



Four-Year Undergraduate Programme

**Bachelor of Technology
Agricultural Engineering**

Faculty of Agriculture

Parul University

Vadodara, Gujarat, India

Faculty of Agriculture
Bachelor of Technology in Agricultural Engineering

1. Vision of the Department

To build sound agricultural engineers with an essence of humanity and the enrichment of society by effective teaching learning process, technical activities and study beyond curriculum.

2. Mission of the Department

M1 To produce good quality agricultural engineers with leadership skills and ethical values to serve the society by organizing expert lectures, seminars, industrial visits.

M2 To develop the required manpower in the field of agricultural engineering suitable for research and education, extension, government agency, private industries, Agro-industries, NGOs etc.

M3 To assist farmers in reducing the cost of cultivation through better utilization of efficient farm machinery, soil and water conservation, irrigation management, value addition through farm level processing, post-harvest technology; protective cultivation and use of renewable energy ultimately help the farmers to increase their earnings.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B.Tech. Agricultural Engineering curriculum enables graduates to attain.

PEO 1	To develop technical skills (critical investigation, communication, analytical and computer) and human relations skills (group dynamics, team building, organization and delegation) to enable students to transform the acquired knowledge into action.
PEO 2	To inculcate critical analysis and communication skills into students to effectively present their views, both in writing and through oral presentations.
PEO 3	To provide an environment for exploring the Research & Development attitude, to help the students in Research and Development field.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Engineering knowledge:	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	Problem analysis:	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	Design/development of solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PLO 4	Conduct investigations of complex problems:	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PLO 5	Modern tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 6	The engineer and society:	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PLO 7	Environment and sustainability:	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	Ethics:	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	Individual and team work:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	Communication:	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	Project management and finance:	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO 12	Life-long learning:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO 1	Graduates will demonstrate an understanding and proficiency in integrating engineering principles in soil and water conservation, Farm machinery, irrigation, renewable energy, and Food processing, to develop sustainable and efficient agricultural systems.
PSO 2	Graduates will apply precision agriculture, renewable energy sources, and modern farm machinery for environmentally sustainable and resource-efficient agricultural processes.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	23
Semester-2	21
Semester-3	21
Semester-4	22
Semester-5	29
Semester-6	25
Semester-7	27
Semester-8	19
Total Credits:	187

Category wise Credit distribution of the programme	
Category	Credit
Major Core	139
Minor Stream	0
Multidisciplinary	3
Ability Enhancement Course	10
Skill Enhancement Courses	3
Value added Courses	0
Summer Internship	22
Research Project/Dissertation	10
Total Credits:	187

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	20103110	Engineering Mechanics	3	2	2	-
2	20103111	Engineering Mathematics-I	3	2	2	-
3	20103112	Engineering Physics	3	2	2	-
4	20103113	Surveying and Levelling	3	1	4	-
5	20103160	Heat and Mass Transfer	2	2	-	-
6	20103161	Engineering Drawing	2	-	4	-
7	20103201	Engineering Chemistry	3	2	2	-
8	20103204	Principles of Soil Science	3	2	2	-
9	20193104	Communication Skills (only for DT/AG)	1	0	2	0
Total			23	13	20	0
Semester 2						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
10	20103153	Engineering Mathematics-II	3	2	2	-
11	20103154	Environmental Science and Disaster Management	3	2	2	-
12	20103155	Fluid Mechanics and Open Channel Hydraulics	3	2	2	-
13	20103158	Theory of Machines	2	2	-	-
14	20103162	Strength of Materials	2	1	2	-
15	20103163	Workshop Technology & Practices	3	1	4	-
16	20103164	Entrepreneurship Development and Business Management	3	2	2	-
17	20103263	Web Designing and Internet Applications	2	1	2	-
Total			21	13	16	0
Semester 3						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut

18	20103202	Principles of Agronomy	3	2	2	-
19	20103203	Engineering Mathematics-III	3	2	2	-
20	20103205	Design of Structures	2	1	2	-
21	20103206	Machine Design	2	2	-	-
22	20103207	Thermodynamics, Refrigeration and Air Conditioning	3	2	2	-
23	20103208	Electrical Machines and Power Utilizations	3	2	2	-
24	20103209	Principles of Horticultural Crops and Plant Protections	2	1	2	-
25	20103210	Soil Mechanics	2	1	2	-
26	20193201	Communication Skills & Personality Development	1	0	2	-
Total			21	13	16	0
Semester 4						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
27	20103254	Building Construction and Cost Estimation	2	2	-	-
28	20103255	AutoCAD Applications	2	-	4	-
29	20103256	Applied Electronics and Instrumentation	3	2	2	-
30	20103257	Tractor and Automotive Engines	3	2	2	-
31	20103258	Engineering Properties of Agricultural Produce	2	1	2	-
32	20103259	Watershed Hydrology	2	1	2	-
33	20103260	Irrigation Engineering	3	2	2	-
34	20103261	Sprinkler and Micro Irrigation Systems	2	1	2	-
35	20103262	Fundamentals of Renewable Energy Sources	3	2	2	-
Total			22	13	18	0
Semester 5						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
36	20103302	Tractor Systems and Controls	3	2	2	-

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
55	20103401	10- weeks Industrial Attachment /Internship (Student READY)	10	-	-	-
56	20103402	10- weeks Experiential Learning On campus (Student READY)	10	-	-	-
57	20103403	Skill Development Training-II (Student READY)	5	-	-	-
58	20103404	Educational Tour (Registration only)	2	-	4	-
Total			27	0	4	0
Semester 8						
S00 72. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
59	20103452	Project Planning and Report Writing	10	-	20	-
60	20103484	Tractor Design and Testing	3	2	2	-
61	20103489	Food Packaging Technology	3	2	2	-
62	20103478	Landscape Irrigation Design and Management	3	2	2	-
Total			19	6	26	0

Detailed Syllabus

Semester 1

- a. Course Name:** Engineering Mechanics
- b. Course Code:** 20103110
- c. Prerequisite:** Knowledge of Applied science
- d. Rationale:** Engineering mechanics is the main subject of engineering which gives a basic base to other subjects
- e. Course Learning Objective:**

CLOBJ 1	Define and differentiate between various types of force systems, including concurrent, parallel, and coplanar force systems.
CLOBJ 2	Demonstrate proficiency in determining the centroids of composite areas using mathematical and graphical methods.
CLOBJ 3	Understand the fundamental principles of truss structures and their significance in engineering.
CLOBJ 4	Gain knowledge of internal forces in structural elements, specifically shear forces and bending moments.

f. Course Learning Outcomes:

CLO 1	Determine the stability of the beams, columns and struts using different methods.
CLO 2	Solve problems relating to centroids of composite areas and involving frictional forces
CLO 3	Analysis of simple trusses by graphical method
CLO 4	Recall the concept of Stress, strain and failure in engineering materials.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30		20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Basic concepts of Engineering Mechanics. Force systems, Centroid, Moment of inertia, Free body diagram and equilibrium of forces.	25%	8

2	Frictional forces Analysis of simple framed structures using methods of joints, methods of sections and graphical method.	25%	8
3	Simple stresses. Shear force and bending moment diagrams.	25%	8
4	Stresses in beams. Torsion. Analysis of plane and complex stresses.	25%	8
		100%	32

i. Text Book and Reference Book:

1. A Text Book of Engineering Mechanics (TextBook) Bansal R K; Laxmi Publishers, New Delhi.
2. Engineering Mechanics (TextBook) Timoshenko S and Young D H; McGraw Hill Book Co., New Delhi.
3. Engineering Mechanics: Statics and Dynamics (Textbook) by Russell C. Hibbeler; Pearson Education, Inc.
4. Engineering Mechanics: Dynamics (Textbook) by J.L. Meriam and L.G. Kraige; John Wiley & Sons, Inc.
5. Engineering Mechanics: Statics (Textbook) by Anthony Bedford and Wallace Fowler; Pearson Education, Inc.

j. Experiment List

Sr. No.	Experiment List
1	Problems on composition and resolution of forces, moments of a force, couples, transmission of a couple, resolution of a force into a force & a couple
2	Problems relating to resultant of; Coplaner force system, collinear force system, concurrent force system, co-planer concurrent force system, co-planer non-concurrent force system, non-coplaner concurrent force system, Non-coplaner non-concurrent force system, system of couples in space
3	Problems relating to centroids of composite areas
4	Problems on moment of inertia, polar moment of inertia, radius of gyration, polar radius of gyration of composite areas
5	Equilibrium of concurrent $\pm$ co-planer and non-concurrent $\pm$ co-planer force systems
6	Problems involving frictional forces
7	Analysis of simple trusses by method of joints and method of sections
8	Analysis of simple trusses by graphical method
9	Problems relating to simple stresses and strains
10	Problems on shear force and bending moment diagrams

11	Problems relating to stresses in beams
12	Problems on torsion of shafts
13	Analysis of plane and complex stresses.

- a. Course Name:** Engineering Mathematics - I
- b. Course Code:** 20103111
- c. Prerequisite:** Students have knowledge of Mathematics such as calculus, coordinate geometry and Statics.
- d. Rationale:** Students will be able to Use calculus or suitable and proper Mathematical tool to understand engineering principles and concepts.
- e. Course Learning Objective:**

CLOBJ 1	Understand and apply vector analysis principles to solve qualitative problems. Demonstrate the ability to determine linear independence and dependence of vectors.
CLOBJ 2	Learn and apply double and triple integration techniques for calculating areas and volumes.
CLOBJ 3	Explain the necessary and sufficient conditions for ordinary differential equations.
CLOBJ 4	Recognize applications of Stoke's theorem and Green's theorem in relevant mathematical problems.

f. Course Learning Outcomes:

CLO 1	Solve qualitative problems based on vector analysis and matrix analysis such as linear independence and dependence of vectors, rank
CLO 2	Demonstrate the applications of double and triple integration in finding the area and volume
CLO 3	Explain about necessary and sufficient condition for ordinary differential equations
CLO 4	Identify applications of Gauss, Stoke's and Green's theorem

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordan method to find inverse of a matrix, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalization of matrices, quadratic forms.	25%	8
2	PAQ form, Echelon form, Solution of linear equations, nature of rank, using Cayley-Hamilton theorem to find inverse of A.	25%	8
3	Differential calculus: Taylor's and Maclaurin's expansions; indeterminate form; curvature, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, maxima and minima. Integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration, application of double and triple integrals to find area and volume.	25%	8
4	Vector calculus: Differentiation of vectors, scalar and vector point functions, vector differential operator Del, Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, identities involving Del, second order differential operator; line, surface and volume integrals, Stoke's, divergence and Green's theorems (without proofs).	25%	8
		100%	32

i. Text Book and Reference Book:

1. Engineering Mathematics (Textbook) by K.A. Stroud and Dexter J. Booth; Palgrave Macmillan.
2. Advanced Engineering Mathematics (Textbook) by Erwin Kreyszig; John Wiley & Sons, Inc.
3. Engineering Mathematics: A Foundation for Electronic, Electrical, Communications, and Systems Engineers (Textbook) by Anthony Croft, Robert Davison, and Martin Hargreaves; Pearson Education Limited.
4. Higher Engineering Mathematics (Textbook) by B.S. Grewal; Khanna Publishers.
5. Engineering Mathematics (Textbook) by John Bird; Routledge.

j. Experiment List

Sr. No.	Experiment List
1	Tutorials on rank of a matrix, reduction to normal form, consistency and solution of linear equations,

2	eigen values and eigen vectors, Cayley-Hamilton theorem, diagonalization of matrices, quadratic forms;
3	Taylor's and Maclaurin's expansion, indeterminate form, curvature, tracing of curves, partial differentiation,
4	maxima and minima, volume and surface of revolution, multiple integrals,
5	Beta and Gamma functions, differentiation of vectors, gradient,
6	divergence and curl of a vector point function, line, surface and volume integrals,
7	Stoke's divergence and Green's Theorems.

- a. **Course Name:** Engineering Physics
- b. **Course Code:** 20103112
- c. **Prerequisite:** Knowledge of Physics and some basic concepts in Mathematics like differentiation, integration, limit, differential equation up to 12th science level.
- d. **Rationale:** Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students
- e. **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to apply electrostatic principles to real-world applications. Solve problems involving the practical use of electrostatics in various contexts.
CLOBJ 2	Explain the significance of different mediums in modifying electric and magnetic fields. Analyze how changes in medium affect the behaviour of electric and magnetic fields.
CLOBJ 3	Gain comprehensive knowledge of Faraday's law and its fundamental principles. Apply Faraday's law to solve problems related to electromagnetic field theory.
CLOBJ 4	Demonstrate the capability to use magnetic field principles in practical applications. Solve problems related to magnetic fields in various scenarios.

f. Course Learning Outcomes:

CLO 1	Develop the ability of students to solve variety of engineering problems.
CLO 2	Explain the importance of medium to modify the electric and magnetic field.
CLO 3	Apply faraday's law in the industries and solve the problem related with electromagnetic field theory.
CLO 4	Adapt to use the practical application using magnetic field.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30		20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Dia, Para and ferromagnetism-classification. Langevin theory of dia and paramagnetism. Adiabatic demagnetization. Weiss molecular field theory and ferromagnetism. Curie-Weiss law.	25%	8
2	Wave particle quality, deBroglie concept, uncertainty principle. Wave function. Time dependent and time independent Schrodinger wave equation, Qualitative explanation of Zeeman effect, Stark effect and Paschan Back effect, Raman spectroscopy. Statement of Bloch's function. Bands in solids, velocity of Bloch's electron and effective mass. Distinction between metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, law of mass action.	25%	8
3	Determination of energy gap in semiconductors. Donors and acceptor levels. Superconductivity, critical magnetic field. Meissner effect. Isotope effect. Type-I and II superconductors, Josephson's effect DC and AC, Squids. Introduction to high T _c superconductors.	25%	8
4	Spontaneous and stimulated emission, Einstein A and B coefficients. Population inversion, He-Ne and Ruby lasers. Ammonia and Ruby masers, Holography-Note. Optical fiber. Physical structure. basic theory. Mode type, input output characteristics of optical fiber and applications. Illumination: laws of illumination, luminous flux, luminous intensity, candle power, brightness.	25%	8
		100%	32

i. Text Book and Reference Book:

1. Text book of optics (TextBook) N. Subrahmanyam, Brij Lal and M. N. Avadhamulu; S. Chand and Co. Ltd., N Delhi, 2006
2. Optical State Physics and Fiber Optics (TextBook) Sarkar Subir Kumar; S. Chand and Co., New Delhi
3. Solid State Physics (TextBook) Saxena B S and Gupta R C; Pragati Prakasam, Meeruth.
4. Engineering Physics (Textbook) by P.K. Palanisamy; Scitech Publications (India) Pvt Ltd.
5. Engineering Physics (Textbook) by R.K. Gaur and S.L. Gupta; Dhanpat Rai Publications.

j. Experiment list

Sr. NO.	Experiment List
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 dielectric constant of material using De Sauty's bridge
4	To determine the value of specific charge (e/m) for electrons by helical method
5	To study the induced e.m.f. as a function of velocity of the magnet
6	To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities
7	To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil
8	To determine the energy band gap in a semiconductor using a p-n Junction diode
9	To determine the slit width from Fraunhofer diffraction pattern using laser beam
10	To find the numerical aperture of optical fiber: To set up the fiber optic analog and digital link
11	To study the phase relationships in L.R. circuit
12	To study LCR circuit
13	To study the variations of thermo emf of a copper-constantan thermo-couple with temperature
14	To find the wave length of light by prism

- a. **Course Name:** Surveying and Levelling
- b. **Course Code:** 20103113
- c. **Prerequisite:** Zeel to learn the subject
- d. **Rationale:** To develop concepts of various types of land surveying and prepare and interpret maps and drawing
- e. **Course Learning Objective:**

CLOBJ 1	To introduce students to various methods employed in quantifying land area through surveying instruments. To provide theoretical knowledge on the principles underlying land quantification techniques.
CLOBJ 2	To equip students with the skills to plan and execute survey work by establishing traverses. To impart practical knowledge in the application of traverse survey techniques in real-world scenarios.
CLOBJ 3	To bridge the gap between theoretical learning and practical application by demonstrating how land surveying principles are employed in the field during traverse surveys. To encourage critical thinking and problem-solving in adapting theoretical concepts to real-world surveying challenges.
CLOBJ 4	To train students in conducting basic field measurements using surveying instruments. To emphasize the importance of accuracy and precision in field data collection.

f. Course Learning Outcomes:

CLO 1	Understand different methods used in quantifying land area using Surveying instruments
CLO 2	Plan and execute survey work by establishing traverse
CLO 3	Apply theoretical learning of Land surveying principles to the practical field for conducting traverse survey
CLO 4	Explain basic field measurements and keep proper record of field data.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	4	3	30		20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction: Basic principles of surveying and classification based on the instruments and work. Introductory reconnaissance survey, hydrographic survey, chain and tape survey, compass survey, plane table survey(Contains brief note on principle, uses and related techniques with description, application and accuracy), types of errors, sources of errors.	17%	3
2	Levelling: Levelling, Levelling difficulties and error in levelling	10%	2
3	Determination of elevation: Spirit levelling(theoretical aspects), Trigonometrical levelling (indirect levelling, levelling on steep ground -- methods) and tachometric surveying, contouring	20%	3
4	Curve Surveying: Introduction, classification of curves and methods of setting out of simple circular curves, elements of a compound and reverse curves, transition curve, types of transition curve, combined curve, types of vertical curves	10%	1
5	Contouring: Contouring, Computation of area and volume	6%	1
6	Theodolite Survey: Theodolite Survey- introduction, types of theodolite, temporary adjustment of theodolite- field operation with theodolite- measurement of horizontal and vertical angles- method of repetition- method of reiteration- Theodolite Traverse- gales traverse Table	22%	3
7	Advance Surveying Instruments: EDM, total Stations, GPS and Laser based instruments	10%	2
8	GPS Surveying: Principles and methods, DGPS, Mapping with GPS	5%	1
		100%	16

i. Text Book and Reference Book:

1. Dr. B. C. Punmia (TextBook) Surveying and Levelling Vol-I; Laxmi Publications Pvt. Ltd.
2. Surveying and Levelling Vol. I (TextBook) Arora K. R; Standard Publications, Delhi
3. Surveying and Levelling Vol.1&2 (TextBook) T.P. Kanetkar and S.V. Kulkarni
4. Surveying and Levelling (Textbook) by T.P. Kanetkar and S.V. Kulkarni; Pune Vidyarthi Griha Prakashan.
5. Elementary Surveying: An Introduction to Geomatics (Textbook) by Charles D. Ghilani and Paul R. Wolf; Pearson Education, Inc.

j. Experiment List

Sr. No.	Experiment List
1	Chain survey of an area and preparation of map;
2	Compass survey of an area and plotting of compass survey
3	Plane table surveying
4	Levelling. L section and X sections and its plotting
5	Contour survey of an area and preparation of contour map
6	Introduction of software in drawing contour
7	Theodolite surveying
8	Ranging by Theodolite, Height of object by using Theodolite
9	Setting out curves by Theodolite
10	Minor instruments.
11	Use of total station.

- a. **Course Name:** Heat and Mass Transfer
- b. **Course Code:** 20103160
- c. **Prerequisite:** Zeel to learn the subject
- d. **Rationale:** Heat and Mass transfer knowledge is essential for Agricultural Engineers
- e. **Course Learning Objective:**

CLOBJ 1	Define fundamental terms related to heat transfer, such as conduction, convection, and radiation. Explain the significance of thermal conductivity, convective heat transfer coefficients, and emissivity.
CLOBJ 2	Develop skills in formulating problems involving various modes of heat transfer (conduction, convection, and radiation). Analyze heat transfer problems using mathematical principles and engineering principles.
CLOBJ 3	Define and characterize boundary layers in the context of fluid flow and heat transfer. Evaluate the impact of boundary layers on flow velocities and heat transfer rates.
CLOBJ 4	Apply analytical methods to obtain exact solutions for temperature variations in specific heat transfer problems. Demonstrate proficiency in solving heat conduction problems using techniques such as separation of variables or integral transforms.

f. Course Learning Outcomes:

CLO 1	Define various terms related to heat transfer.
CLO 2	Formulate and analyze problem involving different modes of heat transfer.
CLO 3	Evaluate boundary layer and its effects on flow velocities and heat transfer.
CLO 4	Solve conduction and radiation heat transfer problems.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	-	2	50	-	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit 1: Concept, methods of heat transfer, thermal conductivity of materials, measurement, General differential equation of conduction.	10%	4

2	Unit 2: One-dimension steady state conduction through plane and composite walls, tubes and spheres with and without heat generation. Electrical analogy. Insulation materials. fins	20%	6
3	Unit 3: Free and forced convection, newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Useful no dimensional numbers. Equation of laminar boundary layer on flat plate in a tube. Laminar forced convection on a flat plate and in a tube. Combined free and forced convection	25%	8
4	Unit 4: Introduction. Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, grey bodies and emissive power, solid angle, intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection and radiation by network	20%	6
5	Unit 5 Types of heat exchangers, fouling factor, and log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers.	15%	4
6	Unit 6: Steady state molecular diffusion in fluids at rest and in laminar flow, Flick's law, mass transfer coefficients. Reynold's analogy.	10%	4
		100%	32

i. Text Book and Reference Book:

1. Heat and mass transfer, P.K.Nag, Tata McGraw Hill New Delhi(Text Book)
2. Heat and mass transfer, A practical approach Yunus A Cengel, Tata McGraw (Text Book)
3. Heat and mass transfer, J.P. Holman, McGraw Hill
4. Heat and Mass Transfer: Fundamentals and Applications (Textbook) by Yunus A. Çengel and Afshin J. Ghajar; McGraw-Hill Education.
5. Fundamentals of Heat and Mass Transfer (Textbook) by Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, and David P. DeWitt; John Wiley & Sons, Inc.

