.P., and V.V. Dhruvanarayana. 1998. Technologies for Wasteland Development. ICAR, New Delhi.
2. Ambast, S.K., S.K. Gupta and Gurcharan Singh (Eds.) 2007. Agricultural Land Drainage -Reclamation of Waterlogged Saline Lands. Central Soil Salinity Research Institute, Karnal, Haryana.
3. Hridai Ram Yadav. 2013. Management of Wastelands. Concept Publishing Company. New Delhi.
4. Karthikeyan, C., K. Thangaraja, C. Cinthia Fernandez and K. Chandrakandon. 2009. Dryland Agriculture and Wasteland Management. Atlantic Publishers and Distributors Pvt. Ltd., New Delhi.
5. Rattan Lal and B.A. Stewart (Ed.). 2015. Soil Management of Smallholder Agriculture.
6. Volume 21 of Advances in Soil Science. CRC Press, Taylor and Francis Group, Florida, USA.

AGEI8R453	Information Technology for Land and Water Management	L	P	C
		2	1	3

UNIT I

The concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. The existing system of information generation and organizations involved in the field of land and water management.

UNIT II

Application and production of multimedia. Internet application tools and web technology. The networking system of information. Problems and prospects of new information and communication technology.

UNIT III

Development of database concept for effective natural resources management. Application of remote sensing, geographic information system (GIS) and GPS. Rational database management system. Object-oriented approaches.

UNIT IV

Information system, decision support systems, and expert systems. Agricultural information management systems - use of mathematical models and programmes.

UNIT V

Application of decision support systems, multi-sensor data loggers, and overview of software packages in natural resource management. Video-conferencing of scientific information.

PRACTICAL SCHEDULE:

1. Multimedia production.
2. Internet applications: E-mail, voice mail, web tools, and technologies.
3. Handling and maintenance of new information technologies and exploiting their potentials.
4. Exercises on database management using the database and spreadsheet programmes.
5. Usage of remote sensing, GIS, and GPS survey in information generation and processing. Exercises on running computer software packages dealing with water balance, crop production, land development, land and water allocation, watershed analysis etc.
6. Exercises on simple decision support and expert systems for management of natural resources. Multimedia production using different soft ware's.
7. Exercises on the development of information system on a selected theme(s).
8. Video-conferencing of scientific information.

TEXTBOOKS:

1. Climate-Smart Agriculture – Source Book. 2013. Food and Agriculture Organization, Rome.
2. Daniel P. Loucks and Eelco van Beek. 2005. Water Resources Systems Planning and Management - An Introduction to Methods, Models, and Applications. UNESCO, Paris.
3. Dipak De and Basavaprabhu Jirli (Eds.). 2010. Communication Support for Sustainable Development. Ganga Kaveri Publishing House, Varanasi – 221001.

AGEI8R454	Remote Sensing and GIS Applications	L	P	C
		2	1	3

UNIT I

The basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows.

UNIT II

Principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil, and water; spectral signatures; different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap.

UNIT III

Stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation-interpretation elements; photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography.

UNIT IV

Satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, an important consideration in the identification of training areas, vegetation indices; microwave remote sensing.

UNIT V

GIS basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties, Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.

PRACTICAL SCHEDULE:

1. Familiarization with remote sensing and GIS hardware.
2. Use of software for image interpretation.
3. Interpretation of aerial photographs and satellite imagery.
4. Basic GIS operations such as image display.
5. Study of various features of GIS software package.
6. Scanning, digitization of maps and data editing.
7. Database query and map algebra.
8. GIS supported case studies in water resources management.

TEXTBOOKS:

1. Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
2. Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
3. George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
4. Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.

AGEI8R455	Minor Irrigation and Command Area Development	L	P	C
		2	1	3

UNIT I

Factors affecting the performance of irrigation projects; types of minor irrigation systems in India; lift irrigation systems: feasibility, type of pumping stations and their site selection, the design of lift irrigation systems.

UNIT II

Tank Irrigation: grouping of tanks, storage capacity, supply works, and Sluices.

UNIT III

Command area development (CAD) programme- components need, scope and development approaches, historical perspective, command area development authorities functions, and responsibilities.

UNIT IV

On-farm development works, reclamation works, use of remote sensing techniques for CAD works.

UNIT V

Water productivity: concepts and measures for enhancing water productivity; Farmers' participation in command area development.

PRACTICAL SCHEDULE

1. Preparation of command area development layout plan.
2. Irrigation water requirement of crops.
3. Preparation of irrigation schedules.
4. Planning and layout of a water conveyance system.
5. Design of surplus weir of tanks.
6. Determination of storage capacity of tanks.
7. Design of the intake pipe and pump house.

TEXTBOOKS:

1. Arora, K.R. 2001. Irrigation, Water Power, and Water Resources Engineering. Standard Publishers Distributors, Delhi.
2. Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.
3. Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Publ.House New Delhi.

AGEI8R456	Precision Farming Techniques for Protected Cultivation	L	P	C
		2	1	3

UNIT I

Protected cultivation: Introduction, History, origin, development, National and International Scenario, components of green house, perspective, Types of green houses, polyhouses /shed nets, Cladding materials, Plant environment interactions – principles of limiting factors. Solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment.

UNIT II

Design and construction of green houses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment. Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fanpad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care etc.

UNIT III

Greenhouse heating – necessity, components, methods, the design of the heating system. Root media – types – soil and soilless media, composition, estimation, preparation and disinfection, bed preparation. Planting techniques in greenhouse cultivation. Irrigation in the greenhouse and net house – Water quality, types of the irrigation system, components, design, installation and material requirement.

