Course code	**Math (E)-101**
Course title	**Engineering Mathematics-I**
Corse credit	**3(2+1)**
Objective of Course	1. The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. 2. He syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. 3. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding the problem of agricultural engineering.
Course Content	**Differential calculus:** Taylor's and Maclaurin's expansions; indeterminate form; curvature, asymptotes, tracing of curves, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, derivative of an implicit function, change of variables, Jacobians, error evaluation, maxima and minima. **Integral calculus:** Reduction formulae; rectification of standard curves, volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration, Gamma and Beta functions, application of double and triple integrals to find area and volume. **Ordinary differential equations:** Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation, Differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel's and Legendre's differential equations. **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).
References:	
Course Outcomes	At the end of the course, learners will be able **CO1**: Use both the limit definition and rules of differentiation to differentiate functions, apply L'Hospital's rule to solve indeterminate forms. **CO2**: Apply partial differentiation to solve maxima and minima problems. **CO3:** Apply integration to compute multiple integrals, area, volume, and integrals in polar coordinates, in addition to change of order and change of variables. **CO4:** Apply various techniques in solving differential equations. **CO5:** Apply vector calculus to solve steady state flow problems.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															
Avg.															

Course code	**Phy(E)-101**
Course title	**Engineering Physics**
Corse credit	**3 (2 + 1)**
Objective of Course	1. To develop a conducive environment for technical education and research with expertise in engineering problem-solving approaches in agriculture and allied sectors with adequate knowledge and skill. 2. To enhance the ability and promote all-round development of the students for formulating solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies and to create a sense of social responsibility. 3. To strengthen Industry-Institution linkage with leading national and international institutions, R&D organizations and professional bodies along with other stakeholders, for promoting techno-entrepreneurship among students.
Course Content	**Course content:** **Theory:** Dia, Para and ferromagnetism-classification. Langevin theory of dia and paramagnetism. Adiabatic demagnetization. Weiss molecular field theory and ferromagnetism. Curie-Weiss law. Wave particle quality, de-Broglie concept, uncertainty principle. Wave function. Time dependent and time independent Schrodinger wave equation, Qualitative explanation of Zeeman effect, Stark effect and Paschan Back effect, Raman spectroscopy. Statement of Bloch's function. Bands iii solids, velocity of Bloch's electron and effective mass. Distinction between metals. insulators and semiconductors. Intrinsic and extrinsic semiconductors, law of mass action. Determination of energy gap in semiconductors. Donors and acceptor levels. Superconductivity, critical magnetic field. Meissner effect. Isotope effect. Type-I and II superconductors, Josephson's effect DC and AC, Squids. Introduction to high Tc superconductors. Spontaneous and stimulated emission, Einstein A and B coefficients. Population inversion, He-Ne and Ruby lasers. Ammonia and Ruby masers, Holography-Note. Optical fiber. Physical structure. basic theory. Mode type, input output characteristics of optical fiber and applications. Illumination: laws of illumination, luminous flux, luminous intensity, candle power, brightness. **Practical:** To find the frequency of A.C. supply using an electrical vibrator; To find the low resistance using Carey Foster bridge without calibrating the bridge wire; To determine dielectric constant of material using De Sauty's bridge; To determine the value of specific charge (e/m) for electrons by helical method; To study the induced e.m.f. as a function of velocity of the magnet; To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities; To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil; To determine the energy band gap in a semiconductor using a p-n Junction diode; To determine the slit width from Fraunhofer diffraction pattern using laser beam; To find the numerical aperture of optical fiber: To set up the fiber optic analog and digital link; To study the phase relationships in L.R. circuit; To study LCR circuit; To study the variations of thermo emf of a copper-constantan thermo-couple with temperature; To find the wave length of light by prism.
References:	1. Brijlal and Subrahmanyam. Text Book of optics. S. Chand and Co., New Delhi. 2. Sarkar Subir Kumar. Optical State Physics and Fiber Optics. S. Chand and Co., New Delhi. 3. Gupta S L, Kumar V Sharma R C. Elements of Spectroscopy. Pragati Prakasam, Meeruth. 4. Saxena B S and Gupta R C. Solid State Physics. Pragati Prakasam, Meeruth. 5. Srivastava B N. Essentials of Quantum Mechanics. Pragati Prakasam, Meeruth. 6. Vasudeva D N. Fundamentals of Magnetism and Electricity. S. Chand and Co., New Delhi.
Course Outcomes	At the end of the course, learners will be able to **CO1**: Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems. **CO2**: Understand measurements technology, usage of new instruments and real time applications in engineering studies. **CO3:** Identifying and applying relevant physical laws and principles to problems.