- a. **Course Name:** Engineering Chemistry
- b. **Course Code:** 20103201
- c. **Prerequisite:** Understanding of Basic knowledge of Science for the application.
- d. **Rationale:** To applying Engineering Chemistry for Agricultural Processing Engineering.
- e. **Course Learning Objective:**

CLOBJ 1	Understand and apply fundamental engineering concepts relevant to the specific branch of study. Analyze and synthesize information to think critically about core engineering principles.
CLOBJ 2	Apply appropriate mathematical techniques to model and solve engineering problems. Demonstrate proficiency in using mathematical concepts to derive quantitative solutions.
CLOBJ 3	Gain an in-depth understanding of major concepts in chemistry relevant to the engineering field. Explore theoretical principles that underpin chemical processes and reactions.
CLOBJ 4	Familiarize oneself with experimental methods in chemistry and chemical engineering. Evaluate and interpret experimental data to draw meaningful conclusions.

f. Course Learning Outcomes:

CLO 1	Demonstrate the ability to think in core concept of their engineering application by studying various topics involved in branch specific applications.
CLO 2	Utilize appropriate mathematical techniques and concepts to obtain quantitative solutions to problems
CLO 3	Understand major concepts, theoretical principles and experimental findings in chemistry.
CLO 4	Utilize modern instrumentation for chemical analysis and separation.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1 Phase rule and its application to one and two component systems	16%	6
2	Chapter 2 Fuels: classification, Calorific value	8%	2
3	Chapter 3 Colloids: classification, Properties	10%	4
4	Chapter 4 Corrosion: causes, Types and method of prevention	8%	2
5	Chapter 5 Water: temporary and permanent hardness, disadvantages of hard water, scale and sludge formation in boilers, boiler corrosion.	8%	2
6	Chapter 6 Analytical methods like thermo-gravimetric, polarographic analysis, nuclear radiation, detectors and analytical applications of radioactive materials	6%	2
7	Chapter 7 Enzymes and their use in the manufacturing of ethanol and acetic acid by fermentation methods, Principles of food chemistry, Introduction to lipids, proteins, carbohydrates, vitamins, food preservatives, colouring and flavouring reagents of food	8%	2
8	Chapter 8 Lubricants: properties, Mechanism, Classification and tests.	8%	2
9	Chapter 9 Polymers. Types of polymerization, Properties, Uses and methods for the determination of molecular weight of polymers. polymers	16%	6
10	Chapter 10 Introduction to IR spectroscopy	12%	4
		100%	32

i. Text Book and Reference Book:

1. Engineering Chemistry (TextBook) By P. C. Jain, M. Jain | Dhanpat Rai & Sons, Delhi
2. Principle of Physical Chemistry (TextBook) By Puri, Sharma and Pathania
3. Engineering Chemistry (Textbook) by Jain and Jain; Dhanpat Rai Publications.

4. Engineering Chemistry (Textbook) by Sivasankar; Tata McGraw-Hill Education.
5. Engineering Chemistry (Textbook) by Ravi Krishnan; New Age International (P) Ltd., Publishers.

j. Experiment List

Sr. No.	Experiment
1.	Determination of temporary and permanent hardness of water by EDTA method.
2.	Estimation of chloride in water
3.	Estimation of dissolved oxygen in water
4.	Determination of BOD in water sample
5.	Determination of COD in water sample
6.	Determination of viscosity of oil
7.	Estimation of activity of water sample
8.	Chromatographic analysis

- a. **Course Name:** Engineering Drawing
- b. **Course Code:** 20103161
- c. **Prerequisite:** Zeal to learn the subject
- d. **Rationale:** Engineering graphics is the language of communication for engineers. Engineering graphics course provides tools and techniques of communication for various fields of engineering.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the functions and proper usage of various drawing instruments such as rulers, compasses, protractors, and drawing boards. Develop proficiency in accurately using drawing instruments to create precise and neat engineering drawings.
CLOBJ 2	Familiarize students with the commonly used symbols and conventions in engineering drawings. Develop the skill to interpret and correctly use symbols for different elements such as dimensions, tolerances, and surface finishes.
CLOBJ 3	Introduce and explain various engineering curves, including but not limited to parabolas, ellipses, and involutes. Equip students with the knowledge and skills to construct these curves accurately using drawing instruments and techniques.
CLOBJ 4	Introduce the principles of descriptive geometry, emphasizing their application in solving engineering problems. Enable students to visualize and represent three-dimensional objects using orthographic projections, auxiliary views, and section views.

f. Course Learning Outcomes:

CLO 1	Demonstrate the use of Drawing Instruments.
CLO 2	Identify the Drawing Symbols, Conventions used in Engineering Drawing.
CLO 3	Construct the Different Types of Engineering Curves.
CLO 4	Apply Descriptive Geometry Principles to Solve Engineering Problems Involving Points, Lines, Planes and Solids.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	4	2	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Sr. No.	Experiment List
1	Introduction of drawing scales: First angle and third angle methods of projection. Principles of Orthographic projections; reference planes.
2	Points and Lines Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines
3	Projection of solids Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids. Preparation of working drawing from models and isometric views. Drawing of missing views. Different methods of dimensioning.
4	Concept of sectioning Concept of sectioning. Revolved and oblique sections. Sectional drawing of simple machine parts
5	Riveted joints and threaded joints Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints. Nomenclature, thread profiles, multi start threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screw, cap screws. Foundation bolts. 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

i. Text Book and Reference Book:

1. Engineering Drawing (TextBook) N.D.Bhatt & V.M. Panchal, Charotar publishing house
2. Engineering graphics P.J.Shah, S. Chand & CO. New Delhi Publications
3. Engineering Mechanics (TextBook)
Timoshenko S and Young D H; McGraw Hill Book Co., New Delhi.
4. Engineering Drawing and Graphics Venugopal k. New age international private limited publishers.

- a. Course Name:** Principles of Soil Science
- b. Course Code:** 20103204
- c. Prerequisite:** Basic knowledge of soil science
- d. Rationale:** Soil science subject knowledge is essential for agricultural engineers
- e. Course Learning Objective:**

CLOBJ 1	Define and differentiate between various types of force systems, including concurrent, parallel, and coplanar force systems.
CLOBJ 2	Demonstrate proficiency in determining the centroids of composite areas using mathematical and graphical methods.
CLOBJ 3	Understand the fundamental principles of truss structures and their significance in engineering.
CLOBJ 4	Gain knowledge of internal forces in structural elements, specifically shear forces and bending moments.

f. Course Learning Outcomes:

CLO 1	Identify the soil forming factors.
CLO 2	Predict the soil type using soil properties.
CLO 3	Explain the soil water plant relationship
CLO 4	Analyse the costs and benefits drawn in farming.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	50	-	-	30	20	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Nature and origin of soil; soil forming rocks and minerals, their classification and composition, soil forming processes, classification of soils soil taxonomy orders; important soil physical properties; and their importance	25%	8
2	soil particle distribution; soil inorganic colloids their composition, properties and origin of charge; ion exchange in soil and nutrient availability	25%	8

3	soil organic matter its composition and decomposition, effect on soil fertility; soil reaction acidic, saline and sodic soils; quality of irrigation water; essential plant nutrients their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils.	25%	8
4	Use of saline and sodic water for crop production, Gypsum requirement for reclamation of sodic soils and neutralising RSC; Liquid fertilisers and their solubility and compatibility	25%	8
		100%	32

i. Text Book and Reference Book:

1. The Nature and Properties of Soil, (TextBook) N.C. Brady and R.R. Weil; Pearson Education
2. Principles of Soil Chemistry (Textbook) by Kim H. Tan; CRC Press.
3. Soil Science: Principles and Practices (Textbook) by R.E. White, J.G. Dixon, and D.G. Aldrich; Blackwell Publishing.
4. Principles of Soil Physics (Textbook) by Rattan Lal; CRC Press.

j. Experiment List

Sr. NO.	Experiment List
1	Identification of rocks and minerals
2	Examination of soil profile in the field
3	Collection of Soil Sample
4	Determination of bulk density; particle density and porosity of soil
5	Determination of organic carbon of soil
6	Determination of Nitrogen, Determination of Phosphorus and Determination of Potassium
7	Identification of nutrient deficiency symptoms of crops in the field
8	Determination of gypsum requirement of sodic soils
9	Determination of water quality parameters

- a. **Course Name:** Communication skills
- b. **Course Code:** 20193104
- c. **Prerequisite:** Knowledge of English Language studied till 12th std
- d. **Rationale:** communication skills are essential for all engineers
- e. **Course Learning Objective:**

CLOBJ 1	Develop the ability to keenly observe and analyze verbal and non-verbal cues in communication. Practice articulating thoughts and ideas persuasively through written and spoken communication.
CLOBJ 2	Explore key theories and models of communication to build a solid foundation. Understand the role of context, culture, and various communication channels in effective communication.
CLOBJ 3	Cultivate active listening skills to comprehend and respond effectively to diverse perspectives. Recognize the impact of attentive listening on building strong interpersonal relationships.
CLOBJ 4	Expand and diversify vocabulary through targeted reading, writing, and vocabulary-building exercises. Apply advanced vocabulary in academic and professional contexts.

f. Course Learning Outcomes:

CLO 1	Develop observation and convincing skills
CLO 2	Develop a deep understanding of the fundamentals of communication
CLO 3	Improve communication skills by appreciating the importance of listening
CLO 4	Develop vocabulary, and refining academic language proficiency

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Crazy Scientist: The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	5%	2

2	Phonetics: IPA Introduction (listening tracks) Phonic Sounds Listening Activity Pronunciation Practice	5%	2
3	Vocabulary Building: Word formation process: Compounding, clipping, blending, derivation, creative respelling, coining and borrowing Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided) Methods to enhance Vocabulary	10%	4
4	Speaking Activity: Role play	10%	4
5	Identifying Common Errors in Writing: Sentence structure Punctuations Subject-Verb Agreement Noun-Pronoun Agreement	10%	4
6	Reading Comprehension: The art of effective reading Employing different reading skills Practice	10%	4
7	Speech a Spoken Exchanges Stage; Delivering different types of speeches: Welcome /Introductory speech Vote of Thanks speeches Farwell speeches	10%	2
8	Professional Presentations: Combating stage fright Preparing power point presentation Delivering PPT	10%	2
9	Picture Connector: In this class the students will be trained to form a logical connection between a set of pictures which will be shared with them. This is geared towards building creativity and presentation skills	5%	2
10	Movie Review: Provides training of writing movie review by showing film. To develop speaking skills using presentation of movie review.	10%	2
11	Error analysis: Tenses Active passive voice Direct indirect speech	10%	2

12	Reporter: Classroom Activity to encourage Communication and Convincing Skills.	5%	2
		100%	32

i. Text Book and Reference Book:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S And Lata P; New Delhi Oxford University Press
3. Practical English Usage MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student F.T. WOOD
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. Oxford Practice Grammar, John Eastwood; Oxford University Press

Semester 2

- a. Course Name:** Engineering Mathematics - II
- b. Course Code:** 20103153
- c. Prerequisite:** Students have knowledge of derivative, integration and matrices
- d. Rationale:** Students are intended to understand the advance concepts and principles of mathematics such as matrices, limit and continuity, periodic function, Fourier series and partial differential equations
- e. Course Learning Objective:**

CLOBJ 1	Develop the ability to construct ordinary and partial differential equations that model real-world phenomena. Understand the principles of mathematical modelling and apply them to various physical, biological, and engineering problems.
CLOBJ 2	Acquire the skill to categorize differential equations based on their order and linearity. Demonstrate proficiency in recognizing the characteristics that determine whether a differential equation is ordinary or partial, and linear or nonlinear.
CLOBJ 3	Comprehend the concept of a solution to a differential equation and its significance in the context of the modelled problem. Explore different methods for finding solutions, such as analytical, numerical, and graphical techniques.
CLOBJ 4	Develop the ability to analyze and interpret curves and regions in the complex plane defined by simple mathematical expressions. Gain insight into the geometric representation of solutions to complex differential equations in the complex plane.

f. Course Learning Outcomes:

CLO 1	Formulate Ordinary and Partial Differential Equation
CLO 2	Classify the differential equations with respect to their order and linearity.
CLO 3	Explain the meaning of solution of a differential equation.
CLO 4	Identify curves and regions in the complex plane defined by simple expressions.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30		20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Ordinary differential equations 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 questions of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel's and Legendre's differential equations	35%	11
2	Functions of a Complex Variable Limit, continuity and analytic function, Cauchy-Riemann equations, Harmonic functions. Infinite series and its convergence, periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series, Harmonic analysis. Fourier Sine and Cosine Series, Fourier series for function having period $2L$, Elimination of one and two arbitrary function	35%	11
3	Partial differential equations Formation of partial differential equations Higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, and application of partial differential equations(one dimensional wave and heat flow equations, Laplace Equation.	30%	10
		100%	32

i. Text Book and Reference Book:

1. Engineering Mathematics (Textbook) by K.A. Stroud and Dexter J. Booth; Palgrave Macmillan.
2. Advanced Engineering Mathematics (Textbook) by Erwin Kreyszig; John Wiley & Sons, Inc.
3. Engineering Mathematics: A Foundation for Electronic, Electrical, Communications, and Systems Engineers (Textbook) by Anthony Croft, Robert Davison, and Martin Hargreaves; Pearson Education Limited.
4. Higher Engineering Mathematics (Textbook) by B.S. Grewal; Khanna Publishers.
5. Engineering Mathematics (Textbook) by John Bird; Routledge.

j. Experiment List

Sr. No.	Experiment List
1	Tutorials on solution of ordinary differential equations of first and higher orders.
2	Series solutions of differential equations.
3	Bessel's and Legendre's differential equations, Convergence of infinite series.
4	Fourier series, harmonic analysis, analytical functions, Cauchy- equations, harmonic functions.
5	Application of partial differential equations.
6	Solution of partial differential equations

a. Course Name: Environmental Science and Disaster Management

b. Course Code: 20103154

c. Prerequisite: Knowledge of science up to 10th standard.

d. Rationale: For a country to progress, sustainable development is one of the key factors. Environment conservation and hazard management is of much importance to every citizen of India.

e. Course Learning Objective:

CLOBJ 1	Understand the various ways in which human activities impact the environment, including factors such as industrialization, urbanization, and resource exploitation.
CLOBJ 2	Gain proficiency in synthesizing information from diverse disciplines such as ecology, geology, economics, and sociology to address complex environmental issues.
CLOBJ 3	Acquire knowledge of the sources and effects of noise, air, water, and soil pollution.
CLOBJ 4	Comprehend the fundamental concepts related to disasters, including their causes, classifications, and impacts on communities and ecosystems.

f. Course Learning Outcomes:

CLO 1	Analyze human impacts on the environment.
CLO 2	Summarize facts, concepts, and methods from multiple disciplines and apply to environmental problems.
CLO 3	Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
CLO 4	Analyze the importance of environment in engineering.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Environmental Science Scope and importance. Natural Resources: Renewable and non-renewable resources Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies	16%	5
2	Food Resources Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, waterlogging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources.	10%	3
3	Ecosystems Equitable use of resources for sustainable lifestyles. Ecosystems: Concept, Structure, function, Producers, consumers, decomposers, Energy flow, ecological succession, food chains, food webs, ecological pyramids. Introduction, types, characteristic features, structure and function of the forest, grassland, desert and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	18%	6
4	Environmental Pollution Environmental Pollution: definition, cause, effects and control measures of a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of	10%	3

	an individual in prevention of pollution. Pollution case studies. Social Issues and the Environment from Unsustainable to Sustainable development, Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change ,global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust dies		
5	Wasteland reclamation Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air(Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.	6%	2
6	Human Population and the Environment Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human Health. Disaster Management: Natural Disasters and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.	20%	6
7	Man Made Disasters Man Made Disasters-Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire ,oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels.	12%	4
8	Disaster reduction International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.	8%	3
		100%	32

i. Text Book and Reference Book:

1. Environmental Science: A Global Concern (Textbook) by William P. Cunningham and Mary Ann Cunningham; McGraw-Hill Education.
2. Environmental Science and Engineering (Textbook) by J. Glynn Henry and Gary W. Heinke; Pearson Education, Inc.

3. Introduction to Environmental Engineering and Science (Textbook) by Gilbert M. Masters and Wendell P. Ela; Pearson Education, Inc.

j. Experiment List

Sr. No.	Experiment List
1	Case Studies and Field work.
2	Visit to a local area to document environmental assets river/forest/grassland/hill/mountain,
3	Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.
4	Expected impact of climate change on agricultural production and water resources, Mitigation Strategies, Economics of climate change.
5	Disaster Management introduction,
6	Natural and Manmade Disaster Studies,
7	Informatics for Disaster Management,
8	Quantitative Techniques for Disaster Management Environmental Impact Assessment (EIA) and Disaster Management Disaster Management Policy Environmental Modelling.

- a. Course Name:** Fluid Mechanics and Open Channel Hydraulics
- b. Course Code:** 20103155
- c. Prerequisite:** Elements of mechanical engineering
- d. Rationale:** The course is designed to give fundamental knowledge of fluid, its properties and behaviour under various conditions.
- e. Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to apply electrostatic principles to real-world applications. Solve problems involving the practical use of electrostatics in various contexts.
CLOBJ 2	Explain the significance of different mediums in modifying electric and magnetic fields. Analyze how changes in medium affect the behaviour of electric and magnetic fields.
CLOBJ 3	Gain comprehensive knowledge of Faraday's law and its fundamental principles. Apply Faraday's law to solve problems related to electromagnetic field theory.
CLOBJ 4	Demonstrate the capability to use magnetic field principles in practical applications. Solve problems related to magnetic fields in various scenarios.

f. Course Learning Outcomes:

CLO 1	Apply the fundamentals of mathematics for solution of fluid flow problems.
CLO 2	Explain the pressure force and its measurement.
CLO 3	Understand the basics of fluid kinematics and dynamics
CLO 4	Calibrate fluid flow measuring devices like venturi-meter, orifice-meter, notches, orifice, mouthpieces

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30		20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Properties of fluids Ideal and real fluid. Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, center of pressure, buoyancy, meta center and metacentric height, condition of floatation and stability of submerged and floating bodies	20%	6
2	Kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flownet. Types of fluid flow, translation, rotation, circulation and vorticity, Vortex motion; Dynamics of fluid flow, Bernoulli's theorem, venture meter, orifice meter and nozzle, siphon	25%	8
3	Laminar flow Stress strain relationships, flow between infinite parallel plates both plates fixed, one plate moving, discharge, average velocity; Laminar and turbulent flow in pipes, general equation for head loss Darcy, Equation, Moody's diagram, Minor and major hydraulic losses through pipes and fittings, flow through network of pipes, hydraulic gradient and energy gradient; Flow through orifices (Measurement of Discharge, Measurement of Time), Flow through Mouthpieces, Flow over Notches , Flow over weirs, Chezy's formula for loss of head in pipes, Flow through simple and compound pipes	35%	12
4	Open channel design and hydraulics Chezy's formula, Bazin's formula, Kutter's Manning's formula, Velocity and Pressure profiles in open channels, Hydraulic jump; Dimensional analysis and similitude Rayleigh's method and Buckingham's 'Pi' theorem, types of similarities, dimensional analysis, dimensionless numbers. Introduction to fluid machinery	20%	6
		100%	32

i. Text Book and Reference Book:

1. "Fluid Mechanics" (Textbook) by Frank M. White; McGraw-Hill Education.
2. "Fluid Mechanics and Hydraulic Machines" (Textbook) by R.K. Bansal; Laxmi Publications.
3. "Open Channel Hydraulics" (Textbook) by Ven Te Chow, David R. Maidment, and Larry W. Mays; McGraw-Hill Education.
4. "Fluid Mechanics: Fundamentals and Applications" (Textbook) by Yunus A. Çengel and John M. Cimbala; McGraw-Hill Education.
5. "Hydraulic Engineering" (Textbook) by Garg S.K.; Khanna Publishers.

j. Experiment List

Sr. No.	Experiment List
1	Study of manometers and pressure gauges;
2	Verification of Bernoulli's theorem;
3	Determination of coefficient of discharge of venturi-meter and orifice meter;
4	Determination of coefficient of friction in pipeline;
5	Determination of coefficient of discharge for rectangular and triangular notch;
6	Determination of coefficient of discharge,
7	coefficient of velocity and coefficient of contraction for flow through orifice;
8	Determination of coefficient of discharge for mouth piece;
9	Measurement of force exerted by water jets on flat and hemispherical vanes;
10	Determination of meta-centric height;
11	Determination of efficiency of hydraulic ram;
12	Performance evaluation of Pelton and Francis turbine;
13	Study of current meter;
14	Velocity distribution in open channels and determination of Manning's coefficient of rugosity