UNIT IV

Fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement. Maintenance of irrigation and fogging systems. Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, principles of selection of a proper application of fertilizers, fertilizer schedule, the rate of application of fertilizers, methods, automated fertilizer application.

UNIT V

Greenhouse climate measurement, control, and management. Insect and disease management in the greenhouse and net houses Selection of crops for greenhouse cultivation, major crops in the greenhouse – irrigation requirement, fertilizer management, cultivation, harvesting and post-harvest techniques; Economic analysis.

PRACTICAL SCHEDULE

1. Estimation of the material required for construction of the greenhouse.
2. Determination of fertilization schedule and rate of application for various crops.
3. Estimation of the material requirement for preparation of root media.
4. Root media preparation, bed preparation, and disinfection.
5. Study of different planting techniques.

6. Design and installation of the irrigation system.
7. Design and installation of the fogging system.
8. Greenhouse heating.
9. Study of different greenhouse environment control instruments.
10. Study of operation maintenance and fault detection in the irrigation system.
11. Study of operation maintenance and fault detection in the fogging system.
12. Economic analysis of greenhouses and net houses.
13. Visit greenhouses.

TEXTBOOK:

1. Singh Brahma and Balraj Singh. 2014. Advances in protected cultivation, New India Publishing Company.
2. Sharma P. 2007. Precision Farming. Daya Publishing House New Delhi.

AGEI8R457	Water Quality and Management Measures	L	P	C
		2	1	3

UNIT I

Natural factors affecting the quality of surface water and groundwater, water quality objectives in relation to domestic, industrial and agricultural activities, drinking water quality standards.

UNIT II

Irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria, point and non-point water pollution sources.

UNIT III

Water contamination due to inorganic and organic compounds, water contamination related to agricultural chemicals, food industry.

UNIT IV

Hydrocarbon and synthetic organic compounds. Arsenic and fluoride contamination in groundwater and remedial measures.

UNIT V

Water decontamination technologies, cultural and management practices for using poor quality water for irrigation

PRACTICAL SCHEDULE:

1. Water quality analysis and classification according to USSL and AICRP criteria.
2. Soil chemical analysis and estimation of lime and gypsum requirements.
3. Study of salinity development under shallow and deep water table conditions.
4. Study of contamination movement and transport in the soil profile.
5. Study of different water decontamination techniques.
6. Study of different cultural and management practices for using poor quality water for irrigation.
7. Field visit to industrial effluent disposal sites.

TEXT BOOKS:

1. FAO. 1996. Control of water pollution from agriculture - FAO irrigation and drainage paper 55.
2. Gray, N.F. Water Technology. Raj Kamal Electric Press, Kundli, Haryana.
3. Hussain, S.K. 1986. Text Book of Water Supply and Sanitary Engineering. Oxford & IBH Publishing Co. New Delhi.
4. Manahan, S.E. 2009. Fundamentals of Environmental Chemistry. CRC Press, New York.
5. McGauhey, P.H. 1968. Engineering Management of water quality. McGraw Hill Book Company, New York.

AGEI8R458	Landscape Irrigation Design and Management	L	P	C
		2	1	3

UNIT I

Conventional method of landscape irrigation- hose irrigation system, quick release coupling system and portable sprinkler with hose pipes.

UNIT II

Modern methods of landscape irrigation- popup sprinklers, spray pop-up sprinkler, shrub adopter, drip irrigation and bubblers.

UNIT III

Merits and demerits of conventional and modern irrigation systems, types of landscapes and suitability of different irrigation methods, water requirement for different landscapes.

UNIT IV

Segments of landscape irrigation systems, Main components of modern landscape irrigation systems and their selection criteria; Types of pipes, pressure ratings, sizing and selection criteria.

UNIT V

An automation system for landscape irrigation- main components, types of controllers and their application, Design of modern landscape irrigation systems, operation and maintenance of landscape irrigation systems.

PRACTICAL SCHEDULE

1. Study of irrigation equipment for landscapes.
2. Design and installation of irrigation system for landscape.
3. Determination of water requirement.
4. Determination of power requirement, pump selection.
5. Irrigation scheduling of landscapes.
6. Study of irrigation controllers and other equipment.
7. Use of AutoCAD in irrigation design: blocks & symbols, head layout, zoning and valves layout,
8. pipe sizing, Pressure calculations etc.,
9. Visit landscape irrigation system and its evaluation.

TEXTBOOKS

1. Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Publ. House New Delhi.
2. Singh Neeraj Partap. 2010. Landscape Irrigation and Floriculture Terminology, Bangalore.
3. Smith Stephen W. Landscape Irrigation and Management. Amazon. com.

AGEI8R459	Plastic Applications in Agriculture	L	P	C
		2	1	3

UNIT I

Introduction of plasticulture - types and quality of plastics used in soil and water conservation, production agriculture and post harvest management. Quality control measures. Present status and future prospective of plasticulture in India.

UNIT II

Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir. Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Drip and sprinkler irrigation systems. Use of polymers in control of percolation losses in fields

UNIT III

Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation. Nursery management - Use of plastics in nursery raising, nursery bags, trays etc. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers.

UNIT IV

Plastic nets for crop protection - anti insect nets, bird protection nets. Plastic fencing. Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products. Plastic cap covers for storage of food grains in open. Use of plastics as alternate material for manufacturing farm equipment and machinery.