	CO4: Developing models and articulating relevant assumptions, approximations, and limitations. **CO5**: Applying mathematical, statistical, and computational skills to develop solutions and Evaluating, assessing, and interpreting their results.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**Chem(E)-101**
Course title	**Engineering Chemistry**
Corse credit	**3(2+1)**

Objective of Course

1. To familiarize the students with the three main types of particle size, especially colloidal size and how their physical properties changes with size and different dispersion systems.
2. To inculcate sound understanding of water quality parameters and disadvantages of hard water in industry as well as domestic use.
3. To impart knowledge on the types of lubricant and its functions.
4. To introduce the basic concepts and applications of phase rule and composites.
5. To facilitate the understanding of important characteristics of fuels, their properties and drawbacks of different types of fuels.
6. To introduce basic introduction to main components of Food chemistry, their classification, importance and deficiency diseases.
7. To impart knowledge on Corrosion-Its causes, types and methods of prevention.

Course Content

Theory:

Course content :

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

Practical:

Determination of temporary and permanent hardness of water by EDTA method: Estimation of chloride in water: Estimation of dissolved oxygen in water: Determination of BOD in water sample: Determination of COD in water sample: Estimation of available chlorine in bleaching powder: Determination of viscosity of oil: Estimation of activity of water sample: Estimation of alkalinity of water sample: Determination of carbonate and non- carbonate hardness by soda reagent:

Determination of coagulation of water and chloride ion content: Determination of specific rotation of an optically active compound: Determination of Xnax and verification of Beer Lambert Law: Determination of calorific value of fuel: Identification of functional groups (alcohol, aldelyde, ketones, carboxylic acid and amide) by IR:Chromatographic analysis: Determination of molar refraction of organic compounds.

References:

Jain P L and Jain M. 1994. Engineering Chemistry. Danpat Rai publishing company Pvt. Ltd., Delhi.

Bahl B S, Arun Bahl and Tuli B D. 2007. Essentials of Physical Chemistry. S.Chand and Co. Ltd., Delhi