- a. **Course Name:** Theory of Machines
- b. **Course Code:** 20103158
- c. **Prerequisite:** Basics of mechanical engineering and mathematics
- d. **Rationale:** Theory of machine is a fundamental course of Agriculture engineers to understand the working mechanism of agriculture related machinery. The subject is important to understand the motion, transmission of the motion and forces responsible for the motion.
- e. **Course Learning Objective:**

CLOBJ 1	Define and differentiate various governors, clutches, belt drives, and power transmission elements. Analyze real-world applications where governors, clutches, belt drives, and power transmission elements are employed.
CLOBJ 2	Develop skills to draw turning moment diagrams for rotating machinery. Calculate the coefficient of fluctuation of speed and energy for different mechanical systems.
CLOBJ 3	Explain the fundamental concepts of kinematics in the context of gear trains. Demonstrate the ability to analyze and model the motion of gear trains.
CLOBJ 4	Understand the principles of kinematics and rigid-body dynamics as applied to machine components. Analyze and interpret the motion and forces involved in kinematically driven machine components.

f. Course Learning Outcomes:

CLO 1	Identify the applications of governors, clutches, belt drives and various power transmission elements
CLO 2	Develop turning moment diagram and calculate the coefficient of fluctuation of speed and energy.
CLO 3	Classify the governors and interpret their characteristics.
CLO 4	Explain the kinematics and rigid-body dynamics of kinematically driven machine components

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	-	2	30		20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Elements, links, pairs, kinematics chain, and mechanisms. Classification of pairs and mechanisms. Lower and higher pairs. Four bar chain, slider crank chain and their inversions. Determination of velocity and acceleration using graphical (relative velocity and acceleration) method. Instantaneous centres	15%	5
2	Types of gears. Law of gearing, velocity of sliding between two teeth in mesh. Involute and cycloidal profile for gear teeth. Spur gear, nomenclature, interference and undercutting. Introduction to helical, spiral, bevel and worm gear. Simple, compound, reverted, and epicycles trains. Determining velocity ratio by tabular method.	15%	5
3	Turning moment diagrams, coefficient of fluctuation of speed and energy, weight of flywheel, flywheel applications.	10%	3
4	Belt drives, types of drives, belt materials. Length of belt, power transmitted, velocity ratio, belt size for flat and V belts. Effect of centrifugal tension, creep and slip on power transmission, Chain drives.	20%	6
5	Types of friction, laws of dry friction. Friction of pivots and collars. Single disc, multiple disc, and cone clutches. Rolling friction, anti-Friction bearings.	10%	4
6	Types of governors. Constructional details and analysis of Watt, Porter, Proell governors. Effect of friction, controlling force curves. Sensitiveness, stability, hunting, isochronism, power and effort of a governor.	20%	6
7	Static and dynamic balancing. Balancing of rotating masses in one and different planes.	10%	3
		100%	32

1. Text Book and Reference Book:

1. "Theory of Machines" (Textbook) by R.S. Khurmi and J.K. Gupta; S. Chand Publishing.
2. "Theory of Machines and Mechanisms" (Textbook) by John J. Uicker Jr., Gordon R. Pennock, and Joseph E. Shigley; Oxford University Press.
3. "Mechanisms and Machines: Kinematics, Dynamics, and Synthesis" (Textbook) by Michael M. Stanisic; Oxford University Press.
4. "Theory of Machines" (Textbook) by Thomas Bevan; Pearson Education Limited.

5. "Theory of Machines" (Textbook) by Sadhu Singh; Khanna Publishers.

- a. **Course Name:** Strength of Materials
- b. **Course Code:** 20103162
- c. **Prerequisite:** Zeel to learn the subject
- d. **Rationale:** Heat and Mass transfer knowledge is essential for Agricultural Engineers
- e. **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to calculate slope and deflection for various types of beams. Apply relevant mathematical techniques to analyze and interpret slope and deflection results.
CLOBJ 2	Introduce and comprehend the Moment Areas Theorem as a method for solving engineering problems. Develop skills in applying the Moment Areas Theorem to determine beam reactions, shear forces, and bending moments..
CLOBJ 3	Understand the behavior of fixed and continuous beams under different loading conditions. Learn methods for analyzing fixed and continuous beams, including determination of reactions, shear forces, and bending moments.
CLOBJ 4	Develop proficiency in analyzing statically intermediate beams using appropriate analytical methods. Solve engineering problems related to statically intermediate beams, considering various loading scenarios.

f. Course Learning Outcomes:

CLO 1	Observe the behavior of various materials under different load conditions.
CLO 2	Understand the concept of Stress, strain and failure in engineering materials.
CLO 3	Determine the stability of the beams, columns and struts using different methods.
CLO 4	Calculate the support reactions for different types of beams with different loading.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Slope and deflection of beams using integration techniques, moment area theorems and conjugate beam method.	25%	4
2	Columns and Struts. Riveted and welded connections. Stability of masonry dams.	25%	4
3	Analysis of statically intermediate beams. Propped beams.	25%	4
4	Fixed and continuous beam analysis using superposition, three moment equation and moment distribution methods.	25%	4
		100%	16

i. Text Book and Reference Book:

1. 'Strength of Materials' (TextBook) By R. S Khurmi, | S. Chand Publishing
2. Mechanics of Structure Vol. I (TextBook) By S B Junarkar
3. Strength of Materials (TextBook) By S. Ramamrutham | Dhanpat Rai Publishing Company (P) Limited
4. "Strength of Materials" (Textbook) by S. Ramamrutham; Dhanpat Rai Publications.
5. "Mechanics of Materials" (Textbook) by Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, and David F. Mazurek; McGraw-Hill Education.

J. Experiment List

Sr. NO.	Experiment List
1	To perform the tension test on metal specimen (M.S., C.I.), to observe the behaviour of materials under load, to calculate the value of E, ultimate stress, permissible stress, percentage elongation etc. and to study its fracture
2	To perform the compression test on Concrete cylinders & cubes, C.I., M.S. & Wood specimens and to determine various physical and mechanical properties
3	To perform the bending test on the specimens; M.S. Girder, Wooden beam, Plain concrete beams and to determine the various physical and mechanical properties
4	To determine Young's modulus of elasticity of beam with the help of deflection produced at centre due to loads placed at centre & quarter points
5	To study the behaviour of materials (G.I. pipes, M.S., C.I.) under torsion and to evaluate various elastic constants
6	To study load deflection and other physical properties of closely coiled helical spring in tension and compression

7	To perform the Rockwell, Vicker's and Brinell's Hardness tests on the given specimens
8	To perform the Drop Hammer Test, Izod Test and Charpay's impact tests on the given specimens
9	To determine compressive & tensile strength of cement after making cubes and briquettes
10	To measure workability of concrete (slump test, compaction factor test)
11	To determine voids ratio & bulk density of cement, fine aggregates and coarse aggregates
12	To determine fatigue strength of a given specimen
13	To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials

- a. Course Name: Workshop Technology & Practices**
- b. Course Code: 20103163**
- c. Prerequisite:** Zeal to learn the subject
- d. Rationale:** Workshop practice is the backbone of the real industrial trades which helps to develop and enhance relevant technical hand skills by technician working in the various engineering industries.
- e. Course Learning Objective:**

CLOBJ 1	Understand and articulate the importance of safety measures in a workshop environment. Identify potential hazards and risks associated with workshop activities.
CLOBJ 2	Familiarize oneself with a variety of tools used in manufacturing and workshop settings. Develop the ability to select and use the appropriate tools for specific operations.
CLOBJ 3	Explore and comprehend various manufacturing techniques applicable to different raw materials. Gain knowledge of processes such as machining, molding, casting, or forming in relation to specific production needs..
CLOBJ 4	Acquire the skills to calculate production timing for given manufacturing processes. Understand the factors influencing production timing, including tool setup, material preparation, and processing time.

f. Course Learning Outcomes:

CLO 1	Recommend safety measures required to be taken while using working in workshop.
CLO 2	Select the appropriate tools required for specific operation.
CLO 3	Understand the different manufacturing technique for production out of the given raw material.
CLO 4	Calculate the production timing and the specific requirements.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit 1 Introduction to various carpentry tools, materials, types of wood and their characteristics and Processes or operations in wood working;	14%	2
2	Unit 2 Introduction to Smithy tools and operations Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Casting processes	14%	2
3	Unit 3 Classification, constructional details of center lathe, Main accessories and attachments. Main operations and tools used on center lathes. Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations	20%	3
4	Unit 4 Types of drilling machines. Constructional details of pillar types and radial drilling machines	25%	4
5	Unit 5 Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine	27%	5
		100%	16

i. Text Book and Reference Book:

1. Elements of Workshop Technology (Vol I & Vol II) (TextBook) By Hajra Choudhary | Media Promoters and Publishers Pvt ltd
2. Workshop Technology (Part I and II).By Chapman W A J | Arnold Publishers (India) Pvt. Ltd., AB/9 Safdarjung Enclave, New Delhi., Pub. Year 1989
3. A Course in Workshop Technology (TextBook) By Raghuwamsi B S | Dhanpat Rai and Sons, 1682 Nai Darak, New Delhi., Pub. Year 1982
4. "Workshop Technology: Manufacturing Processes" (Textbook) by B.S. Raghuvanshi; Dhanpat Rai Publications.
5. "Workshop Technology (Volume 1 & 2)" (Textbook) by Chapman W.A.J.; Macmillan Education.

j. Experiment List

Sr. NO.	Experiment List
1	Preparation of simple joints: Cross half Lap joint and T-Halving joint
2	Preparation of Dovetail joint, Mortise and tenon joint
3	Jobs on Bending, shaping etc
4	Jobs on Drawing, Punching, Rivetting
5	Introduction to tools and measuring instruments for fitting
6	Jobs on sawing, filing and right angle fitting of MS Flat
7	Practical in more complex fitting job
8	Operations of drilling, reaming, and threading with tap and dies
9	Introduction to tools and operations in sheet metal work
10	Making different types of sheet metal joints using G.I. sheets.
11	Introduction to welding equipment, processes tools, their use and precautions
12	Jobs on ARC welding – Lap joint, butt joint
13	T-Joint and corner joint in Arc welding
14	Gas welding Practice – Lab, butt and T-Joints
15	Introduction to metal casting equipment, tools and their use
16	Mould making using one-piece pattern and two pieces pattern
17	Demonstration of mould making using sweep pattern, and match plate patterns
18	Introduction to machine shop machines and tools
19	Demonstration on Processes in machining and use of measuring instruments;
20	Practical jobs on simple turning, step turning
21	Practical job on taper turning, drilling and threading
22	Operations on shaper and planer, changing a round MS rod into square section on a shaper
23	Demonstration of important operations on a milling machine, making a slot, gear tooth forming and indexing
24	Any additional job

- a. Course Name:** Entrepreneurship Development and Business Management
- b. Course Code:** 20103164
- c. Prerequisite:** Basic knowledge of Entrepreneurship Development and Business Management
- d. Rationale:** Aware about business environment
- e. Course Learning Objective:**

CLOBJ 1	Define entrepreneurship and its key components. Identify and explain the stages of entrepreneurship development.
CLOBJ 2	Introduce various business management strategies, such as cost leadership and differentiation. Teach students how to align business strategies with organizational goals. Provide practical examples of businesses employing different management strategies.
CLOBJ 3	Cover fundamental concepts of business, including finance, marketing, operations, and human resources. Explore the interplay between various business functions and their impact on overall business performance..
CLOBJ 4	Introduce various market analysis techniques, such as SWOT analysis, PESTEL analysis, and Porter's Five Forces. Provide hands-on experience in applying market analysis techniques to real-world business situations.

f. Course Learning Outcomes:

CLO 1	Understand the basics of entrepreneurship development
CLO 2	Apply different business management strategy
CLO 3	Improve understanding of business and marketing
CLO 4	Apply different market analyses techniques

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Entrepreneurship, management – Management functions – planning- Organizing -Directing – motivation – ordering – leading – supervision-Communication and control –	25%	8

	Capital – Financial management – importance of financial statements – balance sheet – profit and loss statement, Analysis of financial statements – liquidity ratios – leverage ratios– Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).		
2	Coverage ratios – turnover ratios – profitability ratios, Agro-based industries – Project – project cycle – Project appraisal and evaluation techniques – undiscounted measures – payback period – proceeds per rupee of outlay, Discounted measures – Net Present Value (NPV) – Benefit-Cost Ratio (BCR) – Internal Rate of Return (IRR) – Net benefit investment ratio (N / K ratio) – sensitivity analysis- Importance of agribusiness in Indian economy International trade-WTO agreements – Provisions related to agreements in agricultural and food commodities. Agreements on agriculture (AOA)	25%	8
3	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.	25%	8
4	Role of ED in economic development of a country Overview of Indian social, political systems and their implications for decision making by individual entrepreneurs Economic system and its implications for decision making by individual entrepreneurs- Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotion of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors Venture capital (VC), contract farming (CF) and joint ventures (JV), public-private partnerships (PPP)- Overview of agricultural engineering industry, characteristics of Indian farm machinery industry.	25%	8
		100%	32

i. Text Book and Reference Book:

1. Management of the Farm Business (TextBook) By Harsh, S.B., Conner, U.J. and Schwab, G.D. | Prentice Hall Inc., New Jersey., Pub. Year 1981
2. Essentials of Management (TextBook) By Joseph I, Massie | Prentice Hall of India

3. Introduction to Agribusiness. (TextBook) By Omri Rawlins, N. | Prentice Hall Inc., New Jersey, Pub. Year 19804.

4. Entrepreneurship Development and Small Business Management" (Textbook) by Vasant Desai; Himalaya Publishing House.

j. Experiment List

Sr. NO.	Experiment List
1	Preparation of business – Strengths Weaknesses Opportunities and Threats (SWOT) analysis
2	Analysis of financial statements (Balance Sheet, Profit loss statement)
3	Compounding and discounting, Break-even analysis
4	Visit to agro-based industries – I
5	Visit to agro-based industries – II
6	Study of Agro-industries Development Corporation
7	Ratio analysis – I
8	Ratio analysis – II
9	Application of project appraisal technique – I(Undiscounted measures)
10	Application of project appraisal technique – II(Discounted Measures)
11	Formulation of project feasibility reports
12	Farm Machinery Project proposals as entrepreneur – individual
13	Farm Machinery Project proposals as entrepreneur – group
14	Presentation of project proposals in the class.

- a. Course Name:** Web Designing and Internet Applications
- b. Course Code:** 20103263
- c. Prerequisite:** Basic knowledge of computer
- d. Rationale:** To acquire the fundamental knowledge of internet technologies, dynamic web page and web site creation.
- e. Course Learning Objective:**

CLOBJ 1	Understand and analyze the latest trends and developments in web and internet technologies. Explore emerging technologies shaping the landscape of the internet and the World Wide Web.
CLOBJ 2	Explain the fundamental principles of computer networks and their components. Demonstrate an understanding of network protocols, addressing, and routing.
CLOBJ 3	Break down the architecture of the Internet and the interconnected nature of the World Wide Web. Prioritize and discuss the key elements contributing to the effective functioning of the Internet.
CLOBJ 4	Recognize essential tools used in web design, including both software and hardware. Gain proficiency in using industry-standard technologies for creating and maintaining web content.

f. Course Learning Outcomes:

CLO 1	Examine the current topics in Web & Internet technologies.
CLO 2	Describe the basic concepts for network implementation.
CLO 3	Prioritize the basic working scheme of the Internet and World Wide Web.
CLO 4	Identify fundamental tools and technologies for web design.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50		100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Basic principles in developing a web designing, Planning process, Five Golden rules of web designing	25%	4
2	Designing navigation bar, Page design, Home Page Layout, Design Concept. Basics in Web Design, Brief History of Internet	25%	4
3	World Wide Web , creation of a web site, Web Standards, Audience requirement.	25%	4
4	Introduction to Java Script, variables & functions, Working with alert, confirm and prompt, Connectivity of Web pages with databases; Project.	25%	4
		100%	16

i. Text Book and Reference Book:

1. Internet Applications in Product Design and Manufacturing. (TextBook) By George Q. Huang, K. L. Mak.
2. Developing web design latest edition (TextBook) By Jennifer Niederst Robbins
3. Responsive Web Design with HTML5 (TextBook) By Frain and Ben.
4. "Web Design with HTML, CSS, JavaScript and jQuery Set" (Textbook) by Jon Duckett; Wiley.
5. "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics" (Textbook) by Jennifer Niederst Robbins; O'Reilly Media.

j. Experiment List

Sr. NO.	Experiment List
1	FLASH: Animation concept FPS (frames per second), 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	GIF ANIMATION: Learning to use FTP, Setting FTP, uploading of site, Using Control panel.
5	JAVA SCRIPT: Working with alert, confirm and prompt, understanding loop, arrays, Creating rollover image, Working with

Semester 3

- a. **Course Name:** Principles of Agronomy
- b. **Course Code:** 20103202
- c. **Prerequisite:** Zeal to learn subject
- d. **Rationale:** Applying agronomy knowledge in different agricultural engineering subjects
- e. **Course Learning Objective:**

CLOBJ 1	Understand the fundamental principles of agronomy, including soil science, crop physiology, and production practices, to establish a solid foundation for effective and sustainable agricultural management.
CLOBJ 2	Explore water, weed, pest, and disease management strategies, aiming to equip students with the knowledge needed to optimize crop yield while minimizing environmental impact.
CLOBJ 3	Analyze the interconnectedness of agronomy with environmental sustainability, fostering an awareness of the ethical and social responsibilities associated with modern agricultural practices.
CLOBJ 4	Investigate emerging research and innovations in agronomy, enabling students to stay abreast of advancements and apply cutting-edge technologies to address challenges in the dynamic field of agriculture.

f. Course Learning Outcomes:

CLO 1	Classify the field crops according to various agronomical aspects.
CLO 2	Understand the role of Climate on crop production
CLO 3	Demonstrate the modern agronomical practices.
CLO 4	Summarize the importance of Agronomy in Agricultural Engineering.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction and scope of agronomy, classification of crops	12%	4
2	Effect of Different Weather Parameters on Crop Growth and Development	9%	3
3	Principles of Tillage, Tilt and its Characteristics	9%	3
4	Methods, time and depth of sowing major field crops	5%	1
5	Methods and time of application of manures and fertilizers	12%	4
6	Organic farming – Sustainable farming	12%	4
7	Soil Water Plant Relationship, Crop coefficient, Water requirement of crops and Critical stages for irrigation	15%	5
8	Weeds and their control	9%	3
9	Crop rotation, cropping systems	9%	3
10	Relay cropping and mixed cropping	8%	2
		100%	32

i. Text Book and Reference Book:

1. Principles of Agronomy (Textbook) T. Y. Reddy and G. H. Shankara Reddy; Kalyani Publishers
2. "Principles of Agronomy" (Textbook) by Reddy M.S.; Kalyani Publishers.
3. "Principles of Agronomy" (Textbook) by Sankara Reddy G.; Kalyani Publishers.
4. "Fundamentals of Agronomy" (Textbook) by Arora R.K. and Shanker A.; Rastogi Publications.

j. Experiment List

Sr. NO.	Experiment List
1	Identification of crops and their varieties, seeds, manures, fertilizers, and weeds
2	Fertilizer application methods
3	Different weed control methods
4	Practice of Ploughing
5	Practice of Puddling

6	Practice of Sowing
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- a. **Course Name:** Engineering Mathematics-III
- b. **Course Code:** 20103203
- c. **Prerequisite:** Basic Concepts of differential equation and data analysis
- d. **Rationale:** The course provides mathematical background related to Agricultural Engineering
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of advanced mathematical concepts, including vector calculus, differential equations, and complex analysis, providing a solid foundation for applications in engineering disciplines.
CLOBJ 2	Explore mathematical techniques for solving higher-order linear differential equations, partial differential equations, and systems of equations, enabling students to analyze and model complex engineering problems.
CLOBJ 3	Apply mathematical methods to engineering problems, emphasizing the use of Laplace transforms, Fourier series, and integral transforms for solving practical engineering problems in areas such as control systems and signal processing.
CLOBJ 4	Gain proficiency in complex analysis, including the study of complex functions, residues, and contour integrals, and understand their relevance in solving engineering problems related to electric circuits and fluid dynamics.

f. Course Learning Outcomes:

CLO 1	Analyze and evaluate the accuracy of common numerical methods.
CLO 2	Apply numerical methods to obtain approximate solutions to mathematical problems
CLO 3	Use Laplace Transform to solve Initial Value Problem
CLO 4	Calculate and interpret the correlation between two variables.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Finite difference and Interpolation: Finite difference, various difference operators and their relation interpolation with equal intervals: Newton's forward and backward interpolation, Bessel's and Stirling's Interpolation with unequal intervals: Newton's divided difference formula, Lagrang interpolation formula	24%	8
2	Numerical Integration and Numerical Differentiation: Trapezoidal rule Simpson's (1/3 and 3/8 rule) Gaussian Quadrature (one, two, three point) formula Picard's and Taylor's method Euler and Modified Euler method Runge Kutta Method	20%	6
3	Laplace Transformations and its application to solutions of ordinary and simulation ODE: Definition of Laplace Transform and its properties Laplace Transforms of some standard functions Solution of ODE and simultaneous ODE using Laplace Transforms	26%	8
4	Testing of Hypothesis: Level of significance, degrees of freedom, statistical errors Large sample test (Z-test) Small sample test (one tailed, two tailed, paired tests) Testing of significance through variance (F-test) Chi-square test: contingency table	18%	6
5	Correlation and Regression Analysis: Karl Pearson's Correlation Coefficient Rank Correlation coefficient Regression lines and coefficients	12%	4
		100%	32

i. Text Book and Reference Book:

1. Handbook of Agricultural Statistics (Textbook) Chandan SRS, Achal Prakasham Masndir, Kanpur
2. Basic Statistics (Textbook) Agrawal BL; Wiley Eastern Ltd, New Age International Ltd.
3. Statistics for Agricultural Science (Textbook) Nageswara Rao G
4. "Advanced Engineering Mathematics" (Textbook) by Erwin Kreyszig; John Wiley & Sons, Inc.
5. "Higher Engineering Mathematics" (Textbook) by B.S. Grewal; Khanna Publishers.

j. Experiment List

Sr. No.	Experiment List
1	Interpolation, Numerical Differentiation, and integration solution of difference equation
2	Numerical Solution of ordinary differential equation of first order and first degree
3	Laplace and inverse Laplace transformation and application to solution ordinary and simultaneous differential equation
4	Problem of One sample, two sample, Z-Test when population S.D. is known and unknown
5	Problem of One sample, two sample paired t-test chi-square test 2×2 and $m \times n$
6	Calculation of correlation coefficient and its testing
7	Contingency table and F-test

- a. **Course Name:** Design of Structure
- b. **Course Code:** 20103205
- c. **Prerequisite:** Basic knowledge of Civil Engineering
- d. **Rationale:** Structure design knowledge is essential for agricultural constructions
- e. **Course Learning Objective:**

CLOBJ 1	Develop a deep understanding of structural analysis principles, including the study of forces, deformations, and stability, to form a solid foundation for designing structures that can withstand various loading conditions.
CLOBJ 2	Explore the behavior of structural elements under different loading scenarios, enabling the analysis of stress and strain distributions, as well as the determination of factors influencing structural safety and performance.
CLOBJ 3	Learn the principles of structural design, including material selection, member sizing, and load distribution, to create structures that meet safety standards, economic constraints, and functionality requirements.
CLOBJ 4	Apply engineering software tools and codes to model, analyze, and design structures, emphasizing hands-on experience in using industry-standard methods to ensure the practical applicability of theoretical concepts in real-world engineering projects.

f. Course Learning Outcomes:

CLO 1	Identify the typical failure modes of RC building, retaining walls
CLO 2	Apply the principles, procedures and current Indian Codal provisions to the analysis and design of structures.
CLO 3	Understand various design philosophy to be used in the design of structural elements.
CLO 4	Analyze and design industrial steel structures including connections.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Loads and use of BIS codes. Design of connections.	25%	4
2	Design of structural steel members in tension, compression and bending.	25%	4
3	Design of steel roof truss. Analysis and design of singly and doubly reinforced section, shear, bond, and tension.	25%	4
4	Design of flanged beams, slabs, columns, foundation, retaining wall and silos.	25%	4
		100%	16

i. Text Book and Reference Book:

1. Mechanics of Structure Vol-I (Textbook) Junarkar S. B. and Shah S. J
2. Strength of Material (Textbook) R. S. Khurmi, S. Chand Publishing
3. "Design of Concrete Structures" (Textbook) by Arthur H. Nilson, David Darwin, and Charles W. Dolan; McGraw-Hill Education.
4. "Design of Steel Structures" (Textbook) by N. Subramanian; Oxford University Press.
5. "Design of Reinforced Concrete Structures" (Textbook) by N. Subramanian; Oxford University Press.

j. Experiment List

Sr. No.	Experiment List
1	Design and drawing of single reinforced beam and 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

- a. **Course Name:** Machine Design
- b. **Course Code:** 20103206
- c. **Prerequisite:** Basic understanding of elements of mechanical engineering
- d. **Rationale:** The course will introduce students to the concept of design of machine component
- e. **Course Learning Objective:**

CLOBJ 1	Acquire a comprehensive understanding of fundamental machine design principles, including the analysis of stress, strain, and material properties, to develop a solid foundation for designing mechanical components and systems.
CLOBJ 2	Explore the application of theories related to fatigue, wear, and failure analysis in machine design, enabling the creation of robust and reliable mechanical structures capable of withstanding long-term usage.
CLOBJ 3	Understand the selection and application of machine elements such as gears, bearings, shafts, and springs, considering factors such as load distribution, lubrication, and manufacturing processes for optimal performance and longevity.
CLOBJ 4	Apply engineering standards and codes to design mechanical components and systems, emphasizing the integration of safety, functionality, and cost-effectiveness in the design process.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts of machine design.
CLO 2	Apply the principles in agricultural equipment design.
CLO 3	Classify different types of machine components etc.
CLO 4	Select suitable motion and power transmission machine elements.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	-	2	50	-	-	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Meaning of design, phases of design and design consideration	7%	2
2	Common engineering materials and their mechanical properties	9%	3
3	Types of loads and stress, theory of failures, factor of safety and selection of allowable stress	8%	3
4	Stress concentration, elementary fatigue, and creep aspects	8%	3
5	Design of cotter joint, knuckle joint, pinned joint and turnbuckle	10%	3
6	Design of welded subjected to static load	6%	2
7	Design of threaded fasteners subjected to direct static load, bolted joint loaded in shear subjected to eccentric loading	10%	3
8	Design of shaft under torsion and combined bending and torsion	10%	3
9	Design of keys, muff, sleeve, and rigid flange couplings	10%	3
10	Design of helical and leaf springs. Design of flat belt, V-belt drives and pulleys	10%	3
11	Design of gears, brackets, levers, column, thin cylindrical and spherical shells	6%	2
12	Design of screw motion mechanism like screw jack, lead screw and selection of antifriction bearings	6%	2
		100%	32

i. Text Book and Reference Book:

1. Machine Design (Textbook) R. C. Patel
2. Machine Design (Textbook) R. S. Khurmi and J. K. Gupta, S. Chand Publishing
3. Machine Design (Textbook) P. S. Agrawal
4. Machine Design (Textbook) D. B. Gohil
5. Machine Design (Textbook) Pandya and Shah, Charotar Publishing House

- a. **Course Name:** Thermodynamics, Refrigeration and Air Conditioning
- b. **Course Code:** 20103207
- c. **Prerequisite:** Physics and mathematics up to 12th science, Element of Mechanical Engineering
- d. **Rationale:** Thermodynamics, Refrigeration and Air Conditioning knowledge is essential for Agricultural Engineers
- e. **Course Learning Objective:**

CLOBJ 1	Develop a fundamental understanding of thermodynamics principles, including the laws of thermodynamics and their application to energy systems, providing a basis for analyzing and designing thermal processes.
CLOBJ 2	Explore the principles of refrigeration and air conditioning, covering topics such as the refrigeration cycle, psychrometrics, and heat transfer, to enable the design and optimization of cooling systems for various applications.
CLOBJ 3	Understand the thermodynamic cycles and processes involved in refrigeration and air conditioning systems, including the vapor compression cycle and its variations, allowing for the efficient design and operation of cooling systems.
CLOBJ 4	Apply principles of heat transfer and fluid mechanics to analyze and design heat exchangers, condensers, , and evaporators, ensuring the effective transfer of energy in refrigeration and air conditioning applications.

f. Course Learning Outcomes:

CLO 1	Understand Concepts and Law of Thermodynamics
CLO 2	Discuss different Application of Thermodynamics
CLO 3	Identify the components of refrigeration systems and describe their functioning.
CLO 4	Discuss the application of refrigeration and air conditioning in Food preservation.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Thermodynamics properties, closed and open system, flow and non-flow processes, gas laws, laws of thermodynamics, internal energy. Application of first law in heating and expansion of gases in non-flow processes. First law applied to steady flow processes. Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, change of entropy of gases in thermodynamics process. Otto, diesel and dual cycles.	25%	8
2	Principles of refrigeration, - units, terminology, production of low temperatures, air refrigerators working on reverse Carnot cycle and Bell Coleman cycle. Vapour refrigeration-mechanism, P-V, P-S, P-H diagrams, vapor compression cycles, dry and wet compression, super cooling, and sub cooling. Vapour absorption refrigeration system. Common refrigerants and their properties.	25%	8
3	Design calculations for refrigeration system. Cold storage plants. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process.	25%	8
4	Air conditioning - principles -Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods, fundamentals of design of complete air conditioning systems - humidifiers and dehumidifiers - cooling load calculations, types of air conditioners - applications.	25%	8
		100%	32

i. Text Book and Reference Book:

1. A Course in Thermodynamics and Heat Engines (TextBook) Kothandaraman C P Khajuria PR and Arora SC
2. Engineering Thermodynamics (TextBook) Khurmi RS.
3. Engineering Thermodynamics (TextBook) P.K. Nag; Tata McGraw Hill
4. Thermodynamics and Heat Power Engineering. (TextBook) Mathur M L and Mehta F S.

j. Experiment List

Sr. NO.	Experiment List
1	Tutorials on thermodynamic air cycles
2	Study and application of P V and T S chart in refrigeration
3	P H chart (or) Mollier diagram in refrigeration
4	Numerical on-air refrigeration cycle systems
5	Numerical on vapour compression cycle refrigeration system
6	Study of domestic water cooler
7	Study of domestic household refrigerator
8	Study of absorption type solar refrigeration system
9	Study of cold storage for fruit and vegetables
10	Freezing load and time calculations for food materials
11	Determination of refrigeration parameters using refrigeration tutor – II
12	Numerical on design of air conditioning systems
13	Study of window air conditioner
14	Study on repair and maintenance of refrigeration and air-conditioning systems
15	Visit to chilling or ice making and cold storage plants.

- a. **Course Name:** Electrical Machines and Power Utilizations
- b. **Course Code:** 20103208
- c. **Prerequisite:** Basic knowledge of Electrical Engineering
- d. **Rationale:** knowledge of Electrical Machines is essential for understanding working of different electrical machines
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of electrical machines, including principles of electromagnetic induction, transformer operation, and the characteristics of various types of electric machines, forming the foundation for electrical power utilization.
CLOBJ 2	Explore the design, construction, and operation of electric machines such as motors and generators, considering factors such as efficiency, torque, and power factor to ensure optimal performance in diverse applications.
CLOBJ 3	Understand the principles of power utilization, covering topics such as power factor correction, load characteristics, and energy-efficient practices, to design and implement systems that maximize electrical energy efficiency.
CLOBJ 4	Apply knowledge of electrical machines and power utilization concepts to analyze, design, and troubleshoot electrical systems, emphasizing the integration of sustainable and efficient practices in electrical power generation and consumption.

f. Course Learning Outcomes:

CLO 1	Identify applications of different Electrical machines.
CLO 2	Perform and analyze the characteristics of different Electrical machines.
CLO 3	Demonstrate the speed control of Electrical Motors.
CLO 4	Observe the construction, working, characteristics of transformers.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses, Transformer: principle of working, construction of single phase transformer, EMF equation	25%	8
2	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)	25%	8
3	EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics, DC motor characteristics, starting of shunt and series motor, starters, speed control methods- field and armature control, polyphase induction motor: construction, operation, phasor diagram, effect of rotor resistance, torque equation, starting and speed control methods	25%	8
4	single phase induction motor: double field revolving theory, equivalent circuit, characteristics, phase split, shaded pole motors, various methods of three phase power measurement; power factor, reactive and apparent power, Concept and analysis of balanced poly-phase circuits; Series and parallel resonance.	25%	8
		100%	32

i. Text Book and Reference Book:

1. Principles of Electronics (Textbook) Mehta V. K.
2. "Electric Machinery Fundamentals" (Textbook) by Stephen J. Chapman; McGraw-Hill Education.
3. "Electrical Machines" (Textbook) by P.S. Bimbhra; Khanna Publishers.
4. "Electric Machines and Power Systems: Volume I" (Textbook) by Vincent Del Toro and Louis A. Tesla; Pearson Education, Inc.
5. "Electrical Machines, Drives, and Power Systems" (Textbook) by Theodore Wildi and Muhammad H. Rashid; Pearson Education, Inc.

j. Experiment List:

Sr. No.	Content
1	Judging maturity for harvesting crops.
2	Study of seed viability and germination test.
3	Identification and description of important fruits crops.
4	Practices of pruning and training in some important fruit crops.
5	Visit to commercial greenhouse.
6	Visit to commercial polyhouse.
7	Cultural operations for vegetable crops (sowing fertilizer application)
8	Cultural operations for vegetable crops (mulching, irrigation and weed control)
9	Seed extraction techniques.
10	Identification of important pests and their control.
11	Identification of diseases and their control.

- a. **Course Name:** Principles of Horticultural Crops and Plant Protections
- b. **Course Code:** 20103209
- c. **Prerequisite:** Zeal to learn subject
- d. **Rationale:** Application of horticulture knowledge in different agricultural engineering subjects
- e. **Course Learning Objective:**

CLOBJ 1	Develop a foundational understanding of horticultural crops, including their classification, growth requirements, and economic importance, providing a basis for effective cultivation and management.
CLOBJ 2	Explore principles of plant protection, covering topics such as pest identification, disease management, and integrated pest management (IPM) strategies, to ensure the health and productivity of horticultural crops.
CLOBJ 3	Understand the principles of crop production in horticulture, including soil preparation, irrigation, and fertilization, to optimize the growth and yield of various horticultural crops.
CLOBJ 4	Apply knowledge of plant protection techniques to implement sustainable and environmentally friendly practices, emphasizing the reduction of chemical inputs and the promotion of biological control methods in horticultural systems.

f. Course Learning Outcomes:

CLO 1	Remember unit operations involved in the processing of fruits and vegetables.
CLO 2	Define importance of horticulture in agriculture
CLO 3	Demonstrate the techniques of vegetative propagation
CLO 4	Assess suitable packaging materials for fruits and vegetables based products.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Scope of horticultural: Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties.	20%	3
2	Criteria for site selection, Layout and planting methods, Nursery raising, commercial varieties/hybrids, sowing and planting times and methods, seed rate and seed treatment for vegetable crops.	25%	4
3	macro and micro propagation methods, Plant growing structures, Pruning and training, crop coefficients, water requirements and critical stages, fertilizer application, fertigation, irrigation methods.	25%	4
4	Harvesting: Grading and packaging, post-harvest practices, Garden tools, management of orchard, Extraction and storage of vegetables seeds.	20%	3
5	Major pests and diseases and their management in horticulture crops.	10%	2
		100%	16

i. Text Book and Reference Book:

1. Postharvest management of Horticultural Crops (TextBook) araswathy, S., T.L. Preethi, S. Balasubramanyan, J. Suresh, N. Revathy and S. Natarajan
2. Horticulture in India (Textbook) Bansal P. C.
3. Diseases of Horticultural Crops (TextBook) Arjunan, G., Karthikeyan, G, Dinakaran, D. and Raguchander, T
4. "Principles of Horticulture" (Textbook) by C.R. Adams; Oxford University Press.
5. "Horticulture: Principles and Practices" (Textbook) by George Acquaah; Pearson Education, Inc.
6. "Principles of Horticulture" (Textbook) by J. Edward Wells and Dennis R. Decoteau; Cengage Learning.

j. Experiment List

Sr. NO.	Experiment List
1	Judging maturity time for harvesting crops.
2	Study of seed variability and germination test.
3	Identification and description of important fruits, flowers and vegetable crops.

4	Study of different garden tools.
5	Preparation of nursery bed.
6	Practices of pruning and training in some important fruit crops
7	Visit to commercial greenhouse/polyhouse.
8	Cultural operations for vegetable crops (sowing, fertilizer application.)
9	Cultural operations for vegetable crops (mulching, irrigation and weed control)
10	Seed extraction techniques.
11	Identification of important pests and their control.
12	Identification of diseases and their control.

- a. **Course Name:** Soil Mechanics
- b. **Course Code:** 20103210
- c. **Prerequisite:** Knowledge of basic physics and mathematics up to 12th
- d. **Rationale:** Soil Mechanics provides essential knowledge to understand the soil physical and mechanical properties
- e. **Course Learning Objective:**

CLOBJ 1	Develop a fundamental understanding of soil mechanics, including soil properties, classification, and the behavior of soils under different loading conditions, providing a basis for geotechnical engineering applications.
CLOBJ 2	Explore the principles of soil compaction, consolidation, and shear strength, enabling the analysis and design of foundations, slopes, and retaining structures for construction projects.
CLOBJ 3	Understand the role of water in soil mechanics, covering topics such as permeability, seepage, and effective stress, to assess and manage potential issues related to groundwater in geotechnical engineering projects.
CLOBJ 4	Apply knowledge of soil mechanics principles to geotechnical engineering problems, including the design of shallow and deep foundations, earth retaining structures, and slope stability analyses, ensuring the safety and stability of civil engineering projects.

f. Course Learning Outcomes:

CLO 1	Measure index properties of soil with different methodologies
CLO 2	Understand the stress condition in soils and discuss analysis of soil stress.
CLO 3	Describe soil compaction and consolidation.
CLO 4	Analyze interrelationships between various soil parameters

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	INTRODUCTION: Introduction to soil mechanics, field of soil mechanics, phase diagram physical and index properties of soil, Classification of soils	25%	4
2	STRESS IN SOIL AND SEEPAGE ANALYSIS: Effective and neutral stress, Elementary concept of Boussinesq and Westergaards analysis, Newmark influence chart, seepage analysis, quick condition, two-dimensional flow- Laplace equation, velocity potential and stream function, flow net construction.	20%	3
3	STRENGTH OF SOIL: Shear strength, Mohr stress circle, theoretical relationship between principle stress circle, theoretical relationship between principal stress, Mohr-coulomb failure theory, effective stress principle, Determination of shear parameters by direct shear test, triaxial test and vane shear test, Numerical exercise based on various types of test	15%	3
4	COMPACTION AND CONSOLIDATION: Compaction: composition of soils, standard and modified proctor test, abbot compaction and Jodhpur mini compaction test, field compaction method and control. Consolidation of soil: Consolidation of soils, one dimensional consolidation spring analogy, Terzaghi's theory Laboratory consolidation test, calculation of void ratio and coefficient of volume change, Taylor's and Casagrande's method, determination of coefficient of consolidation.	20%	3
5	EARTH PRESSURE AND SLOPE STABILITY: Earth pressure, Plastic equilibrium in soils, active and passive states, Rankines theory of earth pressure, active and passive earth pressure for cohesive soils, simple numerical exercise, Stability of slopes: Introduction to stability analysis of infinite and finite slopes, friction circles method, Taylor's stability number.	20%	3
		100%	16

i. Text Book and Reference Book:

1. Soil Mechanics and Foundations (TextBook) Punmia .B.C; Laxmi Publications
2. Basic and Applied Soil Mechanics Gopal Ranjan and Rao .A.S.R; New age international Ltd
3. Soil Mechanics & Foundation Engineering (TextBook) Arora K.R; Standard Pub.

4. "Principles of Geotechnical Engineering" (Textbook) by Braja M. Das; Cengage Learning.

J. Experiment List

Sr. NO.	Experiment List
1	Determination of water content of soil.
2	Determination of specific gravity of soil.
3	Determination of field density of soil by core cutter method.
4	Determination of field density by sand replacement method.
5	Grain size analysis by sieving (Dry sieve analysis)
6	Grain size analysis by hydrometer method.
7	Determination of liquid limit by Casagrande's method.
8	Determination of liquid limit by cone penetrometer and plastic limit.
9	Determination of shrinkage limit.
10	Determination of permeability by constant head method.
11	Determination of permeability by variable head method.
12	Determination of compaction properties by standard proctor test.
13	Determination of shear parameters by direct shear test.
14	Determination of unconfined compressive strength of soil.
15	Determination of shear parameters by Tri-axial test.
16	Determination of consolidation properties of soils.