UNIT V

Plastics for aquacultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries. Silage film technique for fodder preservation. Agencies involved in the promotion of plasticulture in agriculture at national and state level. Human resource development in plasticulture applications.

PRACTICAL SCHEDULE

1. Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting Ponds.
2. Study of plastic components of drip and sprinkler irrigation systems, laying and flushing of laterals.
3. Study of components of subsurface drainage system.
4. Study of different color plastic mulch laying.
5. Design, estimation and installation of green, poly and shade net houses, low tunnels etc.
6. Study on cap covers for food grain storage, innovative packaging solutions - leno bags, crates,
7. Bins, boxes, vacuum packing, unit packaging, CAS and MAP and estimation.
8. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters and preparation of vermi-bed and silage film for fodder preservation.
9. Study of plastic parts in making farm machinery.
10. Visits to nearby manufacturing units/dealers of PVC pipes.
11. Visits to drip and sprinkler irrigation systems.
12. Visits to greenhouse/ polyhouse/shadehouse/ nethouse etc.
13. Visits to farmers' fields with these installations.

TEXT BOOKS:

1. Brahma Singh, Balraj Singh, Naved Sabir and Murtaza Hasan. 2014. Advances in Protected Cultivation. New India Publishing Agency, New Delhi.
2. Brown, R.P. 2004. Polymers in Agriculture and Horticulture. RAPRA Review Reports :
3. Vol. 15, No. 2, RAPRA Technology Limited, U.K.
4. Central Pollution Control Board. 2012. Material on Plastic Waste Management. Parivesh Bhawan, East Arjun Nagar, Delhi-110032.
5. Charles A. Harper. 2006. Handbook of Plastics Technologies. The Complete Guide to Properties and Performance. McGraw-Hill, New Delhi.
6. Dubois. 1978. Plastics in Agriculture. Applied Science Publishers Limited, Essex, England.

AGEI8R460	Mechanics of Tillage and Traction	L	P	C
		2	1	3

UNIT I

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

UNIT II

Design of tillage tools principles of soil cutting, design equation, force analysis.

UNIT III

Application of dimensional analysis in soil dynamics and traction prediction equation.

UNIT IV

Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, tyre size, tyre lug geometry and their effects.

UNIT V

Tyre testing, soil compaction and plant growth, variability and application of GIS in soil dynamics.

PRACTICAL SCHEDULE

1. Measurement of static and dynamic soil parameters related to tillage.
2. Soil parameters related to puddling and floatation.
3. Draft for passive rotary and oscillating tools.
4. Slip and sinkage under dry and wet soil conditions and load and fuel consumption for different farm operations.
5. Weight transfer and tractor loading including placement and traction aids.
6. Studies on tyres, tracks and treads under different conditions, and soil compaction and a number of operations.

TEXTBOOKS

1. Vandenberg and Gill. Tillage and Traction.
2. Liljedahl JB and others. Tractor and Power Units.
3. Daniel Hill. Fundamentals of Soil Physics.
4. Terzaghi K & Peck Ralph B. Soil Mechanics in Engineering Practices.

AGEI8R461	Farm Machinery Design and Production	L	P	C
		2	1	3

UNIT I

Introduction to design parameters of agricultural machines & design procedure. Characteristics of farm machinery design. Research and development aspects of farm machinery. Design of standard power transmission components used in agricultural machines: mechanical & hydraulic units.

UNIT II

Introduction to safety in power transmission. Application of design principles to the systems of selected farm machines. Critical appraisal in production of Agricultural Machinery; Advances in material used for agricultural machinery.

UNIT III

Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques including powder metallurgy, EDM (Electro- Discharge Machining), Heat Treatment of steels including pack carburizing. Shot pining process, etc. Limits, Fits & Tolerances, Jigs & Fixtures.

UNIT IV

Industrial lay-out planning, Quality production management. Reliability. Economics of process selection. Familiarization with Project Report.

PRACTICAL SCHEDULE

1. Familiarization with different design aspects of farm machinery and selected components.
2. Solving design problems on farm machines & equipment.
3. Visit to Agricultural machinery manufacturing industry.
4. Tractor manufacturing industry Jigs and Fixtures study in relation to agricultural machinery.
5. Fits, tolerances, and limits.
6. Layout planning of a small scale industry.
7. Problems in Economics of process selection.
8. Preparation of a project report.
9. Case study for the manufacturing of simple agricultural machinery.

TEXT BOOKS:

1. Richey, C.B. Agricultural Engineering Handbook.
2. Adinath M and AB Gupta. Manufacturing Technology.
3. Sharma PC and DK Aggarwal. Machine Design.
4. Narula V. Manufacturing process.
5. Singh S. Mechanical Engineer's Handbook.
6. Chakrabarti NR. Data book for Machine Design.

AGEI8R462	Human Engineering and Safety	L	P	C
		2	1	3

UNIT I

Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance.

UNIT II

Information input process, visual displays, major types and use of displays, auditory and factual displays, speech communications.

UNIT III

Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems. Human motor activities, controls, tools and related devices.

UNIT IV

Anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, air pollution.

UNIT V

Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

PRACTICAL SCHEDULE:

1. Calibration of the subject in the laboratory using bi-cycle ergo-meter.
2. Study and calibration of the subject in the laboratory using mechanical treadmill.
3. Use of respiration gas meter from human energy point of view.
4. Use of Heart Rate Monitor.
5. Study of general fatigue of the subject using Blink ratio method.
6. Familiarization with electro-myograph equipment, anthropometric measurements of a selected subjects.
7. Optimum work space layout and locations of controls for different tractors.
8. Familiarization with the noise and vibration equipment.
9. Familiarization with safety gadgets for various farm machines.