Course Outcomes	At the end of the course, learners will be able **CO1**: To analyse the quality of water samples with respect to their hardness, acidity, alkalinity and DO. **CO2**: Ability to Identify various functional group (alcohol, aldelyde, ketones, carboxylic acid and amid) by IR. **CO3:**Develop familiarity with the basic food components like Vitamins, Carbohydrates, Proteins ,Enzymes **CO4**: Ability to differentiate different types of polymers and its applications in day to day use and industrial applications. **CO5**:To judge the quality of fuel.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP-101**
Course title	**Workshop Practice**
Corse credit	**0+1**
Objective of Course	1. To provide opportunities to develop practical skills in mechanical engineering through hands-on workshop activities. 2. To develop understanding of safety protocols and practices within a workshop environment. 3. To facilitate the application of theoretical concepts learned in the classroom to real-world scenarios. 4. To encourage work collaboratively on projects that simulate real engineering challenges, promoting problem-solving skills and creative thinking in a hands-on setting.
Course Content	The subject is completely based on Practical. The theoretical topic will be discussed in the Practical classes before assigning the Practical jobs of Carpentry shop, Smithy shop, Fitting shop, Welding and Sheet metal shop.
References:	1. Workshop Technology Vol. I & II , By: S.K. Hajra Chaudhary 2. Workshop Technology , By: Chapman 3. Workshop Technology , By: S.K. Gupta 4. Manufacturing Technology, By: S. Dalela
Course Outcomes	At the end of the course, learners will be able **CO1**: **Enhanced Practical Skills:** Graduates will demonstrate enhanced practical skills in mechanical engineering, having successfully participated in hands-on workshop activities that involve the use of tools, machines, and materials commonly used in the field. **CO2**: **Commitment to Workshop Safety:** Students will exhibit a commitment to workshop safety, applying acquired knowledge and habits to create a secure working environment when utilizing tools and equipment in various mechanical engineering applications. **CO3: Effective Application of Theoretical Knowledge:** Graduates will showcase the ability to effectively apply theoretical knowledge gained in the classroom to real-world scenarios, demonstrating a practical understanding of mechanical engineering principles. **CO4: Project-Based Problem Solving:** Students will exhibit proficiency in project-based problem-solving, having engaged in collaborative projects that simulate real engineering challenges, emphasizing creative thinking and practical application of engineering concepts in a workshop setting.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**RE-101**
Course title	**Applied Electronics and Instrumentation**
Corse credit	**3 (2+1)**
Objective of Course	1. To understand the mechanisms of current flow in semi-conductors. 2. To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application. 3. To provide information on the basics of Electronic Measurements. 4. To include specialized information needed for Analog and Digital Instrumentation. 5. To exploit an instrument's potential, to be aware of its limitations.
Course Content	**Theory:** Semiconductors, PN junction, V-I characteristics of PN junction, diode as a circuit element, rectifier, clipper, clamper, voltage multiplier, capacitive filter, diode circuits for OR & AND (both positive and negative logic), bipolar junction transistor: operating point, classification(A,B & C) of amplifier, various biasing methods (fixed, self, potential divider), h-parameter model of a transistor, analysis of small signal CE amplifier, phase shift oscillator, analysis of differential amplifier using transistor, ideal OP-AMP characteristics, linear and non-linear applications of OPAMP (adder, subtractor, integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator), zener diode voltage regulator, transistor series regulator, current limiting, OP-AMP voltage regulators, Basic theorem of Boolean algebra, Combinational logic circuits(basic gates, SOP rule and K-map), 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, bounden tube, LVDT, strain gauge and tacho-generator. **Practicals:** To study V-I characteristics of PN junction diode; To study Half wave, full wave and Bridge Rectifier; To study transistor characteristics in CE configurations; To design study fixed and self-bias transistor; To design study potential divider bias transistor; To study a Diode as clipper and clamper; To study a OP-AMP IC 741 as inverting and non-inverting amplifier; To study a OP-AMP IC 741 as differentiator amplifier; To study a differential amplifier using two transistor; To study a OP-AMP IC 741 as differential amplifier; To study a zener regulator circuit; To study a OP-AMP IC 741 as a active rectifier; To study a OP-AMP IC 741 as a comparator; To familiarize with various types of transducers.
References:	1. Electronic Principles , By: Albert Paul Malvino, TMH.. 2. Electrical Engineering Fundamentals, By: Vincent Del Toro, PHI.. 3. A course in electrical and electronic measurements & instrumentation, By: A.K Sawhney, Dhanpat Rai. 4. Electronic Devices & Circuit Theory By: Boylestad, PHI. 5. Electronic Devices & Circuits, By: Allen Mottershead, PHI.
Course Outcomes	At the end of the course, learners will be able. **CO1:** Demonstrate the flow of charge carriers in semiconductor and interpret the VI relations. **CO2:** Understand the physical and functional properties of diode. **CO3:** Compare the properties of different configurations of bipolar junction transistors. **CO4:** Correctly interpret the measurement results. **CO5:** Suggest the instrument suitable for a specific application