- a. **Course Name:** Communication Skills and Personality Development
- b. **Course Code:** 20193201
- c. **Prerequisite:** Knowledge and application of English is crucial for Organizational Communication
- d. **Rationale:** Students will be able to adopt and develop the right mindsets early in their professional career which will bring about a positive and sustainable change in their overall personality.
- e. **Course Learning Objective:**

CLOBJ 1	Develop effective verbal and written communication skills, including clarity, coherence, and persuasion, to enhance professional interactions and convey ideas with precision.
CLOBJ 2	Cultivate active listening skills, fostering the ability to comprehend, interpret, and respond appropriately to diverse communication contexts, thereby promoting positive interpersonal relationships.
CLOBJ 3	Enhance non-verbal communication skills, including body language, gestures, and facial expressions, to convey confidence, credibility, and emotional intelligence in various personal and professional situations.
CLOBJ 4	Explore techniques for effective public speaking and presentation skills, mastering the art of structuring content, engaging audiences, and delivering impactful messages for successful communication.

f. **Course Learning Outcomes:**

CLO 1	Speak and participate in oral organizational communication
CLO 2	Utilize technology to facilitate efficient interpersonal communication
CLO 3	Utilize verbal & non-verbal communication for delivering a business presentation
CLO 4	Understand soft skills required for professional growth

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Email etiquette & Email writing: Trains students on detailed email and letter writing etiquette. Students will be able to write formal letters following certain stipulated formats. They will learn different types of letters for different official purposes.	5%	1
2	Interpersonal Communication at Workplace: Dynamics of communication: process, concept, nature and barriers to communication. Non-verbal Communication Activity	5%	1
3	Precis Writing: Develop adequate knowledge of precise writing techniques.	5%	1
4	Paragraph Development: Structure of Paragraph Construction of Paragraph using transitions and connecting Devices	5%	1
5	Paragraph Jumbles: Students will be able to solve the jumbled paragraph which comes in different exams by solving the worksheet	10%	2
6	Public Speaking: Choosing appropriate pattern Selecting appropriate method Art of persuasion Making speeches effective Delivering different types of speeches	10%	2
7	Reading Comprehension: Worksheets: To enable the students, develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	5%	2
8	Listening Skills (practice & test): Small everyday conversation & comprehension Inquiry based listening questions	10%	3
9	Misplaced Modifiers: Students will understand how to place the improperly separated word, phrase, or clause from the word it describes.	5%	1
10	Advanced vocabulary Building: Phrasal verbs	10%	2

	Idiotic Expression (Chart Activity) Developing Technical vocabulary (Memory Game) Homophones, Homonyms & Confusable		
11	Letter Writing: Layout Appreciation Letter Apology Letter Acknowledge Letter	10%	2
12	Resume Building: Cover Letter Resume	10%	2
13	Group Discussion: Communication core Definition, types, process, guidelines Mock Round	10%	2
		100%	32

i. Text Book and Reference Book:

1. "How to Win Friends and Influence People" by Dale Carnegie; Pocket Books.
2. "The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change" by Stephen R. Covey; Simon & Schuster.
3. "Communication Skills for Dummies" by Elizabeth Kuhnke; For Dummies.
4. "The Definitive Book of Body Language" by Allan Pease and Barbara Pease; Bantam Books.
5. "Crucial Conversations: Tools for Talking When Stakes Are High" by Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler; McGraw-Hill Education.

Semester 4

- a. Course Name:** Building Construction and Cost Estimation
- b. Course Code:** 20103254
- c. Prerequisite:** Basic knowledge of Building Construction and Cost Estimation
- d. Rationale:** Knowledge of the basics of building construction helps to construct a building project successfully. Cost estimation plays key role in a successful construction project.
- e. Course Learning Objective:**

CLOBJ 1	Understand the principles of construction materials, techniques, and structural systems to make informed decisions in building design and construction.
CLOBJ 2	Develop proficiency in cost estimation and budgeting, enabling the ability to accurately assess and control the financial aspects of construction projects.
CLOBJ 3	Acquire skills in project planning and management, employing methodologies such as the critical path method to ensure efficient execution of building construction projects.
CLOBJ 4	Cultivate a holistic understanding of the interplay between material choices, structural design, cost considerations, and project management, fostering comprehensive competence in the field of building construction and cost estimation.

f. Course Learning Outcomes:

CLO 1	Understand the physical properties of construction materials.
CLO 2	Analyze various components of building and their function and purposes.
CLO 3	Understand construction of components of building.
CLO 4	Recognize and classify the need of Estimation and Specification.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	-	2	50	-	-	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Building Materials: Rocks, Stones, Bricks Properties and varieties of Tiles, Lime, Cement, Concrete, Sand. Glass, Rubber, Plastics, iron, Steel, Aluminum, Copper, Nickle. Timber.	25%	8
2	Building components: Lintels, Arches, stair cases, Different types of floors,	25%	8
3	Finishing: Damp Proofing and water proofing, Plastering, pointing, white washing and distempering - Painting, building design, Design procedures, Technology, building construction, Types of agricultural buildings and related needs, application of design theory and practice to the conservation, sloped and flat roof buildings,	25%	8
4	construction economics: Preliminary estimates, Detailed Estimates of Buildings source of cost information, use of cost analyses for controlling design, Factors affecting building costs; cost evaluation of design and planning alternatives for building and estate development, Measurement and pricing, 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	25%	8
		100%	32

i. Text Book and Reference Book:

1. Estimation and Costing' (TextBook) B. N Dutta; UBS Publishers' Distributors Pvt. Ltd.
2. Building Construction (TextBook) Dr. B. C. Punmia, Ashokkumar Jain, Arunkumar Jain; Laxmi Publicatons, Delhi
3. Building materials (TextBook) S. K. Duggal; New Age International
4. Engineering Materials (TextBook) S.C. Rangwala; Charotar Publishing House

- a. **Course Name:** AutoCAD Applications
- b. **Course Code:** 20103255
- c. **Prerequisite:** Basic knowledge of engineering drawing and computer.
- d. **Rationale:** Designing irrigation survey and different agricultural machinery
- e. **Course Learning Objective:**

CLOBJ 1	Develop a foundational understanding of AutoCAD tools, commands, and interface to create, edit, and manipulate 2D and 3D drawings.
CLOBJ 2	Learn precision drafting techniques, including dimensioning, scaling, and annotation, to produce accurate and professional-quality technical drawings.
CLOBJ 3	Explore 3D modeling features to create detailed three-dimensional representations of objects and structures, enhancing visualization and design communication.
CLOBJ 4	Gain proficiency in customizing AutoCAD through the creation of templates, styles, and scripts, streamlining workflows and improving efficiency in design processes.

f. Course Learning Outcomes:

CLO 1	Understand the basic concept of design software Auto CAD.
CLO 2	Apply the principles in agricultural equipment design.
CLO 3	Demonstrate CNC machine and its components
CLO 4	Visualize the machine components in detail.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	4	2	-	-	100	0	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List

Sr. NO.	Experiment List
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.

i. Text Book and Reference Book:

1. "AutoCAD 2022 and AutoCAD LT 2022 Essentials" by Scott Onstott; Wiley.
2. "Mastering AutoCAD 2022 and AutoCAD LT 2022" by George Omura and Brian C. Benton; Wiley.
3. "AutoCAD 3D Modeling: Exercise Workbook" by Steve Heather; Industrial Press, Inc.
4. "AutoCAD 2022 Tutorial First Level 2D Fundamentals" by Randy Shih; SDC Publications.
5. "AutoCAD 2022 for Architectural Design" by Tutorial Books; Independently published.

- a. **Course Name:** Applied Electronics and Instrumentation
- b. **Course Code:** 20103256
- c. **Prerequisite:** Basic knowledge of Electrical Engineering
- d. **Rationale:** Rationale: Sound knowledge about various techniques used for the Measurement of industrial parameters is essential for the student of engineering
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of electronic components, circuits, and their applications in various electronic systems.
CLOBJ 2	Explore principles of instrumentation and measurement, including sensors, transducers, and data acquisition systems, to design and implement effective measurement solutions.
CLOBJ 3	Gain proficiency in signal processing techniques for extracting, analyzing, and interpreting information from electronic signals, contributing to the enhancement of measurement accuracy.
CLOBJ 4	Understand the principles of control systems and automation, including the design and implementation of feedback control mechanisms in electronic and instrumentation systems.

f. Course Learning Outcomes:

CLO 1	Develop the ability to analyze and design analog electronic circuits using discrete components.
CLO 2	Analyze the performance of the various types of feedback amplifiers
CLO 3	Understand statistical data presentation and evaluation from static and dynamic characteristics including errors of different electro-mechanical instruments
CLO 4	Recommend appropriate instruments to measure given sets of parameters.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Semiconductors. p-n junction. V-I characteristics of p-n junction. diode as a circuit element. rectifier. clipper. damper, voltage multiplier, capacitive filter. diode circuits for OR & AND (both positive and negative logic)	25%	8
2	bipolar junction transistor: operating point. classification (A, B & C) of amplifier. various biasing methods (fixed. self potential divider). h- parameter model of a transistor. analysis of small signal. CE amplifier. phase shift oscillator, analysis of differential amplifier using transistor. ideal OP-AMP characteristics.	25%	8
3	linear and non-linear applications of OP- AMP (adder. subtractor. integrator, active rectifier. comparator. differentiator. differential, instrumentation amplifier and oscillator). zener diode voltage regulator. transistor series regulator. current limiting. OP-AMP voltage regulators.	25%	8
4	Basic theorem of Boolean algebra. Combinational logic circuits (basic gates. SOP rule and Kmap). binary ladder D/A converter, successive approximation A/D converter, generalized instrumentation, measurement of displacement. temperature. velocity, force and pressure using potentiometer. resistance thermometer. thermocouples. Bourdon tube. LVDT. strain gauge and tachogenerator.	25%	8
		100%	32

i. Text Book and Reference Book:

1. "Applied Electronics" (Textbook) by R.S. Sedha; S. Chand & Company Ltd.
2. "Modern Electronic Instrumentation and Measurement Techniques" (Textbook) by Albert D. Helfrick and William D. Cooper; Prentice Hall.
3. "Electronic Instrumentation and Measurements" (Textbook) by David A. Bell; Oxford University Press.
4. "Electronics Instrumentation & Measurement" (Textbook) by U.A. Bakshi and A.V. Bakshi; Technical Publications.
5. "Electronic Instrumentation" (Textbook) by H.S. Kalsi; Tata McGraw-Hill Education.

j. Experiment List:

Sr. NO.	Experiment List
1	To study V-1 characteristics of p-n junction diode
2	To study half wave. full wave and bridge rectifier
3	To study transistor characteristics in CE configurations
4	To design and study fixed and self bias transistor
5	To design and study potential divider bias transistor
6	To study a diode as clipper and clamper
7	To study a OP-AMP IC 741 as inverting and non- inverting amplifier
8	To study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor
9	To study a OP-AMP IC 741 as differential amplifier
10	To study a zener regulator circuit
11	To study a OP-AMP IC 741 as a active rectifier
12	To study a OP-AMP IC 741 as a comparator
13	To familiarize with various types of transducers.

- a. **Course Name:** Tractor and Automotive Engines
- b. **Course Code:** 20103257
- c. **Prerequisite:** Basic knowledge of thermodynamics
- d. **Rationale:** Tractor and Automotive Engines subject is essential for agricultural engineers
- e. **Course Learning Objective:**

CLOBJ 1	Develop a thorough understanding of internal combustion engines, with a focus on the principles of operation, thermodynamics, and combustion processes.
CLOBJ 2	Explore the components and systems within automotive powertrains, including transmissions, differentials, and drivetrain configurations, to comprehend the integrated functioning of modern vehicles.
CLOBJ 3	Understand the dynamics of tractors, including factors influencing traction, stability, and overall performance in agricultural applications.
CLOBJ 4	Gain proficiency in diagnosing and troubleshooting engine-related issues in both automotive and tractor engines, and learn effective maintenance practices to ensure optimal performance and longevity.

f. Course Learning Outcomes:

CLO 1	Discuss the significance of various fuels, their properties and tests.
CLO 2	Elaborate thermodynamic principles of IC engine.
CLO 3	Elaborate engine components, their construction, operating principles and functions.
CLO 4	Develop an understanding of working of tractor engine.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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 ideal cycle. General	25%	8

	energy equation and heat balance sheet. Study of mechanical, thermal and volumetric efficiencies. 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.		
2	Study of importance of air cleaning system. Study of types of air cleaners and performance characteristics of various air cleaners. Study of 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. Study of carburetion system, carburetors and their main functional components. Study of fuel injection system ± Injection pump, their types, working principles.	25%	8
3	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.	25%	8
4	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 ignition system of SI engines. Study of electrical system including battery, starting motor, battery charging, cut-out, etc. Comparison of dynamo and alternator. Familiarization with the basics of engine testing	25%	8
		100%	32

i. Text Book and Reference Book:

1. "Tractor and Automotive Engines" (Textbook) by Roger L. Haney; Delmar Cengage Learning.
2. "Automotive Engineering Fundamentals" (Textbook) by Richard Stone and Jeffrey K. Ball; SAE International.
3. "Automotive Mechanics: Principles and Practices" (Textbook) by Joseph Heitner; Cengage Learning.
4. "Modern Automotive Technology" (Textbook) by James E. Duffy; Goodheart-Willcox Publisher.
5. "Tractor Engines: Design and Applications" (Textbook) by Anantnarayan and Krishnakumar; Prentice-Hall of India Pvt. Ltd.

j. Experiment list

Sr. NO.	Experiment List
1	Introduction to different systems of CI engines
2	Engine parts and functions, working principles etc.
3	Air cleaning system
4	Fuel Supply system of SI engine
5	Diesel injection system and timing
6	Cooling system, fan performance, thermostat, and radiator performance evaluation
7	Part load efficiencies and governing
8	Lubricating system and adjustment
9	Starting and electrical system
10	Ignition system
11	Tractor engine heat balance and engine performance curves
12	Visit to engine manufacturer/ assembler/ spare parts agency.

- a. **Course Name:** Engineering Properties of Agricultural Produce
- b. **Course Code:** 20103258
- c. **Prerequisite:** Zeal to Learn Subject
- d. **Rationale:** Applying Engineering Properties of Agricultural Produces subject knowledge in agriculture processing equipment design.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the physical characteristics of agricultural produce, including size, shape, density, and texture, to analyze their suitability for processing and handling.
CLOBJ 2	Explore the mechanical behavior of agricultural products, focusing on attributes such as hardness, elasticity, and fracture toughness, to optimize machinery and equipment for harvesting and processing.
CLOBJ 3	Examine the thermal properties of agricultural produce, including thermal conductivity and specific heat, to design appropriate storage and processing conditions that preserve quality.
CLOBJ 4	Learn the significance of moisture content and water activity in agricultural products, understanding their impact on storage, preservation, and microbial stability.

f. Course Learning Outcomes:

CLO 1	Identify the engineering properties of Agricultural produce.
CLO 2	Understand biological properties of food.
CLO 3	Apply food engineering principles in agriculture processing equipment design.
CLO 4	Determine the properties of locally available Agricultural produce.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Theory Classification and importance of engineering properties of Agricultural Produce	5%	1
2	Shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area of grains, fruits and vegetables	10%	2
3	Thermal properties, Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion,	10%	2
4	Friction in agricultural materials; Static friction, Kinetic friction, rolling resistance Angle of internal friction, angle of repose, Flow of bulk granular materials,	15%	3
5	Aero dynamics of agricultural products drag coefficients, terminal velocity.	10%	2
6	Rheological properties; force, deformation, stress, strain, elastic plastic and viscous behaviour, Newtonian and Non-Newtonian liquid, Viscoelasticity, Newtonian and NonNewtonian fluid, Pseudo-plastic, Dilatant	20%	3
7	Thixotropic, Rheoplectic and Bingham Plastic Foods, Flow curves.	10%	1
8	Electrical properties; dielectric loss factor, loss tangent A.C. conductivity and dielectric constant, method of determination	10%	1
9	Application of engineering properties in handling processing machines storage structures	10%	1
		100%	32

i. Text Book and Reference Book:

1. "Postharvest Technology and Food Process Engineering" (Textbook) by Amalendu Chakraverty; Springer.
2. "Food Engineering: Integrated Approaches" (Textbook) by Gustavo V. Barbosa-Canovas, Jasim Ahmed, and Enrique Ortega-Rivas; Springer.
3. "Principles of Food Processing" (Textbook) by Dennis R. Heldman; Springer.
4. "Engineering Properties of Foods" (Textbook) by M.A. Rao and S.S. H. Rizvi; CRC Press.
5. "Unit Operations in Food Processing" (Textbook) by R.L. Earle and M.D. Earle; Springer.

j. Experiment List

Sr. NO.	Experiment List
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.

- a. **Course Name:** Watershed Hydrology
- b. **Course Code:** 20103259
- c. **Prerequisite:** Zeal to Learn Subject
- d. **Rationale:** Watershed hydrology subject knowledge is essential for agricultural engineers
- e. **Course Learning Objective:**

CLOBJ 1	Develop a foundational understanding of watershed hydrology, including the study of precipitation, runoff, and the interconnected processes influencing water movement within a watershed.
CLOBJ 2	Explore the principles and techniques of hydrological modeling to simulate and analyze the behavior of water flow, precipitation, and runoff patterns within a watershed.
CLOBJ 3	Understand methods for assessing water quality within a watershed, including the impact of land use, pollution sources, and ecological factors on water quality parameters.
CLOBJ 4	Learn strategies for sustainable watershed management, considering factors such as land use planning, soil conservation, and water resource development to ensure long-term environmental health and water availability.

f. Course Learning Outcomes:

CLO 1	Describe rainfall measurement in detail.
CLO 2	Discuss estimation and measurement of various hydrological parameters.
CLO 3	Study geomorphology of watersheds.
CLO 4	Understand runoff and flood control methods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

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h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Hydrologic cycle, precipitation and its forms	8%	1
2	Rainfall measurement and estimation of mean rainfall	10%	1
3	Frequency analysis of point rainfall	10%	1
4	Mass curve, hyetograph, depth-area-duration curves and intensity- duration frequency relationship	6%	1
5	Hydrologic processes-Interception, infiltration -factors influencing, measurement and indices	6%	1
6	Evaporation - Estimation and measurement	5%	1
7	Runoff - Factors affecting, measurement, stage - discharge rating curve	6%	1
8	Estimation of peak runoff rate and volume	5%	1
9	Rational method, Cook's method and SCS curve number method	5%	1
10	Geomorphology of watersheds ± Linear, aerial and relief aspects of watersheds stream order, drainage density and stream frequency	5%	1
11	Hydrograph - Components, base flow separation, unit hydrograph theory	6%	1
12	S-curve, synthetic hydrograph, applications and limitations	6%	1
13	Stream gauging - discharge rating curves, flood peak, design flood and computation of probable flood	6%	1
14	Flood routing ± channel and reservoir routing	5%	1
15	Drought ± classification, causes and impacts	5%	1
16	drought management strategy	6%	1
		100%	32

i. Text Book and Reference Book:

1. Engineering Hydrology (TextBook) K. Subramanya; Tata McGraw Hill Pub. Co.
2. Hydrology and Soil Conservation Engineering: Including Watershed Management (TextBook)
3. Ghanshyam Das; Prentice Hall India Learning Private Limited

4. "Watershed Hydrology" (Textbook) by Vijay P. Singh; CRC Press.
5. "Watershed Management: Principles and Applications" (Textbook) by Vijay P. Singh

j. Experiment List

Sr. No.	Experiment List
1	Visit to 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 Cook's method and rational
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

- a. **Course Name:** Irrigation Engineering
- b. **Course Code:** 20103260
- c. **Prerequisite:** Basic knowledge of Soil and water Engineering Principles
- d. **Rationale:** The subject irrigation is essential for efficient management of irrigation practices and also to understand the water needs of the crop.
- e. **Course Learning Objective:**

CLOBJ 1	Develop a foundational understanding of different irrigation systems, including surface irrigation, sprinkler systems, and drip irrigation, and their applications in agriculture.
CLOBJ 2	Explore the principles of crop water requirements and irrigation scheduling, focusing on efficient water use to optimize crop yield and quality.
CLOBJ 3	Learn the design and layout of irrigation infrastructure, including canals, pipes, pumps, and control structures, to ensure the efficient and equitable distribution of water in agricultural fields.
CLOBJ 4	Understand the interaction between soil and water, including soil moisture retention and drainage principles, to address issues related to waterlogging and salinity in irrigated areas.

f. Course Learning Outcomes:

CLO 1	Study methods of irrigation water measurement.
CLO 2	Estimate earth work and cost in land grading.
CLO 3	Discuss soil water plant relationship in detail.
CLO 4	Distinguish different irrigation methods

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Major and medium irrigation schemes of India, purpose of irrigation, sources of irrigation water, present status of development and utilization of different water resources of the country.	6%	2
2	Measurement of irrigation water, weir, notches, flumes and orifices and other methods.	18%	6
3	Open channel water conveyance system, design and lining of irrigation field channels, on farm structures for water conveyance, control & distribution, underground pipe conveyance system: components and design.	20%	6
4	Land grading: criteria for land levelling, land levelling design methods, estimation of earth work.	12%	4
5	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.	12%	4
6	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.	12%	4
7	Surface irrigation methods of water application, border, check basin and furrow irrigation - adaptability, specification and design considerations.	20%	6
		100%	32

i. Text Book and Reference Book:

1. Irrigation Theory and Practice (TextBook) A.M. Michael
2. Principles of Agricultural Engineering Vol-II (TextBook) A. M. Michael & T P Ojha
3. Irrigation Water Management- Principles and Practice (TextBook) Dilip Kumar Majumdar
4. "Irrigation Engineering" (Textbook) by R.N. Reddy; Tata McGraw-Hill Education.
5. "Irrigation Engineering" (Textbook) by Basak; Oxford University Press.

j. Experiment List

Sr. No.	Experiment List
1	Measurement of soil moisture by different soil moisture measuring instruments
2	Measurement of irrigation water.
3	Measurement of infiltration rate.
4	Determination of bulk density, field capacity and wilting point
5	Study of land grading methods
6	Estimation of evapotranspiration
7	Design of underground pipe line system
8	Estimation of irrigation efficiency
9	Infiltration by inflow-outflow method
10	Evaluation of border irrigation method
11	Evaluation of furrow irrigation method
12	Evaluation of check basin irrigation method