TEXT BOOKS:

1. Chapanis A. 1996. Human Factors in System Engineering. John Wiley & Sons, New York.
2. Dul J. and Weerdmeester B. 1993. Ergonomics for Beginners. A Quick Reference Guide. Taylor and Francis, London.
3. Mathews J. and Knight A. A. 1971. Ergonomics in Agricultural Equipment Design. National Institute of Agricultural Engineering.
4. Astrand P. And and Rodahl K. 1977. Textbook of Work Physiology. Mc Hill Corporation, New York.
5. Mark S. Sanders and Ernest James McCormick. 1993. Human Factors in Engineering and
6. Design. Mc Hill Corporation, New York.
7. Keegan J J, Radke AO. 1964. Designing vehicle seats for greater comfort. SAE Journal;72:50~5.

AGEI8R453	Tractor Design and Testing	L	P	C
		2	1	3

UNIT I

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

UNIT II

Design of mechanical power transmission in agricultural tractors: single disc, multi disc and cone clutches.

UNIT III

Rolling friction and anti-friction bearings. Design of Ackerman Steering and tractor hydraulic steering.

UNIT IV

Study of special design features of tractor engines and their selection viz. cylinder, piston, piston pin, crankshaft, etc.

UNIT V

Design of seat and controls of an agricultural tractor. Tractor Testing.

PRACTICAL SCHEDULE

1. Design problem of tractor clutch – (Single/ Multiple disc clutch).
2. Design of gear box(synchromesh/constant mesh).
3. Variable speed constant mesh drive
4. Selection of tractor tires.
5. Problem solving on clutch and gear.
6. Problem on design of governor.
7. Design and selection of hydraulic pump.
8. Engine testing as per BIS code.
9. Drawbar performance in the lab.
10. PTO test and measure the tractor power in the lab/field.
11. Determining the turning space, turning radius and brake test.
12. Hydraulic pump performance test and air cleaner and noise measurement test.
13. Visit to tractor Implement/Farm machinery Testing centre.

TEXT BOOKS:

1. Liljedahl J B & Others. Tractors and Their Power Units.
2. Raymond N, EA Yong and S Nicolas. Vehicle Traction Mechanics.
3. Maleev VL. Internal Combustion Engines.
4. Kirpal Singh. Automobile Engineering – Vol I and Vol II.

AGEI8R464	Hydraulic Drives and Controls	L	P	C
		2	1	3

UNIT I

Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements. Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors.

UNIT II

Pumps, Pump Classifications, operation, performance, Displacement, Design of Gear Pumps, Vane Pumps, Piston Pumps.

UNIT III

Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors. Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves Hydraulic Circuit Diagrams and Troubleshooting.

UNIT IV

United States of American Standards Institute USASI Graphical Symbols, tractor hydraulics, nudging system, ADDC.

UNIT V

Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs).

PRACTICAL SCHEDULE

1. Introduction to hydraulic systems.
2. Study of hydraulic pumps, hydraulic actuators.
3. Study of hydraulic motors, hydraulic valves, colour codes and circuits.
4. Building simple hydraulic circuits.
5. Hydraulics in tractors.
6. Introduction to pneumatics, pneumatics devices, pneumatics in agriculture.
7. Use of hydraulics and pneumatics for robotics.

TEXT BOOKS:

1. Kepner RA, Bainer & EL Barger. Principles of Farm Machinery.
2. Anthony E. Fluid Power and Applications.
3. Majumdar. Oil Hydraulic System.
4. Merit. Hydraulic Control Systems.

AGEI8R465	Precision Agriculture and System Management	L	P	C
		2	1	3

UNIT I

Precision Agriculture – need and functional requirements. Familiarization with issues relating to natural resources.

UNIT II

Familiarization with equipment for precision agriculture including sowing and planting machines, power sprayers, land clearing machines.

UNIT III

Laser guided land levellers, strawchopper, straw-balers, grain combines, etc.

UNIT IV

Introduction to GIS based precision agriculture and its applications. Introduction to sensors and application of sensors for data generation. Database management.

UNIT V

System concept. System approach in farm machinery management, problems on machinery selection, maintenance and scheduling of operations. Application to PERT and CPM for machinery system management

PRACTICAL SCHEDULE

1. Familiarization with precision agriculture problems and issues.
2. Familiarization with various machines for resource conservation.
3. Solving problems related to various capacities, pattern efficiency, system limitation, etc.
4. Problems related to cost analysis and inflation and problems related to selection of equipment, replacement, break-even analysis, time value of money etc.

TEXT BOOKS:

1. Kuhar J E. The Precision Farming Guide for Agriculturist.
2. Dutta SK. Soil Conservation and land management.
3. Sigma and Jagmohan. Earth Moving Machinery.
4. Wood and Stuart. Earth Moving Machinery.
5. DeMess MN. Fundamentals of Geographic Information System.
6. Hunt Donnell. Farm Power and Machinery Management.

AGEI8R466	Food Quality and Control	L	P	C
		2	1	3

UNIT I

Basics of Food Science and Food Analysis, Concept, objectives and need of food quality. Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition.

UNIT II

Sampling; purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials. Quality control, Quality control tools, Statistical quality control,

UNIT III

Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality. Food adulteration and food safety. TQM and TQC, consumer preferences and acceptance.

UNIT IV

Food Safety Management Systems GAP, GHP, GMP. Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industry (SSOP), Food Laws and Regulations in India, FSSAI,

UNIT V

Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimentarius Commission), Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism.