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP 103**
Course title	**Engineering Drawing**
Corse credit	**2 (0+2)**
Objective of Course	1. To develop understanding of basic rules of engineering drawing, scales, orthographic Projection. 2. To develop skill for projection of points, lines, planes, and solids, Sectioning 3. To equipped with drawing skill development of surfaces. 4. Draw isometric projection and perspective views of an object/solid.
Course Content	Introduction of drawing scales; Principles of orthographic projections; References planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines; Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids.
References:	Elementary Engineering Drawing, By: N.D. Bhatt , Engineering Drawing & Graphics, By: K. Venugopal Engineering Drawing, By: D.N. Ghose Geometrical Drawing , By: R. K. Dhawan, Engineering Drawing , By: P. S. Gill
Course Outcomes	At the end of the course, learners will be able. **CO1**: Discuss about basic rules of engineering drawing, dimensioning, drawing scales, orthographic Projection. **CO2**: Draw the projection of points, lines, planes, solid. **CO3:** Apply the concept of. development of surfaces **CO4:** Draw the various drawing in practical applications views and working drawings.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**ES-101**
Course title	**Environmental Science**
Corse credit	**3(3+0)**
Objective of Course	1. Understand and evaluate the global scale of environmental problems; and. Reflect critically on their roles, responsibilities, and identities as citizens. 2. To learn how the natural world works, to understand how humans interact with the environment, and to find ways to deal with environmental problems and live more sustainably. 3. Introduce the problems related to population growth and non-Renewable resources. 4. Prevent environmental impacts generated by an organization's activities, services or products.
Course Content	**Course content :** Definition, Scope and Importance.Ecosystem Types, structure and functions. Bio-diversity Value, threats and conservation. Natural Resources Forest, mineral, soil and water –Their uses and abuses. Environmental pollution –Causes, effects and control measures of air, Water, soil, marine, thermal and noise pollution. Nuclear hazards. Bio-safety and risk assessment. Rural and urban waste management. Global Warming. Environmental act and related issues. Human population, health and social welfare.
References:	Environmental Science- A new Approach, By: S.S. Purohit, Q. J. Shamani and A.K. Agarwal Environment, Biodiversity and Conservation , By: M. A. Khan and S. Farooq Conservation of Biodiversity and Natural Resources, By: M. P. Singh, Soma Dey and Bijay S. Singh.
Course Outcomes	At the end of the course, learners will be able **CO1**: To solve environmental issues in an inclusive manner.

	CO2: Demonstrate mastery of core ecological and physical science concepts and methods as they pertain to environmental problem-solving. **CO3:** Recognize and integrate the international, cross-cultural, and transdisciplinary nature of environmental problems in analyses and solutions. **CO4**: Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems. **CO5:** To comprehend about causes, impact and control over population growth.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**PFE - 101**
Course title	**Computers Programming and Data Structures**
Corse credit	**3 (1 + 2)**
Objective of Course	1. Write a C programs 2. Implement different programming constructs and decomposition of problems into functions. 3. Use and implement data structures like arrays and structures to obtain solutions. 4. To impart fundamental knowledge on various data structures
Course Content	Introduction to high level languages, Primary data types and user defined data types, Variables, typecasting, Operators, Building and evaluating Expressions, Standard library functions, Managing Input and Output, Decision making, Branching, Looping, Arrays, User defined functions, passing arguments and returning values, recursion, scope and visibility of a variable, String functions, Structures and union, Pointers, Stacks, Push/Pop operations, Queues, Insertion and deletion operations, Linked lists
References:	▪ Programming in ANCI , By:C, E. Balagurusamy, ▪ The C programming Language, By: Brian W. Kernighan, Dennis M. Ritchie, ▪ Introduction to Data Structures in C, By: Ashok N. Kamthane, ▪ Data Structures and Algorithms, By: Aho A. V., J. E. Hopcroft, J.D. Ullman Addison-Wesley, 1983 ▪ Algorithms Design and Analysis, By: Horowitz, E., S. Sahni ▪ Fundamentals of Data Structures in PASCAL, By: Horowitz E., S. Sahni
Course Outcomes	At the end of the course, learners will be able **CO1**: Describe the fundamentals of C programming Language **CO2**: Apply appropriate Control structures to solve problems. **CO3**: Describe the concept of Arrays and UDF. **CO4**: demonstrate knowledge on different data structures.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course code	**Eng (E) - 101**
Course title	**English**
Corse credit	**2 (1 + 1)**
Objective of Course	1. Students should have basic knowledge about English Grammar and sentence Structure 2. Students should be able to articulate better in English 3. Students' should be able to pronounce better 4. Students' should be able to write basic reports and applications
Course Content	Grammar Tenses, voice change, Direct/Indirect narration, Prepositions and Determiners, Word Formation with parts of Speech, Types of sentences, Elementary Knowledge of English Sound with word stress, and intonation Patterns. Composition letter, Application, Summary and report writing.
References:	▪ Bridge intensive course, By: B. J. Carrol (Oxford Uni. Press) ▪ Modern English Grammar,By: N.Krishnaswamy (Maemilan) ▪ Spoken English for India, By: Bansal & Harrison ▪ Developing Programmes and Materials for Language Learning, By: Fraida Dubin & Elite Olshtain ▪ Communicative Approach to Language Teaching, By: David H.Wyatt
Course Outcomes	At the end of the course, learners will be able to **CO1**: understand basic grammatical structures and use them in the right context **CO2**: write definitions, descriptions, narrations and essays on various topics **CO3**: use language effectively in professional contexts