- a. **Course Name:** Sprinkler and Micro Irrigation Systems
- b. **Course Code:** 20103261
- c. **Prerequisite:** Basic knowledge of irrigation engineering
- d. **Rationale:** Knowledge of different micro irrigation systems and their design are essential for an Agricultural Engineer.
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of the principles underlying sprinkler and micro irrigation systems, including water distribution, nozzle types, and emitter technologies.
CLOBJ 2	Explore the various components of sprinkler and micro irrigation systems, such as pumps, pipes, valves, and emitters, and learn how to design efficient and uniform water distribution layouts.
CLOBJ 3	Understand the factors influencing water application efficiency in sprinkler and micro irrigation, including nozzle selection, pressure regulation, and spacing of emitters, to optimize water use and minimize wastage.
CLOBJ 4	Learn best practices for the management and maintenance of sprinkler and micro irrigation systems, including monitoring techniques, scheduling, and troubleshooting to ensure reliable and effective operation.

f. **Course Learning Outcomes:**

CLO 1	Differentiate sprinkler and micro-irrigation system.
CLO 2	Design irrigation system for a field.
CLO 3	Utilize micro irrigation for fertigation.
CLO 4	Carry out regular maintenance of MIS.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation systems; design of sprinkler irrigation system: layout selection, hydraulic design of lateral, submain and main pipe line, design steps; selection of pump and power unit for sprinkler irrigation system; performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency;	35%	6
2	Micro Irrigation Systems: types-drip, spray, & bubbler systems, merits and demerits, different components; Design of drip irrigation system: general considerations, wetting patters, irrigation requirement, emitter selection, hydraulics of drip irrigation system, design steps; necessary steps for proper operation of a drip irrigation system; maintenance of micro irrigation system: clogging problems, filter cleaning, flushing and chemical treatment;	35%	6
3	Fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation.	30%	4
		100%	16

i. Text Book and Reference Book:

1. Irrigation Theory and Practice (TextBook) A.M. Michael
2. Micro irrigation for cash crops (TextBook) Choudhary M.L and Kadam U.S
3. "Principles of Micro Irrigation Design" (Textbook) by Donald H. Gray and Jerry K. Davis; Arno Press.
4. "Design of Micro Irrigation Systems" (Textbook) by Shyam K. Yadav; CRC Press.
5. "Micro Irrigation Systems" (Textbook) by Megh R. Goyal; CRC Press.

j. Experiment List

Sr. NO.	Experiment List
1	Study of different components of sprinkler irrigation system
2	Design and installation of sprinkler irrigation system
3	Determination of precipitation pattern, discharge and uniformity coefficient
4	Cost economics of sprinkler irrigation system
5	Study of different components of drip irrigation
6	Design and installation of drip irrigation system

7	Determination of pressure discharge relationship and emission uniformity for given emitter
8	Study of different types of filters and determination of filtration efficiency
9	Determination of rate of injection and calibration for chemigation/fertigation
10	Design of irrigation and fertigation schedule for crops
11	Field visit to micro irrigation system and evaluation of drip system; cost economics of drip irrigation system

- a. **Course Name:** Fundamentals of Renewable Energy Sources
- b. **Course Code:** 20103262
- c. **Prerequisite:** Basic knowledge of renewable energy and its importance
- d. **Rationale:** Fundamental of renewable energy sources subject knowledge is essential for agricultural engineers.
- e. **Course Learning Objective:**

CLOBJ 1	Develop a foundational understanding of renewable energy sources, including solar, wind, hydro, geothermal, and biomass, and their significance in addressing sustainable energy needs.
CLOBJ 2	Explore the principles of solar energy, covering topics such as photovoltaic systems, solar thermal technologies, and their applications in electricity generation and heating.
CLOBJ 3	Understand the principles of wind energy conversion, including wind turbine technology, site assessment, and integration into the power grid for reliable electricity production.
CLOBJ 4	Explore the utilization of hydropower and biomass as renewable energy sources, considering the design and operation of hydroelectric plants and the conversion of organic materials into bioenergy.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts of different renewable energy sources.
CLO 2	build the knowledge of different principles to generate energy from waste
CLO 3	describe working of different renewable energy technology.
CLO 4	Classify the different types of energy conservation method

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Concept and limitation of Renewable Energy Sources (RES), Criteria for assessing the potential of RES.	6%	2
2	Classification of RES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of renewable energy sources with non-renewable sources.	6%	2
3	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, Solar Photo voltaics: p-n junctions.	19%	6
4	Solar cells, PV systems, Stand alone, Grid connected solar power station, Calculation of energy through photovoltaic power generation and cost economics.	13%	4
5	Wind Energy: Energy available from wind, General formula, Lift and drag. 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.	19%	6
6	Bio-energy: Pyrolysis of Biomass to produce solid, liquid and gaseous fuels.	6%	2
7	Biomass gasification, Types of gasifier, various types of biomass cook stoves for rural energy needs.	12%	4
8	Biogas: types of biogas plants, biogas generation, factors affecting biogas generation and usages, design consideration, advantages and disadvantages of biogas spent slurry.	19%	6
		100%	32

i. Text Book and Reference Book:

1. Non-Convectional Energy Sources (TextBook) G D Rai; Khanna Publishers, Delhi
2. Renewable Energy Resources: basic principle & application(TextBook) Tiwari and Ghosal; Narosa Publication
3. Biogas Technology - A Practical Hand Book (TextBook) Khandelwal, K. C. and Mahdi, S.S.; Tata McGraw Hill Publishing Co. Ltd.
4. "Renewable Energy Systems: A Smart Energy Systems Approach to the Choice and Modeling of 100% Renewable Solutions" (Textbook) by Henrik Lund; Academic Press.
5. "Fundamentals of Renewable Energy Processes" (Textbook) by Aldo V. da Rosa; Academic Press.

j. Experiment List

Sr. NO.	Experiment List
1	Study of different types of solar cookers.
2	Study of different types of solar water heating system.
3	Study of natural convection solar dryer and forced convection solar dryer.
4	Study of solar desalination unit.
5	Study of solar greenhouse for agriculture production.
6	Study of different types of biogas plants.
7	Study of different types of biomass gasifiers.
8	Study of different types of biomass improved cook-stoves.
9	Study of solar photovoltaic system.

Semester 5

- a. Course Name:** Tractor Systems and Controls
b. Course Code: 20103302
c. Prerequisite: knowledge of Farm Power and Field operation and Maintenance of Tractor and Farm Machinery
d. Rationale: Tractor Systems and Controls knowledge is essential for Agricultural Engineers
e. Course Learning Objective:

CLOBJ 1	Understand the principles and functions of tractor systems and controls.
CLOBJ 2	Demonstrate proficiency in operating and maintaining tractor systems.
CLOBJ 3	Analyze and troubleshoot common issues in tractor systems.
CLOBJ 4	Apply safety measures in the operation of tractors and their controls.

f. Course Learning Outcomes:

CLO 1	Understand the various tractor systems
CLO 2	Knowledge About tractor principles and operation.
CLO 3	Analyze tractor control and maintenance methods.
CLO 4	Identify the various tractor systems components.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Study of need for transmission system in a tractor. Transmission system –types, major functional systems. Study of clutch – need, types	4%	1
2	Chapter 2: Clutch: functional requirements, construction and principle of operation. Familiarization with single plate, multi-plate, centrifugal and dual clutch systems	8%	3

3	Chapter 3: Study of Gear Box – Gearing theory, principle of operation, gear box types, functional requirements, and calculation for speed ratio.	8%	3
4	Chapter 4: Study of differential system – need, functional components, construction, calculation for speed reduction. Study of need for a final drive.	4%	1
5	Chapter 5: Study of Brake system – types, principle of operation, construction, calculation for braking torque.	4%	1
6	Chapter 6: Study of steering system – requirements, steering geometry characteristics, functional components, calculation for turning radius. Familiarization with Ackerman steering. Steering systems in track type tractors.	8%	3
7	Chapter 7: Study of Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements. Familiarization with the Hydraulic system adjustments and ADDC.	8%	3
8	Chapter 8: Study of tractor power outlets – PTO.	4%	1
9	Chapter 9: Introduction to traction. Traction terminology. Theoretical calculation of shear force and rolling resistance on traction device.	8%	3
10	Chapter 10: Study of wheels and tyres – Solid tyres and pneumatic tyres, tyre construction and tyre specifications. Study of traction aids.	8%	3
11	Chapter 11: Study of tractor mechanics – forces acting on the tractor. Determination of CG of a tractor.	8%	3
12	Chapter 12: Determination and importance of moment of inertia of a tractor. Study of tractor static equilibrium, tractor stability especially at turns.	8%	2
13	Chapter 13: Determination of maximum drawbar pulls. Familiarization with tractor as a spring-mass system.	8%	2
14	Chapter 14: Ergonomic considerations and operational safety.	8%	2

15	Chapter 15: Introduction to tractor testing. Deciphering the engine test codes.	4%	1
		100%	32

i. Text Book and Reference Book:

1. Tractors & their power units (TextBook) J.B. Liljedahl, P.K. Turnquist, D.W. Smith, Makota Hoki,
2. Tractors and Automobiles (TextBook) Rodichev V and G Rodicheva
3. AUTOMOBILE ENGINEERING (PART-1) (TextBook) KIRPAL SINGH; STANDARD PUBLISHERS
4. Agricultural Engineer's Handbook (TextBook) C.B. Richey; McGrawHill

j. Experiment List

Sr. NO.	Experiment List
1	Introduction to transmission systems and components
2	Study of clutch functioning, parts and design problem on clutch system
3	Study of different types of gear box, calculation of speed ratios
4	Study on differential and final drive and planetary gears
5	Study of brake systems and some design problems
6	Study of Steering system, geometry and adjustments. Calculation for turning radius.
7	Study of Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements. Familiarization with the Hydraulic system adjustments and ADDC
8	Study of tractor power outlets – PTO. PTO standards, types and functional requirements
9	Study of CG and Moment of Inertia of a tractor
10	Traction performance of a traction wheel

- a. **Course Name:** Farm Machinery and Equipment-I
- b. **Course Code:** 20103303
- c. **Prerequisite:** Knowledge of basic engineering, soil science and crop husbandry.
- d. **Rationale:** This is one of the basic subjects of the course that deals with the primary & secondary tillage, plant protection and earth moving implements/machinery.
- e. **Course Learning Objective:**

CLOBJ 1	Gain knowledge of various farm machinery and equipment.
CLOBJ 2	Develop skills in the selection and utilization of farm machinery.
CLOBJ 3	Understand maintenance practices for farm machinery.
CLOBJ 4	Evaluate the economic and operational efficiency of different farm equipment.

f. Course Learning Outcomes:

CLO 1	Describe the objectives of Farm mechanization.
CLO 2	Classify the Farm Machineries, equipment and materials.
CLO 3	Explain selection of the machineries.
CLO 4	Discuss the forces acting on tillage tools and hitching systems.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Introduction to Mechanization in agriculture.	6%	2
2	Chapter 2: Classification of farm machineries, materials of construction.	6%	2
3	Chapter 3: Principles of operation and selection of machines used for production of crops.	6%	2

4	Chapter 4: Field capacities and economics.	10%	3
5	Chapter 5 Tillage, primary and secondary tillage equipments	16%	5
6	Chapter 6: Forces acting on tillage tools	10%	3
7	Chapter 7: Hitching systems and controls, draft measurement of tillage equipment	10%	3
8	Chapter 8: Earth moving equipment- their construction and working principles viz. bulldozer, trencher, elevator etc	10%	3
9	Chapter 9: Sowing, planting and transplanting equipment ± their calibration and adjustments, fertilizer application equipment	16%	5
10	Chapter 10: Weed control and plant protection equipment, sprayers and dusters, their calibration, selection, constructional features of different components and adjustments, test codes and their related uses	10%	4
		100%	32

i. Text Book and Reference Book:

1. Principle of farm machinery (TextBook) R.A. Kepner, Roy Bainer & E.L. Berger
2. Farm machines & equipments (TextBook) C. P. Nakra
3. Agricultural Engg. (through workedexamples) (TextBook) R. Lal and A.C. Datta
4. Farm machine (TextBook) Claude Cuplin
5. Elements of Agril. Engg (TextBook) J. Sahay

j. Experiment List

Sr. NO.	Experiment List
1	Introduction to various machines and implement available in lab.
2	Constructional details, adjustment and working of M.B. Plough
3	Constructional details, adjustment and working of Disc Plough
4	Constructional details, adjustment and working of secondary tillage tools
5	Measurement of field capacity and field efficiency of M.B. plough
6	Measurement of field capacity and field efficiency of disc harrow.
7	Measurement of draft and fuel consumption of agricultural implements
8	Calibration of seed drill.
9	Working of sprayer for nozzle discharge and field capacity.
10	Working of weeding equipment.

a. **Course Name:** Agricultural Structures and Environmental Control

b. **Course Code:** 20103304

c. **Prerequisite:** Knowledge of Engineering Properties of Agricultural Produce

d. **Rationale:** This course is designed on Integrated farming to increase the income in agriculture with poultry and dairy farm. The different environmental factors are to be studied for efficient design of different farm structures and its use

e. **Course Learning Objective:**

CLOBJ 1	Comprehend the design and construction of agricultural structures.
CLOBJ 2	Analyze the role of environmental control in agriculture.
CLOBJ 3	Apply principles of environmental control to optimize crop production.
CLOBJ 4	Assess the environmental impact of agricultural structures.

f. **Course Learning Outcomes:**

CLO 1	Understand the basic environmental factors.
CLO 2	Explain the basic design of agricultural structures.
CLO 3	Evaluate selection criteria and economical aspects of the agricultural structures.
CLO 4	Select the sites and orientation of sanitation buildings.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50		100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Planning and layout of farmstead.	5%	2
2	Chapter 2: Scope, importance and need for environmental control, physiological reaction of livestock environmental factors,	5%	2

3	Chapter 3 Environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods	10%	3
4	Chapter 4: Livestock production facilities, BIS Standards for dairy, piggery, poultry and other farm structures.	5%	2
5	Chapter 5: Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc	10%	3
6	Chapter 6: Storage of grains, Causes of spoilage, Water activity for low and high moisture food and its limits for storage, Moisture and temperature changes in grain bins	5%	2
7	Chapter 7: Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins),	15%	4
8	Chapter 8: Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin, Calculation of pressure in bins, Storage of seeds	15%	4
9	Chapter 9 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 rural community	10%	3
10	Chapter 10 Site and orientation of building in regard to sanitation, community sanitation system; sewage system and its design, cost and maintenance, design of septic tank for small family.	10%	3
11	Chapter 11 Estimation of domestic power requirement, source of power supply and electrification of rural housing.	10%	3
		100%	32

i. Text Book and Reference Book:

1. Principles and practices of Agricultural Structures and Environmental Control (TextBook) Pandey, P.H.; Kalyani Publishers, Ludhiana
2. Principles of Agricultural Engineering, Vol. I (TextBook)

Ojha, T.P and Michael, A.M.; Jain Brothers, Karol Bag, New Delhi.

3. Text Book of Environmental Engineering (TextBook) Venugopal Rao, P.; Prentice Hall of India, New Delhi.
4. "Agricultural Structures: A Textbook for Students of Agricultural Science and Civil Engineering" (Textbook) by H. Alan Lacey; Wiley-Blackwell.
5. "Design of Agricultural Engineering Structures" (Textbook) by Narendra Singh Rathore; CRC Press.

j. Experiment List

Sr. NO.	Experiment List
1	Measurements for environmental parameters and cooling load of a farm building
2	Design and layout of a dairy farm
3	Design and layout of a poultry house
4	Design and layout of a goat house/ sheep house
5	Design of a farm fencing system
6	Design of a feed/fodder storage structures
7	Design of grain storage structures
8	Design and layout of commercial bag and bulk storage facilities
9	Study and performance evaluation of different domestic storage structure
10	Estimation of a Farm building

- a. **Course Name:** Post Harvest Engineering of Cereals, Pulses and Oil Seeds
- b. **Course Code:** 20103305
- c. **Prerequisite:** Knowledge of Engineering Properties of Agricultural Produce
- d. **Rationale:** To know about different operations perform after harvesting the crop to obtain the grain in edible form, Value addition of the Cereals, Pulses and Oil Seeds crops, increase the market price of the agriculture products and promote export of agricultural commodities.
- e. **Course Learning Objective:**

CLOBJ 1	Understand post-harvest processes for cereals, pulses, and oilseeds.
CLOBJ 2	Learn techniques for storage and preservation of harvested crops.
CLOBJ 3	Evaluate post-harvest machinery and equipment.
CLOBJ 4	Implement quality control measures in post-harvest engineering.

f. Course Learning Outcomes:

CLO 1	Establish small scale food processing Industries and can become a small entrepreneur
CLO 2	Determine the unit operations suitable for a specific agricultural produce.
CLO 3	Identify the post-harvest engineering operations.
CLO 4	Understand different engineering properties of horticultural crops

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	4	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Cleaning and grading, aspiration, scalping; size separators, screens, sieve analysis, capacity and effectiveness of screens	6%	2

2	Chapter 2: Various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone, shape graders.	5%	2
3	Chapter 3: Size reduction: principle, Bonds law, Kicks law, Rittingers law, procedure (crushing, impact, cutting and shearing), Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill.	10%	3
4	Chapter 4: Material handling equipment. Types of conveyors: Belt, roller, chain and screw. Elevators: bucket, Cranes & hoists. Trucks (refrigerated/unrefrigerated), Pneumatic conveying.	5%	2
5	Chapter 5: Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect	6%	2
6	Chapter 6: 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	5%	2
7	Chapter 7: Dryer performance, Different methods of drying, batch-continuous; mixing-non-mixing, Sun mechanical, conduction, convection, radiation, superheated steam, tempering during drying	6%	2
8	Chapter 8: Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray	5%	1
9	Chapter 9: Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes.	5%	1
10	Chapter 10: 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.	10%	3
11	Chapter 11: Milling of wheat, unit operations and equipment	3%	1

12	Chapter 12: Milling of pulses: traditional milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods: CFTRI and Pantnagar methods. Pulse milling machines,	6%	2
13	Chapter 13: Milling of corn and its products.	3%	1
14	Chapter 14: Dry and wet milling. Milling of oilseeds: mechanical expression, screw press, hydraulic press, solvent extraction methods, preconditioning of oilseeds	6%	2
15	Chapter 15: refining of oil, stabilization of rice bran	5%	2
16	Chapter 16: Extrusion cooking: principle, factors affecting, single and twin screw extruders	6%	2
17	Chapter 17: By-products utilization	5%	2
		100%	32

i. Text Book and Reference Book:

1. Post harvest technology of cereals, pulses and oilseeds (TextBook) Chakraverty, A.
2. Unit operations of Agricultural Processing (TextBook) Sahay, K. M. & K.K. Singh
3. Rice Processing and Allied Operations (TextBook) Dash, S.K., Bebartta, J.P. and Kar, A.; Kalyani Publishers, New Delhi
4. "Engineering Properties of Foods" (Textbook) by M.A. Rao and S.S. H. Rizvi; CRC Press.
5. "Unit Operations in Food Processing" (Textbook) by R.L. Earle and M.D. Earle; Springer.

j. Experiment List

Sr. NO.	Experiment List
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 equipments in rice mills and their performance evaluation
12	Study of different equipments in pulse mills and their performance evaluation
13	Study of different equipments in oil mills and their performance evaluation
14	Type of process flow charts with examples relating to processing of cereals pulses and oil seeds
15	Visit to grain processing industries

- a. **Course Name:** Soil and Water Conservation Engineering
- b. **Course Code:** 20103306
- c. **Prerequisite:** Basic knowledge of soil and water conservation practices
- d. **Rationale:** Soil and Water conservation engineering knowledge is essential for Agricultural Engineer
- e. **Course Learning Objective:**

CLOBJ 1	Assess the principles of soil and water conservation.
CLOBJ 2	Analyze erosion control methods and strategies.
CLOBJ 3	Design and implement soil and water conservation practices.
CLOBJ 4	Assess the environmental and agricultural benefits of conservation engineering.

f. **Course Learning Outcomes:**

CLO 1	Recall soil erosion- causes, types and agents of soil erosion.
CLO 2	Describe the mechanics of soil erosion.
CLO 3	Explain soil loss estimation in detail.
CLO 4	Understand the land use classification and design of grassed water ways.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Soil erosion - Introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion	4%	1
2	Chapter 2: Water erosion - Mechanics and forms - splash, sheet, rill, gully, ravine and stream bank erosion	4%	1

3	Chapter 3: Gullies - Classification, stages of development.	8%	3
4	Chapter 4: Soil loss estimation ± Universal soil loss equation (USLE) and modified USLE.	8%	3
5	Chapter 5: Rainfall erosivity - estimation by KE>25 and EI30 methods	4%	1
6	Chapter 6: Soil erodibility - topography, crop management and conservation practice factors	4%	1
7	Chapter 7: Measurement of soil erosion - Runoff plots, soil samplers	8%	3
8	Chapter 8: Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching	8%	3
9	Chapter 9: Engineering measures± Bunds and terraces.	4%	1
10	Chapter 10: Bunds - contour and graded bunds - design and surplussing arrangements.	8%	3
11	Chapter 11: Terraces - level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stonewall and trenching	8%	3
12	Chapter 12: Gully and ravine reclamation - principles of gully control - vegetative measures, temporary structures and diversion drains	8%	3
13	Chapter 13: Grassed waterways and design	4%	1
14	Chapter 14: Wind erosion- Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes	8%	3
15	Chapter 15: Land capability classification	4%	1