PRACTICAL SCHEDULE

1. Examination of cereals & pulses from one of go-downs and market shops in relation to FPO and BIS specifications.
2. Detection of adulteration and examination of ghee for various standards of AGMARK & BIS standards.
3. Detection of adulteration and examination of spices for AGMARK and BIS standards.
4. Detection of adulteration and examination of milk and milk products for BIS standards.
5. Detection of adulteration and examination of fruit products such as jams, jellies, marmalades for FPO specification.
6. Visit to quality control laboratory.
7. Case study of statistical process control in food processing industry.
8. Study of registration process and licensing procedure under FSSAI.
9. Study of sampling techniques from food processing establishments.
10. Visit to food processing laboratory and study of records and reports maintained by food processing laboratory.

TEXT BOOKS:

1. Ranganna S. Hand book of Analysis and Quality Control for Fruit and Vegetable Products.
2. Srilakshmi B, Food Science.
3. Sharma Avanthi. A text book of Food Science and Technology.
4. Mudambi Sumati R, Rao Shalini M and Rajagopal M.V. Food Science.
5. Potter NN and Hotchkiss JH, Food Science.
6. Dev Raj, Rakesh Sharma and Joshi V.K, Quality for Value Addition in Food Processing.
7. The Food Safety and Standards Act along with Rules & Regulations. Commercial LawPublishers (India) Pvt. Ltd.

AGEI8R467	Food Plant Design and Management	L	P	C
		2	1	3

UNIT I

Food plant location, selection criteria, Selection of processes, plant capacity, Requirements of plant building and its components, Project design, flow diagrams, selection of equipment, process and controls, Objectives and principles of food plant layout.

UNIT II

Salient features of processing plants for cereals, pulses, oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products. Introduction to Finance, Food Product Marketing, Food Business Analysis and Strategic Planning,

UNIT III

Introduction to Marketing, Food Marketing Management, Supply chain management for retail food products. Entrepreneurship development in food industry, SWOT analysis, generation, incubation and commercialization of ideas and innovations.

UNIT IV

New product development process, Government schemes and incentive for promotion of entrepreneurship.

UNIT V

Govt. policy on small and medium scale food processing enterprise, export and import policies relevant to food processing sector, procedure of obtaining license and registration under FSSAI, Cost analysis and preparation of feasibility report.

PRACTICAL SCHEDULE:

1. Preparation of project report.
2. Preparation of feasibility report.
3. Salient features and layout of pre processing house.
4. Salient features and layout of Milk and Milk product plants.
5. Evaluation of given layout.
6. Salient features, design and layout of modern rice mill.
7. Salient features, design and layout of Bakery and related product plant.
8. Study of different types of records relating to production of a food plant.
9. Study of different types of records relating to finance of a food plant.
10. Study of different types of records relating to marketing of a food business.
11. Brain storming and SWOT analysis to start a food processing business.

TEXT BOOKS:

1. Hall, H.S. and Rosen, Y.S. Milk Plant Layout. FAO Publication, Rome.
2. Lopez Antonio. Gomez. Food Plant Design.
3. Robberts Theunis C. Food plant engineering systems by, CRC Press, Washington.
4. Maroulis Z B and Saravacos G D. Food plant economics. Taylor and Francis, LLC
5. Mahajan M. Operations Research. Dhanpat Rai and Company Private Limited, Delhi
6. Maroulis Z B. Food Process Design. Marcel Dekker, Inc ,Cimarron Road, Monticello, New York 12701, USA.

AGEI8R468	Food Packaging Technology	L	P	C
		2	1	3

UNIT I

Factors affecting shelf life of food material during storage, Interactions of spoilage agents with environmental factors as water, oxygen, light, pH, etc. and general principles of control of the spoilage agents; Difference between food infection, food intoxication and allergy. Packaging of foods, requirement, importance and scope, frame work of packaging strategy, environmental considerations.

UNIT II

Packaging systems, types: flexible and rigid; retail and bulk; levels of packaging; special solutions and packaging machines, technical packaging systems and data management packaging systems, Different types of packaging materials, their key properties and applications, Metal cans, manufacture of two piece and three piece cans, Plastic packaging, different types of polymers used in food packaging and their barrier properties. manufacture of plastic packaging materials, profile extrusion, blown film/ sheet extrusion.

UNIT III

Blow molding, extrusion blow molding, injection blow molding, stretch blow molding, injection molding. Glass containers, types of glass used in food packaging, manufacture of glass and glass containers, closures for glass containers. Paper and paper board packaging, paper and paper board manufacture process, modification of barrier properties and characteristics of paper/ boards. Relative advantages and disadvantages of different packaging materials; effect of these materials on packed commodities.

UNIT IV

Nutritional labelling on packages, CAS and MAP, shrink and cling packaging, vacuum and gas packaging; Active packaging, Smart packaging, Packaging requirement for raw and processed foods, and their selection of packaging materials, Factors affecting the choice of packaging materials, Disposal and recycle of packaging waste, Printing and labelling, Lamination, Package testing: Testing methods for flexible materials, rigid materials and semi rigid materials.

UNIT V

Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test, etc.), plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.), aluminium foil (thickness, pin holes, etc.), glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility, etc.).