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															

Course code	**Math (E)-102**
Course title	**Engineering Mathematics-II**
Corse credit	**3(2+1)**
Objective of Course	1. This course is designed to cover topics such as Matrix Algebra, Complex Analysis, Fourier series and Partial differential equation. 2. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. 3. The various methods of complex analysis can be used for efficiently solving the problems that occur in agricultural engineering. 4. The Fourier series finds its application in agricultural engineering for measuring the acceleration of its vehicles, gauging distance covered, and estimating fuel consumption. 5. Partial differential equations are used to model many physical phenomena, including fluid dynamics, heat transfer, and structural mechanics
Course Content	**Matrices:** Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix, consistency and solution of linear equations, eigen values and eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalisation of matrices, Bilinear and quadratic forms. **Functions of a Complex Variable:** Limit, continuity and derivative of complex functions, analytic function, Cauchy-Reimann equations, conjugate functions, Harmonic functions. **Fourier series:** 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. **Partial differential equations:** Formation of partial differential equations, Lagrange's linear equation, Higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, application of partial differential equations (one dimensional wave and heat flow equations, two dimensional steady state heat flow equation (Laplace equation).
References:	

Course Outcomes	At the end of the course, learners will be able to **CO1:** Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices. **CO2:** Analytic functions, C-R equations and harmonic function. **CO3:** to apply various techniques to solve fourier series. **CO4:** to apply various techniques in solving partial differential equations.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**PFE-102**
Course title	**Electrical Circuits**
Corse credit	**3 (2+1)**
Objective of Course	1. To impart basic knowledge about electric circuits and networks to the students. 2. To develop in students the ability to analyze various types of electric circuits and networks. 3. To make the students understand the various network theorems and its usage in analyzing the circuits and networks
Course Content	**Theory:** Semiconductors, PN junction, V-I characteristics of PN junction, diode as a circuit element, rectifier, clipper, clamper, voltage multiplier, capacitive filter, diode circuits for OR & AND (both positive and negative logic), bipolar junction transistor: operating point, classification(A,B & C) of amplifier, various biasing methods (fixed, self, potential divider), h-parameter model of a transistor, analysis of small signal CE amplifier, phase shift oscillator, analysis of differential amplifier using transistor, ideal OP-AMP characteristics, linear and non-linear applications of OPAMP (adder, subtractor, integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator), zener diode voltage regulator, transistor series regulator, current limiting, OP-AMP voltage regulators, Basic theorem of Boolean algebra, Combinational logic circuits(basic gates, SOP rule and K-map), 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, bounden tube, LVDT, strain gauge and tacho-generator.
References:	1. Electronic Principles, By: Albert Paul Malvino, TMH.. 2. Electrical Engineering Fundamentals, By: Vincent Del Toro, PHI.. 3. A course in electrical and electronic measurements & instrumentation, By: A.K Sawhney, Dhanpat Rai. 4. Electronic Devices & Circuit Theory, By: Boylestad, PHI. 5. Electronic Devices & Circuits, By: Allen Mottershead, PHI.
Course Outcomes	At the end of the course students will be able to **CO1:** Name the various circuit elements, explain the behaviour of circuit elements and circuits and analyze the circuits using KVL, KCL, Mesh analysis and Nodal analysis techniques. **CO2:** State various network theorems,explain it and use it for solving the problems of electric circuits and networks. **CO3:** Relate first order and second order differential equations to electric circuits and networks, explain it, solve it for obtaining the transient responses of RL, RC and RLC networks and categorize RLC Networks **CO4:** Describe fundamental concepts used in single phase and three phase AC circuits and coupled circuits, explain these concepts, and solve problems pertaining to these circuits.