16	Chapter 16: Rate of sedimentation, silt monitoring and storage loss in tanks	8%	2
		100%	32

i. Text Book and Reference Book:

1. Introduction to Soil and Water Conservation Engineering (TextBook) Mal, B.C; Kalyani Publishers
2. Principles of Agricultural Engineering Vol-II (TextBook) A M Michael & T P Ojha
3. Land and water management; Principles and Practices (TextBook) V V N Murthy
4. Soil and water Conservation Engineering (TextBook) R Suresh

j. Experiment List

Sr. NO.	Experiment List
1	Study of different types and forms of water erosion.
2	Exercises on 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 MUSLE.
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 rate of sedimentation and storage loss in tanks.
15	Computation of soil loss by wind erosion.
16	Design of shelterbelts and wind breaks for wind erosion control.
17	Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures

- a. **Course Name:** Watershed Planning and Management
- b. **Course Code:** 20103307
- c. **Prerequisite:** Basic knowledge of hydrologic processes and watershed
- d. **Rationale:** Knowledge about watershed management is important for Agricultural Engineer
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of watersheds and their importance.
CLOBJ 2	Develop skills in watershed planning and management.
CLOBJ 3	Analyze the impact of land use on watersheds.
CLOBJ 4	Implement sustainable practices for watershed management.

f. **Course Learning Outcomes:**

CLO 1	Memorize watershed concept.
CLO 2	Describe watershed management in detail.
CLO 3	Discuss watershed management measures.
CLO 4	Relate watershed management and planning.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Watershed - introduction and characteristics.	6%	1
2	Chapter 2: Watershed development - problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use	10%	2

	practices and socio-economic factors		
3	Chapter 3: 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.	10%	2
4	Chapter 4: Water budgeting in a watershed	6%	1
5	Chapter 5: Management measures - rainwater conservation technologies - in-situ and ex-situ storage, water harvesting and recycling	10%	2
6	Chapter 6: Dry farming techniques - inter-terrace and inter-bund land management	8%	1
7	Chapter 7: Integrated watershed management - concept, components, arable lands - agriculture and horticulture, non-arable lands - forestry, fishery and animal husbandry	12%	2
8	Chapter 8: Effect of cropping systems, land management and cultural practices on watershed hydrology.	8%	1
9	Chapter 9: Watershed programme - execution, follow-up practices, maintenance monitoring and evaluation	10%	1
10	Chapter 10: Participatory watershed management - role of watershed associations, user groups and self-help groups.	8%	1
11	Chapter 11: Planning and formulation of project proposal for watershed management programme including cost-benefit analysis	12%	2
		100%	16

i. Text Book and Reference Book:

1. Hydrology and Soil Conservation Engineering: Including Watershed Management (TextBook)
Ghanshyam Das; Prentice Hall India Learning Private Limited
2. Field Manual on Watershed Management. (TextBook)

Katy, J.C., R.P. Singh, Shrinivas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra.; CRIDA, Hyderabad.

3. Participatory Integrated Watershed Management: A Field Manual. (TextBook)
Sharda, V.N., A.K. Sikka and G.P. Juyal.; Central Soil and Water Conservation Research and Training Institute, Dehradun.
4. Fundamentals of Watershed Management Technology. (TextBook) Singh, G.D. and T.C. Poonia;
Yash Publishing House, Bikaner

j. Experiment List

Sr. NO.	Experiment List
1	Exercises on 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 functional requirement of watershed development structures.
9	Study of watershed management technologies
10	Practice on software for analysis of hydrologic parameters of watershed.
11	Study of role of various functionaries in watershed development programmes
12	Techno-economic viability analysis of watershed projects.
13	Visit to watershed development project areas.

- a. **Course Name:** Drainage Engineering
- b. **Course Code:** 20103308
- c. **Prerequisite:** Knowledge of irrigation and drainage engineering
- d. **Rationale:** Drainage Engineering is essential for planning effective methods of land utilization
- e. **Course Learning Objective:**

CLOBJ 1	Gain knowledge of drainage systems and their importance.
CLOBJ 2	Design and implement drainage solutions for agricultural land.
CLOBJ 3	Evaluate the impact of drainage on soil and crop productivity.
CLOBJ 4	Implement best practices for drainage engineering.

f. Course Learning Outcomes:

CLO 1	Familiarize with the objectives of drainage and its problems.
CLO 2	Study surface, sub-surface drainage systems.
CLO 3	Discuss drainage materials, structures and economic aspects of drainage.
CLO 4	Design of channels and drains.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Water logging- causes and impacts	6%	1
2	Chapter 2: Drainage, objectives of drainage, familiarization with the drainage problems of the state	6%	1
3	Chapter 3: Surface drainage coefficient, types of surface	8%	1

	drainage		
4	Chapter 4: Design of surface drains	8%	1
5	Chapter 5: Sub-surface drainage: purpose and benefits, investigations of design parameters	10%	2
6	Chapter 6: Hydraulic conductivity, drainable porosity, water table	8%	1
7	Chapter 7: Derivation of Hooghoudt's and Ernst's drain spacing equations	12%	2
8	Chapter 8: Drainage materials, drainage pipes, drain envelope	8%	1
9	Chapter 9: Layout, construction and installation of drains, drainage structures	12%	2
10	Chapter 10: vertical drainage; bio-drainage; mole drains	8%	1
11	Chapter 11: reclamation of saline and alkaline soils, leaching requirements	8%	1
12	Chapter 12: Conjunctive use of fresh and saline water	6%	1
		100%	32

i. Text Book and Reference Book:

1. Principles of Agricultural Engineering Vol-II (TextBook) A M Michael & T P Ojha
2. Land and water management; Principles and Practices (TextBook) V V N Murthy
3. "Drainage Engineering" (Textbook) by James N. Luthin; Wiley.
4. "Drainage Engineering" (Textbook) by S. K. Garg; Khanna Publishers.
5. "Handbook of Agricultural Drainage" (Textbook) by Wesley W. Wallender and J. R. Rydz; CRC Press.

j. Experiment List

Sr. NO.	Experiment List
1	In-situ measurement of hydraulic conductivity by 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 envelope
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 sub-surface drainage system
12	Cost analysis of surface and sub-surface drainage system

- a. **Course Name:** Renewable Power Sources
- b. **Course Code:** 20103309
- c. **Prerequisite:** Basic Knowledge of renewable energy technology
- d. **Rationale:** The subject Renewable Power Sources is essential for generation of energy through various methods
- e. **Course Learning Objective:**

CLOBJ 1	Understand the principles of renewable power sources in agriculture.
CLOBJ 2	Analyze the application of renewable energy in farming.
CLOBJ 3	Evaluate the economic and environmental impact of renewable power sources.
CLOBJ 4	Implement renewable energy solutions in agricultural settings.

f. **Course Learning Outcomes:**

CLO 1	Understand the power generation phenomena from the different sources
CLO 2	Apply various renewable technology for the energy generation
CLO 3	Classify various methods of energy conversion
CLO 4	Describe working of different renewable energy technology.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Energy consumption pattern & energy resources in India. Renewable energy options, potential and utilization.	6%	2
	Chapter 2: Biogas technology and mechanisms, generation of		

2	power from biogas, Power generation from urban, municipal and industrial waste.	18%	6
3	Chapter 3: Design & use of different commercial sized biogas plant	13%	4
4	Chapter 4: Solar thermal and photovoltaic Systems for power generation.	14%	4
5	Chapter 5: Central receiver (Chimney) and distributed type solar power plant, OTEC, MHD, hydrogen and fuel cell technology.	24%	8
6	Chapter 6: Wind farms. Aero-generators. Wind power generation system.	6%	2
7	Chapter 7: Power generation from biomass (gasification & Dendro thermal), Mini and micro small hydel plants.	13%	4
8	Chapter 8: Fuel cells and its associated parameters.	6%	2
		100%	32

i. Text Book and Reference Book:

1. Non-Conventional Energy Sources (TextBook) G D Rai; Khanna Publishers
2. Solar Energy and Utilization (TextBook) G.D. Rai; khanna publishers, New Delhi.1982
3. Biogas Technology - A Practical Hand Book (TextBook) Khandelwal, K. C. and Mahdi, S. S.; Tata McGraw Hill Publishing Co. Ltd., 1983
4. Renewable Energy Resources: basic principle & application (TextBook) Tiwari and Ghosal; NarosaPublication
5. "Fundamentals of Renewable Energy Processes" (Textbook) by Aldo V. da Rosa; Academic Press.

j. Experiment list

Sr. NO.	Experiment List
1	Performance evaluation of solar water heater
2	Performance evaluation of 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 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.

- a. **Course Name:** Employability Skill
- b. **Course Code:** 20193301
- c. **Prerequisite:** learn the importance of soft skills required for professional growth
- d. **Rationale:** Acquiring soft skills, life skills & aptitude skills are crucial for organizational communication as well as for employability respectively.
- e. **Course Learning Objective:**

CLOBJ 1	Develop strong verbal and written communication skills.
CLOBJ 2	Demonstrate the ability to convey ideas clearly and concisely.
CLOBJ 3	Practice professional communication in both individual and group settings.
CLOBJ 4	Utilize communication tools and technologies effectively in a work environment.

f. **Course Learning Outcomes:**

CLO 1	Enhance employability skills of the learners by enabling them to write effective resume
CLO 2	Face the interview with confidence
CLO 3	Develop their managerial communication competence
CLO 4	Facilitate development of good reading & comprehension skills by deepening vocabulary, and refining academic language proficiency.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Who gets the heart? Introductory session for the students about soft-skills and an activity-based session intended to improve students' reasoning and convincing skill.	5%	2

2	Goal Setting: Students will learn to set their short term & long term goal.	5%	2
3	Attention to details: Students will able to capture every minute detail and present the work in a clear, complete, precise and easy to understand language.	7%	2
4	Critical thinking: students will be able to think out-of-the-box to solve various problems and to assess the effectiveness of the opposing argument to test the validity of the proposition.	7%	2
5	Logical reasoning: Students will able to think logically when it comes to their problem solving ability.	5%	2
6	Data arrangement(Analytical reasoning): To help students to acquire skill in analytical reasoning & Implementation of some tricks to do the same.	6%	2
7	Workplace Etiquette.: Students will learn about Dress Etiquette, Cubical Etiquette, Telephone Etiquette.	5%	2
8	Emotional Intelligence: Student will be able to build high IQ after analyzing their IQ.	5%	2
9	Advanced Listening skills: Demonstrate ability to listen more than two minutes audio clips & solve questions based on it.	10%	3
10	Team-Building & Team work: To help students to understand importance of team building & how to work along with team.	10%	2
11	Abstract Reasoning: Students will learn how to measure their abstract reasoning ability & how we can improve the same to reason logically. Generally, abstract reasoning tests measure non-verbal abilities.	10%	2
12	Coding & Decoding (Verbal & non-verbal): Students will learn to improve verbal & non verbal ability to understand how to crack basic puzzles.	5%	2
13	Future Guidance:	5%	2

	(Opportunities after successful completion of dairy technology course)		
14	Personal Interview with Resume: Session based on Personal Interview(Basics), Personal Interview (Advanced), Mock session	15%	5
		100%	32

i. Reference Books:

1. Communication Skills Kumar S and Lata P; New Delhi Oxford University Press
2. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
3. A Remedial English Grammar for Foreign Student F.T. WOOD On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
4. Quantitative Aptitude for Competitive Examinations Dr. R.S. Aggarwal

Semester 6

- a. **Course Name:** Computer Programming and Data Structures
- b. **Course Code:** 20103352
- c. **Prerequisite:** Basic knowledge of fundamentals of programming.
- d. **Rationale:** This subject provides basic knowledge of performance analysis and measurements and implementation of different data structure using programming language.
- e. **Course Learning Objective:**

CLOBJ 1	Acquire proficiency in computer programming languages and concepts.
CLOBJ 2	Develop skills in algorithm design and analysis.
CLOBJ 3	Understand the fundamentals of data structures and their applications.
CLOBJ 4	Demonstrate the ability to write and debug programs for real-world problem-solving.

f. Course Learning Outcomes:

CLO 1	Interpret the computer programming language concepts.
CLO 2	Develop programming skills which require to solve given problem.
CLO 3	Design programs connecting decision structures, loops and functions.
CLO 4	Understand the fundamentals of data structures

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction to high level languages, Primary data types and user defined data types, Variables, typecasting, Operators,	25%	4
2	Building and evaluating expressions, Standard library functions, managing input and output, Decision making	25%	4

3	Branching, Looping, Arrays, User defined functions, passing arguments and returning values, recursion, scope and visibility of a variable	25%	4
4	String functions, Structures and union, Pointers, Stacks, Push/Pop operations, Queues, Insertion and deletion operations, Linked lists.	25%	4
		100%	16

i. Text Book and Reference Book:

1. Computer Oriented Numerical Methods (TextBook) Rajaraman V.; Prentice Hall of India. Pvt. Ltd., New Delhi.
2. Computer Programming in 'C (TextBook) Rajaraman V; Prentice Hall of India Pvt.Ltd., New Delhi.
3. "Introduction to Algorithms" (Textbook) by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein; The MIT Press.
4. "Data Structures and Algorithm Analysis in C++" (Textbook) by Mark A. Weiss; Pearson Education, Inc.
5. "Programming: Principles and Practice Using C++" (Textbook) by Bjarne Stroustrup; Addison-Wesley Professional.

j. Experiment List

Sr. NO.	Experiment List
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 & switch
6	Developing program using loop statements while, do & for
7	Using nested control structures
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 & external variables
13	Using pointers
14	Implementing Stacks
15	Implementing push/pop functions
16	Creating queues
17	Developing linked lists in C language
18	Insertion/Deletion in data structures

- a. **Course Name:** Farm Machinery and Equipment-II
- b. **Course Code:** 20103353
- c. **Prerequisite:** Knowledge of basic engineering, soil science and crop husbandry
- d. **Rationale:** This is one of the basic subjects of the course that deals with the plant protection, harvesting, and threshing equipments/machinery used in the agriculture production system
- e. **Course Learning Objective:**

CLOBJ 1	Gain advanced knowledge of farm machinery and equipment.
CLOBJ 2	Develop skills in the selection, operation, and maintenance of specialized farm equipment.
CLOBJ 3	Analyze and optimize the use of farm machinery for different agricultural tasks.
CLOBJ 4	Implement safety measures in the operation of advanced farm machinery.

f. **Course Learning Outcomes:**

CLO 1	Explain the principles and types of cutting machines.
CLO 2	Understand the mechanisms of harvesting machines.
CLO 3	Discuss the selection of farm machines.
CLO 4	Utilize various codes for testing the farm machinery.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Introduction to plant protection equipment ± sprayers and dusters. Classification of sprayers and sprays. Types of nozzles.	6%	2
2	Chapter 2: Calculations for calibration of sprayers and chemical application rates.	6%	2

3	Chapter 3: Introduction to interculture equipment. Use of weeders ± manual and powered. Study of functional requirements of weeders and main components.	6%	2
4	Chapter 4: Familiarization of fertilizer application equipment.	3%	1
5	Chapter 5: Study of harvesting operation ± harvesting methods, harvesting terminology. Study of mowers ± types, constructional details, working and adjustments.	9%	3
6	Chapter 6: Study of shear type harvesting devices ± cutter bar, inertial forces, counter balancing, terminology, cutting pattern. Study of reapers, binders and windrowers ± principle of operation and constructional details	12%	4
7	Chapter 7: Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay.	9%	3
8	Chapter 8: Introduction to threshing systems ± manual and mechanical systems. 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.	13%	4
9	Chapter 9: Study of grain combines, combine terminology, classification of grain combines, study of material flow in combines. Computation of combine losses, study of combine troubles and troubleshooting.	13%	4
10	Chapter 10: Study of chaff cutters and capacity calculations. Study of straw combines ± working principle and constructional details. Study of root crop diggers ± principle of operation, blade adjustment and approach angle, and calculation of material handled.	13%	4
11	Chapter 11: Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Introduction to vegetables and fruit harvesting equipment and tools.	10%	3

		100%	32
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i. Reference Books:

1. Principle of farm machinery (TextBook) R.A. Kepner, Roy Bainer & E.L. Berger
2. Farm Machinery & Equipment (TextBook) H.P. Smith & L.H. Wilkey
3. Farm Machinery (TextBook) Claude Culpin Granada
4. Elements of farm machinery (TextBook) A.C. Srivastava

j. Experiment List

Sr. NO.	Experiment List
1	Study of sprayers, & dusters, and Calculations for chemical application rates
2	Familiarization with manual and powered weeding equipment and identification of functional components
3	Study of fertilizer application equipment including manure spreaders and fertilizer broadcasters.
4	Study of various types of mowers, reaper, reaper-binder. Study of functional components of mowers and reapers.
5	Familiarization with threshing systems, cleaning systems in threshers.
6	Familiarization with functional units of Grain combines and their types.
7	Calculations of losses in threshers and combines
8	Study of root crop diggers and familiarization with the functional units and attachments.
9	Familiarization with the working of cotton and maize harvesters.
10	Familiarization with vegetable and fruit and fodder harvesters

- a. **Course Name:** Post Harvest Engineering of Horticultural Crops
- b. **Course Code:** 20103354
- c. **Prerequisite:** Knowledge of Engineering properties of Biological material
- d. **Rationale:** Fruits and Vegetables processing Industries play an important role in Indian economy. The knowledge on fruits and vegetables post-harvest operation is highly required for the students and processors to reduce post-harvest losses, to prepare value added products, packaging, preservation and quality attributes.

e. Course Learning Objective:

CLOBJ 1	Understand the unique post-harvest engineering requirements for horticultural crops.
CLOBJ 2	Learn techniques for the handling, storage, and processing of horticultural products.
CLOBJ 3	Evaluate and implement post-harvest technologies specific to horticultural crops.
CLOBJ 4	Implement quality control measures in post-harvest engineering for horticultural crops.

f. Course Learning Outcomes:

CLO 1	Establish small scale food processing Industries and can become a small entrepreneur
CLO 2	Develop some new quality products also and can export it.
CLO 3	Plan of new Food processing Industries will be increased in the cluster where raw products are available
CLO 4	Understand different engineering properties of horticultural crops

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Importance of processing of fruits and vegetables, spices, condiments and flowers.	8%	3
2	Chapter 2: Characteristics and properties of horticultural crops important for processing	8%	3
3	Chapter 3: Peeling: Different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling, and thermal peeling), 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),	24%	8
4	Chapter 4: 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	48%	14
5	Chapter 5: Equipment for chilling and freezing (mechanical & cryogenic	12%	4
		100%	32

i. Text Book and Reference Book:

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

J. Experiment List:

Sr. NO.	Experiment List
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 product
9	Visit to fruit and vegetable processing industry
10	Visit to spice processing plant.

- a. **Course Name:** Water Harvesting and Soil Conservation Structures
- b. **Course Code:** 20103355
- c. **Prerequisite:** Knowledge of soil and water conservation measures
- d. **Rationale:** The knowledge of soil and water conservation structure and water harvesting is very essential for Agricultural Engineer
- e. **Course Learning Objective:**

CLOBJ 1	Understand the principles and methods of water harvesting.
CLOBJ 2	Gain knowledge of soil conservation structures and their design.
CLOBJ 3	Analyze the impact of water harvesting and soil conservation on agricultural productivity.
CLOBJ 4	Design and implement water harvesting and soil conservation structures for sustainable farming.

f. **Course Learning Outcomes:**

CLO 1	Introduce and classify water harvesting structures.
CLO 2	Study flow in open channels, runoff measuring structures.
CLO 3	Design drop structures, drop inlet and chute spillway.
CLO 4	Estimate costs of hydraulic structures.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Water harvesting -principles, importance and issues. Water harvesting techniques - classification based on source, storage and use. Runoff harvesting ± short-term and long-term techniques.	6%	2
	Chapter 2: Short-term harvesting techniques - terracing and	7%	2

2	bunding, rock and ground catchments. Long term harvesting techniques - purpose and design criteria.		
3	Chapter 3: Structures - farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes. Farm pond- components, site selection design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction.	18%	6
4	Chapter 4: Percolation pond - site selection, design and construction details. Design considerations of nala bunds	10%	3
5	Chapter 5: Soil erosion control structures - introduction, classification and functional requirements.	3%	1
6	Chapter 6: 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. Hydraulic jump and its application.	18%	6
7	Chapter 7: 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.	10%	3
8	Chapter 8: Loads on head wall, variables affecting equivalent fluid pressure, triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.	10%	3
9	Chapter 9: 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.	18%	6
		100%	32

i. Text Book and Reference Book:

1. Water Harvesting and Recycling: Indian Experiences (TextBook)
Samra, J.S., V.N. Sharda and A.K. Sikka; CSWCR&TI, Dehradun, Allied Printers
2. Rainwater Harvesting for Agriculture in the Dry Areas. (TextBook)
Theib Y. Oweis, Dieter Prinz and Ahmed Y. Hachum.; CRC Press, Taylor and Francis Group, London
3. Principles of Agricultural Engineering Vol-II (TextBook) A M Michael & T P Ojha
4. Land and water management; Principles and Practices (TextBook) V V N Murthy
5. Soil and water Conservation Engineering (TextBook) R Suresh

j. Experiment List

Sr. NO.	Experiment List
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 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 softwares for design of soil and water conservation structures.
13	Field visit to watershed project areas treated with soil and water conservation measures / structures.