PRACTICAL SCHEDULE:

1. Identification of different types of packaging materials.
2. Determination of tensile/ compressive strength of given material/package.
3. To perform different destructive and non-destructive tests for glass containers, Vacuum packaging of agricultural produces.
4. Determination of tearing strength of paper board.
5. Measurement of thickness of packaging materials.
6. To perform grease-resistance test in plastic pouches.
7. Determination of bursting strength of packaging material.
8. Determination of water-vapour transmission rate.
9. Shrink wrapping of various horticultural produce.
10. Testing of chemical resistance of packaging materials.
11. Determination of drop test of food package and visit to relevant industries.

TEXT BOOKS:

1. Coles, R., McDowell, D., Kirwan, M .J. 2003. Food Packaging Technology. Blackwell Publishing Co.
2. Gosby, N.T. 2001. Food Packaging Materials. Applied Science Publication
3. John, P.J. 2008. A Handbook on Food Packaging Narendra Publishing House,
4. Mahadevia, M., Gowramma, R.V. 2007. Food Packaging Materials. Tata McGraw Hill
5. Robertson, G. L. 2001. Food Packaging and Shelf life: A Practical Guide. Narendra Publishing House.

AGEI8R469	Development of Processed Products	L	P	C
		2	1	3

UNIT I

Process design, Process flow chart with mass and energy balance, Unit operations and equipments for processing.

UNIT II

New product development, Technology for value added products from cereal, pulses and oil seeds, Milling, puffing, flaking, Roasting, Bakery products, snack food.

UNIT III

Extruded products, oil extraction and refining, Technology for value added products from fruits, vegetables and spices, Canned foods.

UNIT IV

Frozen foods, dried and fried foods, Fruit juices, Sauce, Sugar based confection, Candy, Fermented food product, spice extracts.

UNIT V

Technology for animal produce processing , meat, poultry, fish, egg products, Health food, Nutra-ceuticals and functional food, Organic food.

PRACTICAL SCHEDULE:

1. Process design and process flow chart preparation.
2. Preparation of different value added products.
3. Visit to roller wheat flour milling, rice milling, spice grinding mill, milk plant, dal and oil mill, fruit/vegetable processing plants & study of operations and machinery.
4. Process flow diagram.
5. Study of various models of the machines used in a sugar mill.

TEXT BOOKS:

1. Geankoplis C. J. Transport processes and unit operations, Prentice-Hall.
2. Rao, D. G. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.
3. Norman N. Potter and Joseph H. Hotchikss. Food Science. Chapman and Hall Pub.
4. Acharya, K T Everyday Indian Processed foods. National Book Trust.
5. Mudambi Sumati R., Shalini M. Rao and M V Rajgopal. Food Science. New Age International Publishers.
6. Negi H.P.S., Savita Sharma, K. S. Sekhon. Hand book of Cereal technology. Kalyani Pub.

AGEI8R470	Process Equipment Design	L	P	C
		2	1	3

UNIT I

Introduction on process equipment design, Application of design engineering for processing equipments.

UNIT II

Design parameters and general design procedure, Material specification, Types of material for process equipments, Design codes, Pressure vessel design, Design of cleaners.

UNIT III

Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger.

UNIT IV

Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers. Design of milling equipments.

UNIT V

Optimization of design with respect to process efficiency, energy and cost, Computer Aided Design.

PRACTICAL SCHEDULE

1. Design of pressure vessel.
2. Design of cleaners.
3. Design of milling equipments.
4. Design of tubular heat exchanger.
5. Design of shell and tube type heat exchanger.
6. Design of plate heat exchanger, dryer.
7. Design of belt conveyor.
8. Design of bucket elevator.
9. Design of screw conveyor.

TEXT BOOKS:

1. Mahajani, V. V. and Umarji, S. B., Process equipment design, Macmillan.
2. Bhattachara, B. C., Introduction to Chemical Equipment design, CBS Publishers and Distributors.
3. Geankoplis C. J. Transport processes and unit operations, Prentice-Hall.
4. Rao, D. G. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.

AGEI8R471	Photovoltaic Technology and Systems	L	P	C
		2	1	3

UNIT I

Solar PV Technology: Advantages, Limitations, Current Status of PV technology, SWOT analysis of PV technology. Types of Solar Cell, Wafer based Silicon Cell, Thin film amorphous silicon cell Thin Cadmium Telluride (CdTe) Cell, Copper Indium Gallium Selenide (CiGS) Cell, Thin film crystalline silicon solar cell.

UNIT II

Solar Photo Voltaic Module: Solar cell, solar module, solar array, series & parallel connections of cell, mismatch in cell, fill factor, effect of solar radiation and temperature on power output of module, I-V and power curve of module.

UNIT III

Balance of Solar PV system: Introduction to batteries, battery classification, lead acid battery, Nicked Cadmium battery, comparison of batteries, battery parameters.

UNIT IV

Charge controller: types of charge controller, function of charge controller, PWM type, MPPT type charge controller, Converters: DC to DC converter and DC to AC type converter.

UNIT V

Application of Solar PV system. Solar home lighting system, solar lantern, solar fencing, solar street light, solar water pumping system, Roof top solar photovoltaic power plant and smart grid.

PRACTICAL SCHEDULE

1. Study of V-I characteristics of solar PV system.
2. Smart grid technology and application.
3. Manufacturing technique of solar array.
4. Different DC to DC and DC to AC converter.
5. Domestic solar lighting system, various solar module technologies.
6. Safe measurement of PV modules electrical characteristics and Commissioning of complete solar PV system.