	CO5: Explain the behaviour of resonant circuits and assess the performance of tuned coupled circuits.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**RE - 102**
Course title	**Surveying and Levelling**
Course credit	**3(1+2)**
Objective of Course	1. Understand conventional and modern methods of surveying. 2. Develop ability to transform basic concept of surveying to field practice. 3. Interpret plans and maps for planning and setting out works. 4. Understand modern surveying techniques for mapping.
Course Content	**Course content:** Surveying Introduction, classification and basic principles Linear measurements. Chain Surveying. Compass survey. Errors in measurements, their elimination and correction. Plane table surveying, Leveling. Contouring, Computation of area and volume. Theodolite traversing. Introduction to setting of curves.
References:	Surveying , By: C.L. Kochher, Kataria Surveying and Levelling Vol.1&2 , By: T.P. Kanetkar and S.V. Kulka Surveying Vol.1&2, By: B.C. Punmia,
	At the end of the course, learners will be able **CO1**: Use conventional instruments to map the parcels of land. **CO2**: Show effectiveness of modern surveying instruments to improve accuracy and to save time and for surveying operations. **CO3:** Analyze the problems of computation of area and volume, setting out of curves and works using surveying knowledge. **CO4:** Appreciate the use of modern techniques for surveying and mapping

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**Agri (E) - 102**
Course title	**Agriculture for Engineers**
Course credit	**4 (3 + 1)**
Objective of Course	1. To expose the students to the fundamental knowledge on Soil physical parameters, Permeability – Compaction, Bearing Capacity and types and methods of soil survey and interpretative groupings and various quality aspects of soil and water studied in theory by performing experiments in the laboratory 2. To expose the students to the fundamental knowledge of agriculture and agronomical aspects beginning from the sowing of crops to the harvesting of the same and they should be able to identify different classification of crops and no house of weather parameters crops sessions tillage and soil water plant relationship

	3. To expose the students on weeds and its control crop rotation cropping system relay cropping as well as application of manures and fertilizers and calculation of the same 4. To expose the students on the scope of horticultural crops and floricultural crops with its improved varieties and requirements of climatic conditions and to express the students to achievements of knowledge of criteria of side selection layout and planting methods with proper fertilizer management 5. Student should be able to get knowledge on seed rate, planting time, Seed treatment for vegetable crops grown in trimming as well as all the agronomical reptiles is beginning from transplanting to harvesting and post-harvest management with proper marketing
Course Content	**Course content:** **Soils**: Nature and origin of soil; soil forming rocks and minerals, their classification and composition, soil forming processes, classification of soils – soil taxonomy orders; important soil physical properties; and their importance; soil particle distribution; soil inorganic colloids – their composition, properties and origin of charge; ion exchange in soil and nutrient availability; soil organic matter – its composition and decomposition, effect on soil fertility; soil reaction – acid, saline and sodic soils; quality or irrigation water; essential plants nutrients – their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils. **Agronomy Definition and scope of agronomy**. Classification of crops, Effect of different weather parameters on crop growth and development. Principles of tillage, tilth and its characteristics. Soil water plant relationship and water requirement of crops, weeds and their control, crop rotation, cropping systems, Relay cropping and mixed cropping. **Horticulture Scope** of horticultural and vegetable crops. Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties, Criteria for site selection, layout and planting methods, nursery raising, macro and micro propagation methods, plant growing structures, pruning and training, fertilizer application, fertigation, irrigation methods, harvesting, grading and packaging, post-harvest practices, Garden tools, management of orchard, Extraction and storage of vegetables seeds.
References:	• The Nature and Properties of Soil, By: N.C. Brady and R.R. Weil • Fundamentals of Soil Science, Ed By ICAR, • Chemistry of Soil, By: E.E. Bear • Principles of Agronomy, By: T. Y. Reddy and G. H. Shankara Reddy • Fundamentals of Agronomy,By: Rajat D. • Principles and Practices of Agronomy,By: S. S. Singh • Introductuion of Agronomy, By: V. W. Vaidya and K. R. Shahastrabudher • Principles of Horticulture, By: Prasad and Kumar • Principles of Horticulture, By: Denison • Horticultural Science, By: J Janick • Plant Propogation : Principles and Practices, By: Hartmen and Kester
	At the end of the course, learners will be able to **CO1**: understand the fundamental knowledge of soil physical parameters and to Perform a soil survey and classify soil based on its characteristics and explain the phase relationship and soil compaction. **CO2**: explain soil physical properties and compare the properties based on soil and water system and analyse the soil chemical properties to classify the arable and problem soils to develop different reclamation practices, analyse Engineering properties of soil and Understand Concepts of bearing capacity and slope stability. **CO3**: understand the fundamental knowledge of horticultural and floricultural crops, to identify the various seats of vegetable crops and floricultural and horticultural crops, to achieve the knowledge on various garden tools pruning and trimming various paste and diseases and its control in greenhouse polyhouse Orchard management etc **CO4:** To understand the fundamental knowledge of agriculture and agronomical aspects, to identify the seed of different crops vs serials pulses oil seeds cash crops vegetable crops spices and condiments etc. and to identify the different

	chemical fertilizers and manure as well as the calculation as per the requirements of different crops **CO5** To achieve the knowledge on sustainable agriculture intercropping mixed cropping and integrated farming system and to have awareness regarding weeds and its control