- a. **Course Name:** Groundwater, Wells and Pumps
- b. **Course Code:** 20103356
- c. **Prerequisite:** Knowledge of Irrigation, Watershed hydrology.
- d. **Rationale:** Ground Water Wells and Pump knowledge is essential for Agricultural Engineers for design of various irrigation systems
- e. **Course Learning Objective:**

CLOBJ 1	Gain knowledge of groundwater resources and their importance in agriculture.
CLOBJ 2	Understand the design and maintenance of wells and pumps for efficient water utilization.
CLOBJ 3	Analyze the principles of groundwater management.
CLOBJ 4	Evaluate the environmental and economic aspects of groundwater use in agriculture.

f. **Course Learning Outcomes:**

CLO 1	Understand about ground water, aquifer and its types.
CLO 2	Study about Ground water hydraulics.
CLO 3	Analyze Pump selection, installation.
CLO 4	Explain the utilities of special purposes.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: Occurrence and movement of ground water; aquifer and its types;	7%	2

2	Chapter 2: classification of wells, fully penetrating tubewells and open wells, familiarization of various types of bore wells;	7%	2
3	Chapter 3: design of open wells	7%	2
4	Chapter 4: groundwater exploration techniques	4%	1
5	Chapter 5: methods of drilling of wells: percussion, rotary, reverse rotary;	8%	3
6	Chapter 6: design of tubewell and gravel pack, installation of well screen, completion and development of well;	10%	3
7	Chapter 7: groundwater hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow's, Theis recovery method;	8%	3
8	Chapter 8: well interference, multiple well systems, estimation of ground water potential, quality of ground water;	7%	2
9	Chapter 9: artificial groundwater recharge techniques	4%	1
10	Chapter 10: pumping systems: water lifting devices; different types of pumps, classification of pumps,	6%	2
11	Chapter 11: component parts of centrifugal pumps, priming, pump selection, installation and trouble shooting	8%	2
12	Chapter 12: performance curves, effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics;	10%	3
13	Chapter 13: hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristic	7%	2
14	Chapter 14: deep well turbine pump and submersible pump.	7%	2
		100%	32

i. Text Book and Reference Book:

1. Water Well and Pumps (TextBook) Michael AM, Khepar SD. and SK Sondhi; Tata Mc-Graw Hill
2. Groundwater Hydrology (TextBook) Todd David Keith and Larry W. Mays.; John Wiley & Sons, New York; 3rd Edition
3. Principles of Agricultural Engineering Vol-II (TextBook) A M Michael & T P Ojha
4. "Groundwater Science" (Textbook) by Charles R. Fitts; Academic Press.
5. "Groundwater Hydrology" (Textbook) by David Keith Todd and Larry W. Mays; John Wiley & Sons, Inc.

j. Experiment List

Sr. NO.	Experiment List
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 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
10	Estimating ground water balance
11	Study of artificial ground water recharge structures
12	study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pump turbine, propeller and other pumps
13	Installation of centrifugal pump
14	Testing of centrifugal pump and study of cavitations
15	Study of hydraulic ram
16	Study and testing of submersible pump

- a. **Course Name:** Tractor and Farm Machinery Operation and Maintenance
- b. **Course Code:** 20103357
- c. **Prerequisite:** The knowledge of Farm Power and Farm Machinery is necessary
- d. **Rationale:** The skill and knowledge of Tractor and Farm Machinery Operation and Maintenance acquired by the students will enable them to handle the farm machinery efficiently.
- e. **Course Learning Objective:**

CLOBJ 1	Develop skills in the safe and efficient operation of tractors and farm machinery.
CLOBJ 2	Gain knowledge of routine maintenance and troubleshooting of agricultural machinery.
CLOBJ 3	Understand the principles of tractor and machinery safety.
CLOBJ 4	Demonstrate proficiency in the operation and maintenance of various farm equipment.

f. Course Learning Outcomes:

CLO 1	Describe rainfall measurement in detail.
CLO 2	Discuss estimation and measurement of various hydrological parameters.
CLO 3	Study geomorphology of watersheds.
CLO 4	Understand runoff and flood control methods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	4	2	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List

Sr. NO.	Experiment List
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. Safety rules and precautions to be

	observed while driving a tractor.
5	Driving practice of tractor.
6	Practice of operating a tillage tool (mould-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. Driving practice with a trail type trolley $\pm$ forward and in reverse direction.
9	Introduction to tractor maintenance $\pm$ precautionary and break-down maintenance.
10	Tractor starting with low battery charge.
11	Introduction to trouble shooting in tractors. Familiarization with tools for general and special maintenance.
12	Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation. Safety hints. Top end overhauling. Fuel saving tips.
13	Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off- season.
14	Repair and maintenance of implements $\pm$ adjustment of functional parameters in tillage implements. Replacement of broken components in tillage implements. Replacement of furrow openers and change of blades of rotavators.
15	Maintenance of cutter bar in a reaper. Adjustments in a thresher for different crops. Replacement of V-belts on implements. Setting of agricultural machinery workshop.

i. Text Book and Reference Book:

1. Engineering Hydrology (TextBook) K. Subramanya; Tata McGraw Hill Pub. Co. New Delhi
2. Hydrology and Soil Conservation Engineering: Including Watershed Management (TextBook)
3. "Tractor and Farm Equipment Maintenance" (Textbook) by M.R. Lindeburg; Professional Publications, Inc.
4. "Tractor and Farm Machinery Operation and Maintenance" (Textbook) by Ken Hellevang and Dennis R. Buckmaster; MidWest Plan Service, Iowa State University.
5. "Farm Machinery and Equipment" (Textbook) by Harry A. Cole and John W. Dickey; Wiley.

- a. **Course Name:** Dairy and Food Engineering
- b. **Course Code:** 20103358
- c. **Prerequisite:** Knowledge of basic food processing techniques
- d. **Rationale:** Knowledge of Dairy and Food Engineering is essential for Agricultural Engineers
- e. **Course Learning Objective:**

CLOBJ 1	Understand the principles of dairy and food engineering.
CLOBJ 2	Gain knowledge of dairy processing and food preservation techniques.
CLOBJ 3	Analyze the design and operation of dairy and food processing equipment.
CLOBJ 4	Implement quality control measures in dairy and food engineering.

f. Course Learning Outcomes:

CLO 1	Understand different concepts of dairy processing plant
CLO 2	acquire the knowledge of different processes and products of dairy industry
CLO 3	Identify scope of food process engineering
CLO 4	Classify the different food preservation method

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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,	25%	8
2	regulation of nanotechnology. Dairy development in India, Engineering, thermal and chemical properties of	25%	8

	milk and milk products, Process flow charts for product manufacture, Unit operation of various dairy and food processing systems. Principles and equipment related to receiving of milk pasteurization, sterilization, homogenization, centrifugation and cream separation.		
3	Preparation methods and equipment for 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, Aseptic processing, Evaporation of food products: principle, types of evaporators, steam economy, multiple effect evaporation, vapour recompression,	25%	8
4	Drying of liquid and perishable foods: principles of drying, spray drying, drum drying, freeze drying, Filtration: principle, types of filters; Membrane separation, RO, Nano-filtration, Ultra filtration and Macro-filtration, equipment and applications, Non-thermal and other alternate thermal processing in Food processing.	25%	8
		100%	32

i. Text Book and Reference Book:

1. Fundamentals of Food Engineering. (TextBook) Rao, D.G; PHI learning Pvt. Ltd. New Delhi
2. Introduction to Food Engineering (TextBook) Singh, R.P. & Heldman, D.R; Academic Press
3. Dairy Plant Engineering and Management (TextBook) Ahmed, T; 4th Ed. Kitab Mahal.
4. Unit Operations of Chemical Engineering (TextBook) McCabe, W.L. and Smith, J. C; McGraw Hill

j. Experiment List

Sr. NO.	Experiment List
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 freezers
9	Study of filtration
10	Design of food processing plants & preparation of layout
11	Visit to multi-product dairy plant
12	Estimation of steam requirements
13	Estimation of refrigeration requirements in dairy & food plant
14	Visit to Food industry

- a. **Course Name:** Bio-energy Systems: Design and Applications
- b. **Course Code:** 20103359
- c. **Prerequisite:** Basic knowledge of Renewable Energy
- d. **Rationale:** Bio-energy Systems: Design and Applications subject knowledge for designing biogas plant and gasifier.
- e. **Course Learning Objective:**

CLOBJ 1	Gain knowledge of bio-energy systems and their applications.
CLOBJ 2	Understand the design and optimization of bio-energy production processes.
CLOBJ 3	Analyze the environmental and economic impact of bio-energy systems.
CLOBJ 4	Implement bio-energy solutions in agricultural and rural settings.

f. **Course Learning Outcomes:**

CLO 1	Understand the prerequisites of biofuel utilisation (processes and equipment) and investigate.
CLO 2	Analyse, design and select energy conversion processes for different applications, taking technological, economic, environmental and societal aspects into account.
CLO 3	Study the biomass preparation techniques.
CLO 4	Discuss process and application of gasification.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Chapter 1: 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.	25%	8

2	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. Biomass preparation techniques for harnessing (size reduction, densification and drying). Thermochemical degradation.	25%	8
3	History of small gas producer engine system. Chemistry of gasification. Gas producer ± type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas. Application, shaft power generation, thermal application and economics.	25%	8
4	Transesterification for biodiesel production. A range of bio-hydrogen production routes. Environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.	25%	8
		100%	32

i. Text Book and Reference Book:

1. Anaerobic digestion of farm and food processing practices- Good practice guidelines (TextBook) British BioGen
2. Renewable Energy Academy: Training wood energy professionals (TextBook) Butler, S
3. Straw for energy production; Technology- Environment Ecology (TextBook) Centre for biomass energy
4. "Bioenergy: Biomass to Biofuels" (Textbook) by Anju Dahiya; CRC Press.
5. "Bioenergy: Principles and Applications" (Textbook) by Yebo Li; John Wiley & Sons, Inc.

j. Experiment List

Sr. NO.	Experiment List
1	Study of anaerobic fermentation system for 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 bio energy 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, Striling and Rankine cycles
10	Study of modern greenhouse technologies.

- a. **Course Name:** Innovation and Entrepreneurship
- b. **Course Code:** 203100357
- c. **Prerequisite:** Knowledge of 12th science level.
- d. **Rationale:** Innovation and Entrepreneurship in B Tech empowers students to drive advancements in dairy processes while fostering a mindset for entrepreneurial ventures in the dynamic dairy industry.
- e. **Course Learning Objective:**

CLOBJ 1	Innovation and Entrepreneurship in B Tech Dairy Technology empowers students to drive advancements in dairy processes while fostering a mindset for entrepreneurial ventures in the dynamic dairy industry.
CLOBJ 2	Acquire the skills necessary to identify and assess opportunities for entrepreneurial ventures within the dairy industry, including market analysis, business planning, and financial management.
CLOBJ 3	Foster a creative and innovative mindset by engaging in hands-on projects and case studies that encourage students to explore novel solutions to challenges in dairy technology, thereby promoting a culture of continuous improvement
CLOBJ 4	Cultivate effective communication and collaboration skills to work within interdisciplinary teams.

f. Course Learning Outcomes:

CLO 1	Study the concept of entrepreneurship development, globalization and the emerging business/ entrepreneurial environment
CLO 2	Acquire the knowledge of SWOT analysis and recognize the policies of Export and import relevant to dairy sector.
CLO 3	Acquire the knowledge of SWOT analysis and recognize the policies of Export and import relevant to dairy sector.
CLO 4	Recruitment and training of manpower and compose the feasibility reports.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	0	2	40	10	-	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Innovation and Entrepreneurship: Definition, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, covers the various stages of setting up and growing an entrepreneurial firm	16%	5
2	Design Thinking: Design Thinking, Design-Driven Innovation, TRIZ (Theory of Inventive Problem Solving), Double diamond theory	16%	5
3	Ideation: Ideation, Opportunity Identification, factors determining competitive advantage, Market segment, market structure, Idea validation.	16%	5
4	Value Proposition: Value proposition, Business Model Canvas, Lean Canvas Model, developing an Effective Business Model.	20%	7
5	Testing, Validation, and Commercialization: Testing, Validation, and Commercialization; covers the concepts of Minimum viable Product (MVP)	16%	5
6	Technological Innovation and Entrepreneurship: Technological Innovation and Entrepreneurship; focusses on technology as a key driver of successful start-up and sustainable ramp up.	16%	5
		100%	32

Semester 8

- a. Course Name:** Tractor Design and Testing
- b. Course Code:** 20103484
- c. Prerequisite:** Basic knowledge of Tractor and their different systems
- d. Rationale:** Design and testing of tractor for various field conditions
- e. Course Learning Objective:**

CLOBJ 1	Identify and comprehend the key components of a tractor. Analyze the testing procedures involved in assessing the performance and functionality of tractors.
CLOBJ 2	Acquire knowledge of tractor design principles and engineering concepts. Develop skills in drafting and designing tractor models using appropriate software.
CLOBJ 3	Understand the fundamentals of entrepreneurship in the context of small-scale tractor industries. Learn to create a business plan for a small-scale tractor industry.
CLOBJ 4	Gain insights into the challenges and opportunities of entrepreneurship in the tractor industry. Develop skills in business management, financial planning, and marketing specific to small-scale tractor enterprises.

f. Course Learning Outcomes:

CLO 1	Test components of tractor and machinery
CLO 2	Design and develop tractor and its component
CLO 3	Plan small scale tractor Industries and can become a small entrepreneur
CLO 4	Design Ackerman Steering and tractor hydraulic steering

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30		20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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.	25%	8
2	Design of mechanical power transmission in agricultural tractors: single disc, multi disc and cone clutches. Rolling friction and anti-friction bearings.	25%	8
3	Design of Ackerman Steering and tractor hydraulic steering.	25%	8
4	Study of special design features of tractor engines and their selection viz. cylinder, piston, piston pin, crankshaft, etc. Design of seat and controls of an agricultural tractor. Tractor Testing.	25%	8
		100%	32

i. Text Book and Reference Book:

1. Tractors & their power units J.B. Liljedahl, P.K. Turnquist, D.W. Smith MakotaHoki,
2. Internal Combustion Engines V. Ganesan; Tata McGraw Hill Book Co.
3. Automobile Engineering Vol- I & II Dr. Kirpal Singh; Standard Pub.& Dist
4. "Tractor and Automotive Engines" (Textbook) by R. K. Rajput; S. Chand & Company Ltd.
5. "Tractor Design and Testing" (Textbook) by Harish C. Rayudu; PHI Learning Pvt. Ltd.

j. Experiment List

Sr. NO.	Experiment List
1	Design problem of tractor clutch $\pm$ (Single/ Multiple disc clutch).
2	Design of gear box (synchromesh/constant mesh), variable speed constant mesh drive.
3	Selection of tractor tires $\pm$ Problem solving.
4	Problem on design of governor.
5	Design and selection of hydraulic pump.
6	Engine testing as per BIS code.
7	Drawbar performance in the lab; PTO test and measure the tractor power in the lab/field.

8	Determining the turning space, turning radius and brake test
9	Hydraulic pump performance test
10	Air cleaner and noise measurement test
11	Visit to tractor testing centre/industry

- a. Course Name:** Food Packaging Technology
- b. Course Code:** 20103489
- c. Prerequisite:** Basic knowledge of Agricultural Process Engineering
- d. Rationale:** Food Packaging Technology subject knowledge is used for different packaging material of food products
- e. Course Learning Objective:**

CLOBJ 1	Explore the economic, environmental, and consumer-driven reasons influencing the rise in food packaging. Analyze historical and contemporary trends in food packaging to identify key drivers.
CLOBJ 2	Examine the primary objectives of food packaging, including preservation, protection, and marketing. Investigate various methods of food packaging, such as vacuum sealing, modified atmosphere packaging, and aseptic packaging.
CLOBJ 3	Explore printing technologies used in food packaging, including flexography, gravure, and digital printing. Examine labelling techniques and their role in providing information to consumers, ensuring compliance, and enhancing product visibility.
CLOBJ 4	Understand the properties of different packaging materials, such as plastics, glass, and metals. Develop the ability to assess the compatibility of packaging materials with specific food products based on factors like shelf life, sensory attributes, and safety.

f. Course Learning Outcomes:

CLO 1	justify the reasons why the food packaging is increased.
CLO 2	Invent and modify methods of food packaging.
CLO 3	Plan different methods of packaging printing and labelling.
CLO 4	Formulate suitability of packaging material for a particular type of food.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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, 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,	25%	8
2	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, 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.	25%	8
3	Relative advantages and disadvantages of different packaging materials; effect of these materials on packed commodities. 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	25%	8
4	Package testing: Testing methods for flexible materials, rigid materials and semi rigid materials; 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.).	25%	8
		100%	32

i. Text Book and Reference Book:

1. Postharvest management of Horticultural Crops araswathy, S., T.L. Preethi, S. Balasubramanyan, J. Suresh, N. Revathy and S. Natarajan
2. Horticulture in India Bansal. P.C
3. Engineering properties of foods Rao M. A. and SH Rizv
4. Food Packaging Science and Technology" (Textbook) by Dong Sun Lee; CRC Press.
5. "Food Packaging: Principles and Practice" (Textbook) by Gordon L. Robertson; CRC Press.
6. "Handbook of Food Packaging" (Textbook) edited by André Le Bail and Jean-Pierre P. Meullenet; CRC Press.

j. Experiment List

Sr. NO.	Experiment List
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
4	Vacuum packaging of agricultural produces
5	Determination of tearing strength of paper board
6	Measurement of thickness of packaging materials
7	To perform grease resistance test in plastic pouches
8	Determination of bursting strength of packaging material
9	Determination of water-vapour transmission rate
10	Shrink wrapping of various horticultural produce
11	Testing of chemical resistance of packaging materials
12	Determination of drop test of food package
13	visit to relevant industries

- a. Course Name:** Landscape Irrigation Design and Management
- b. Course Code:** 20103478
- c. Prerequisite:** Basic knowledge of Irrigation Engineering
- d. Rationale:** Design and Management of Landscape Irrigation in orchard, hilly etc. farming
- e. Course Learning Objective:**

CLOBJ 1	Compare and contrast the advantages and disadvantages of various irrigation methods. Gain practical knowledge about the installation and operation of common irrigation systems.
CLOBJ 2	Learn the principles behind calculating crop water requirements. Understand factors influencing crop water needs, such as plant type, soil conditions, and climate.
CLOBJ 3	Develop the ability to assess the irrigation needs of a given landscape. Acquire skills to analyze site-specific factors influencing irrigation system design.
CLOBJ 4	Understand the role of pumps in irrigation systems. Learn the criteria for selecting an appropriate pump for different landscapes.

f. Course Learning Outcomes:

CLO 1	Choose various irrigation systems for landscape.
CLO 2	Estimate the crop water requirement.
CLO 3	Recommend and design suitable irrigation system for landscape.
CLO 4	Recommend a suitable pump and calculate its power requirement.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
2	-	2	3	30		20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Conventional method of landscape irrigation- hose irrigation system, quick release coupling system and portable sprinkler with hose pipes; Modern methods of landscape irrigation- pop-up sprinklers, spray popup sprinkler, shrub adopter, drip irrigation and bubblers;	25%	8
2	Merits and demerits of conventional and modern irrigation systems, types of landscapes and suitability of different irrigation methods, water requirement for different landscapes, Segments of landscape irrigation systems	25%	8
3	Main components of modern landscape irrigation systems and their selection criteria; Types of pipes, pressure ratings, sizing and selection criteria	25%	8
4	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	25%	8
		100%	32

i. Text Book and Reference Book:

1. "Landscape Irrigation: Design and Management" by Pete Melby and Phil Burkart; Delmar Cengage Learning.
2. "Irrigation Principles and Practices" by Martin Burton; Pearson.
3. "Landscape Irrigation Design Manual" by Rain Bird Corporation; Rain Bird Corporation.
4. "Practical Design and Management of Small-Scale Irrigation in Eastern Africa" by Japhet Kashaigili and Johannes Wessels; IWMI.
5. "Handbook of Landscape Irrigation" by Nelson A. Ngwa; CRC Press.

j. Experiment List

Sr. No.	Experiment List
1	Study of irrigation equipments for landscapes
2	Design and installation of irrigation system for landscape, determination of water requirement.
3	Determination of power requirement, pump selection.
4	Irrigation scheduling of landscapes, Study of irrigation controllers and other equipments
5	Use of AutoCAD in irrigation design: blocks & symbols, head layout, zoning and valves layout, pipe sizing, Pressure calculations etc.

6	Visit to landscape irrigation system and its evaluation
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