TEXT BOOKS:

1. Rai GD. 1998. Non-conventional Sources of Energy. Khanna Pub.
2. Rathore N.S., Kurchania A.K., Panwar N.L. 2006. Renewable Energy: Theory & Practice, Himanshu Publications,.
3. Solanki C.S. 2011. Solar Photovoltaic: Fundamentals, Technologies and Applications, PHI Learning Private Ltd.
4. Meinel & Meinel. Applied Solar Energy.
5. Derrick, Francis and Bokalders, Solar Photo-voltaic Products.

AGEI8R472	Waste and By-Products Utilization	L	P	C
		2	1	3

UNIT I

Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc., Concept, scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD).

UNIT II

Fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette.

UNIT III

Generation of electricity using surplus biomass, producer gas generation and utilization, Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermin-composting, Pretreatment of waste: sedimentation, coagulation, flocculation and floatation.

UNIT IV

Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters.

UNIT V

Phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation, Effluent treatment plants, Environmental performance of food industry to comply with ISO-14001 standards.

PRACTICAL SCHEDULE

- 1.Determination of temperature, pH, turbidity solids content, BOD and COD of waste water.
- 2.Determination of ash content of agricultural wastes and determination of un-burnt carbon in ash.
- 3.Study about briquetting of agricultural residues, Estimation of excess air for better combustion of briquettes.
- 5.Study of extraction of oil from rice bran.
- 6.Study on bioconversion of agricultural wastes.
- 7.Recovery of germ and germ oil from by-products of cereals.
- 8.Visit to various industries using waste and food by-products.

TEXT BOOKS:

1. Markel, I.A. 1981. Managing Livestock Waste, AVI Publishing Co.
2. Pantastico, ECB. 1975. Post Harvest Physiology, Handling and utilization of Tropical and Subtropical fruits and vegetables, AVI Pub. Co.
3. V.K. Joshi & S.K. Sharma. Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency.
4. Prashar, Anupama and Bansal, Pratibha. 2007-08. Industrial Safety and Environment. S.K. Kataria and sons, New Delhi
5. Garg, S K. 1998. Environmental Engineering (Vol. II) – Sewage Disposal and Air Pollution Engineering. Khanna Publishers, New Delhi
6. Bhatia, S.C.. 2001. Environmental Pollution and Control in Chemical Process Industries. Khanna Publishers, New Delhi.

AGEI8R473	Artificial Intelligence	L	P	C
		3	0	3

UNIT I

Foundation and history of artificial intelligent, problems and techniques – AI programming languages, introduction to LISP and PROLOG- problem spaces and searches, blind search strategies, Breadth first- Depth first- heuristic search techniques Hill climbing: best first-A* algorithm AO* algorithm- game tree, Min max algorithms, game playing- alpha beta pruning.

UNIT II

Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability.

UNIT III

Bayes probabilistic interferences and Dempster shafer theory, Heuristic methods, symbolic reasoning under uncertainty, Statistical reasoning, Fuzzy reasoning, Temporal reasoning, Non monotonic reasoning.

UNIT IV

Planning and planning in situational calculus, representation for planning, partial order planning algorithm, learning from examples, discovery as learning, learning by analogy, explanation based learning, neural nets, genetic algorithms.

UNIT V

Principles of Natural language processing, rule based systems architecture, Expert systems, knowledge acquisition concepts, AI application to robotics, and current trends in intelligent systems.

TEXT BOOKS:

1. Russell, S. and P. Norvig. 1998. Artificial Intelligence: A Modern Approach. Prentice Hall.
2. Rich, Elain and Kevin Knight. 1991. Artificial Intelligence. TMH.
3. Patrick Henry Winston. 1992. Artificial intelligence. Addition Wesley 3rd Ed.
4. Nilson Nils J. Principles of Artificial Intelligence. Norsa Publishing House.

AGEI8R474	Mechatronics	L	P	C
		2	1	3

UNIT I

Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach. Sensors and transducers, performance terminology, Displacement, Position & Proximity Sensors, photo-electric transducers, flow transducers, optical sensors and transducers.

UNIT II

Actuators, Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor. Signal conditioning process, filtering digital signal, multiplexers, data acquisition, digital signal processing, measurement system, pulse modulation, data presentation systems.

UNIT III

System modeling & control, Mathematical Models, Engineering Systems, Electro-mechanical & Hydraulicmechanical Systems, Modelling Dynamic Systems, Transfer Functions, Control Modes, PID Controller.

UNIT IV

Micro-processor & computer, Computer and Interfacing, Micro-computer Structure, Micro-controllers, Application of Microcontrollers, PLC. Robotics, Robot components, robot classification and specification, Work envelopes, other basic parameters of robots.

UNIT V

Robot applications, Robot applications in manufacturing, Material transfer and machine loading/ unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Future applications.

PRACTICAL SCHEDULE

1. Selection of sensor for a particular application from Catalogue/Internet.
2. Design a mechatronics product/system and incorporate application of mechatronics for enhancing product values.
3. To study the hardware and software of mechatronics kit.
4. To move a table in X-direction within the range of proximity sensors using Control-X software.
5. To run a motor with PLC.
6. To run a conveyor with computer.
7. To study the movement of actuating cylinders and sensors.

TEXT BOOKS:

1. Bolton, W. Mechatronics. Pearson Education Asia.
2. Wolfram, Stadler. Analytical Robotics and Mechatronics. Mc-Graw Hill.
3. Doebelin E.O. Measurement Systems. Mc-Graw Hill.
4. Mahind, A.P. Introduction to Digital Computer Electronics. TMH.
5. Niku, S.Y. Introduction to Robotics: Analysis, systems and applications”, Pearson Education Asia.
6. Craig, J.J. Introduction to Robotics. Pearson Education Asia.

AGEI8R475	Management of Canal Irrigation System	L	P	C
		2	1	3

UNIT I

Purpose benefits and ill effects of irrigation; typical network of canal irrigation system and its different physical components; canal classification based on source of water, financial output, purpose, discharge and alignment.

UNIT II

Canal alignment: general considerations for alignment; performance indicators for canal irrigation system evaluation, Estimation of water requirements for canal command areas and determination of canal capacity; water duty and delta, relationship between duty, base period and delta, factors affecting duty and method of improving duty;

UNIT III

Silt theory: Kennedy's theory, design of channels by Kennedy's theory, Lacey's regime theory and basic regime equations, design of channels by Lacey's theory, maintenance of unlined irrigation canals.

UNIT IV

Measurement of discharge in canals, rostering (canal running schedule) and warabandhi, necessity of canal lining: advantages and disadvantages, types of canal lining and desirable characteristics for the suitability of lining materials; design of lined canals.

UNIT V

Functions of distributary head and cross regulators; canal falls, their necessity and factors affecting canal fall; sources of surplus water in canals and types of canal escapes; requirements of a good canal outlet and types of outlet.

PRACTICAL SCHEDULE

1. Estimation of water requirement of canal commands.
2. Determination of canal capacity.
3. The layout of canal alignments on topographic maps, drawing of canal sections in cutting, full banking and partial cutting and partial banking.
4. Determination of longitudinal section of canals.
5. Design of irrigation canals based on silt theories.
6. Design of lined canals.
7. Formulation of warabandhi.
8. Study of canal outlets, regulators, escapes, and canal fall.

TEXTBOOKS:

1. Arora, K.R. 2001. Irrigation, Water Power, and Water Resources Engineering. Standard Publishers Distributors, Delhi.
2. Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.
3. Sahasrabudhe SR. 2011. Irrigation Engineering and Hydraulic Structures. SK Kataria & Sons Reprint 2015.

NON CREDIT COURSES

NG18R1001 or 02 and 03	NSS or NCC and Physical Education	L	P	C
		0	2	2

Theory

Course aims at evoking social consciousness among students through various activities viz., working together, constructive and creative social work, to be skilful in executing democratic leadership, developing skill in programme development to be able for self employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Following activities are to be taken up under the NSS course:

- Introduction and basic components of NSS: Orientation
- NSS programmes and activities
- Understanding youth
- Community mobilisation
- Social harmony and national integration
- Volunteerism and shramdan
- Citizenship, constitution and human rights
- Family and society
- Importance and role of youth leadership
- Life competencies
- Youth development programmes
- Health, hygiene and sanitation
- Youth health, lifestyle, HIV AIDS and first aid
- Youth and yoga
- Vocational skill development
- Issues related environment
- Disaster management
- Entrepreneurship development
- Formulation of production oriented project
- Documentation and data reporting
- Resource mobilization
- Additional life skills
- Activities directed by the Central and State Government

All the activities related to the National Service Scheme course is distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV each having one credit load. The entire four courses should be offered continuously for two years. A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one day camp in a year and one special camp for duration of 7 days at any semester break period in the two year. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

NG18R3004	Skill Development Training-I	L	P	C
		0	5	5

This will include capacity building and skill development of the students in planning, development, formulation, monitoring, and evaluation of the project for entrepreneurial proficiency. Skill Development will have 0+5 credit hours and include Aquarium Fabrication, Analysis of Soil and Water Quality Parameters, Preparation of Fish Products or in any appropriately applied aspect of fisheries.

NG18R4001	EDUCATIONAL TOUR	L	P	C
		0	2	2

Visit places of interest in other states (other than Tamil Nadu, Pondicherry) related to the subjects taught in Farm Machinery and Power, Soil and Water Conservation Engineering, Agricultural Process Engineering, Bio Energy and Agricultural Structures, viz.,

Visit dairy plant – National seed processing plant, IARI, New Delhi – energy division of IIT – tractor and allied farm equipment manufacturing industries – Tata energy research institute, - National physical laboratory – appraisal of environmental pollution problem in Agra – architectural splendor of Tajmahal – an Environmental research institute at Jaipur. Technical museums at Bangalore and New Delhi.

Parametric data analysis at forest research institute, soil, and water conservation research and training institute, Remote sensing center, Dehradun – WALMI (water and land management institute). – Dhun valley project – observation of soil erosion and control measures – appraisal of drainage NDRI Karnal –food and fruit processing industries, solar, photo, voltaic production system at EC (Electronic Corporation of India) – sea and coastal erosion studies at Bombay – BARC, observation of dry land technology at ICRISAT and central dry land research institute at Hyderabad. HMT – Indian telephone industrials BEL Viswesharya industrial museum – Bharath earthmovers – BHEL (PV models) at Bangalore, CFTRI, Mysore.

The students will be evaluated as indicated below:

S.No	Item	Marks
1.	Attendance	10
2.	Behaviour	15
3.	Tour diary	15
4.	Tour record	15
5.	Written test	30
6.	Viva voce	15
7.	Total	100

NG18R4002	Skill Development Training-II	L	P	C
		0	5	5

This will include capacity building and skill development of the students in planning, development, formulation, monitoring, and evaluation of the project for entrepreneurial proficiency. Skill Development will have 0+5 credit hours and include Aquarium Fabrication, Analysis of Soil and Water Quality Parameters, Preparation of Fish Products or in any appropriate applied an aspect of fisheries.