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP - 102**
Course title	**Workshop Technology**
Corse credit	**2+1**
Objective of Course	1. To develop fundamental welding proficiency. 2. To introduce the principles of arc welding, including the equipment and tools involved. 3. To familiarize students with casting processes, covering the principles and methods. 4. To develop proficiency in operating lathe and shaper machine by covering the main operations and tools used. 5. To understand milling and drilling machines.
Course Content	Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment, and tools. Casting processes. Classification, constructional details of centre lathe, Main accessories, and attachments. Main operations and tools used on centre lathes. Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations. Types of drilling machines. Constructional details of pillar types and radial drilling machines. Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine.
References:	1. Workshop Technology Vol. I & II , By: S.K. Hajra Chaudhary 2. Workshop Technology , By: Chapman 3. Workshop Technology , By: S.K. Gupta Manufacturing Technology, By: S. Dalela
Course Outcomes	At the end of the course, learners will be able **CO1**: **Demonstrated Fundamental Welding Skills:** Graduates will demonstrate proficiency in fundamental welding techniques, having developed hands-on skills and knowledge in various types of welding and oxyacetylene gas welding. **CO2: Applied Knowledge in Arc Welding:** Students will apply principles of arc welding, showcasing a practical understanding of the equipment and tools involved, and the ability to execute welding techniques effectively. **CO3: Competence in Casting Processes:** Graduates will exhibit competence in casting processes, demonstrating an understanding of the principles and methods involved in casting, enabling them to make informed decisions in material selection and casting applications. **CO4: Proficiency in Lathe and Shaper Operations:** Graduates will develop proficiency in operating lathe and shaper machines, showcasing skills in using the main operations, tools, and accessories associated with these machines. **CO5: Comprehensive Understanding of Milling and Drilling Machines:** Students will achieve a comprehensive understanding of milling and drilling

	machines, including constructional details, work holding devices, tool holding devices, and the ability to perform main operations on milling machines.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP-104**
Course title	**Engineering Mechanics**
Course credit	**3(2+1)**
Objective of Course	1. To understand the concept of basic engineering mechanism. 2. Understand the force systems and draw free body diagram to analyze rigid body equilibrium. 3. Comprehend the principles of friction and solve engineering mechanics problems associated with frictional force. 4. Compute the centroid, first moment and second moment of an area. 5. Understand the concept of motion of particles and rigid bodies.
Course Content	**Course content:** Basic concepts. Force systems. Centroid. Moment of inertia. Free body diagram and equilibrium of forces. Frictional forces. Analysis of simple framed structures using method of joints, method of sections and graphical method. Simple stresses. Shear force and bending moment diagrams. Stresses in beams. Torsion. Analysis of plane and complex stresses.
References:	**Suggested Readings** • Engineering Mechanics , By: R.S. Khurmi & Gupta • Engineering Mechanics, By: R. K. Bansal • Engineering Mechanics , By: R.V. Kulkarni • Engineering Mechanics , By: S.C. Arora • Engineering Mechanics (Vol. I) Statics , By: Archie Higdon and William B. Stiles, • Strength of Materials , By: S. Ramanurutham & R. Narayanan, • Analysis of Structures Vol. I & Vol. II , By: V. M. Vazirani & M. M. Ratwani • Mechanics of materials , By: E. P. Popov, • Applied Mechanics & Strength of Materials , By: I. B. Prasad
Course Outcomes	At the end of the course, learners will be able **CO1**: Students will understand the concepts of engineering mechanics. **CO2**: Students will understand the vectorial representation of forces and moments. **CO3:** Students will gain knowledge regarding centre of gravity and moment of inertia and apply them for practical problems. **CO4:** Students will gain knowledge regarding various types of forces and reactions and draw free body diagram to quicker solutions for complicated problems. **CO5:** Student will gain knowledge on friction on equilibrium and its application.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	FMP - 106
Course title	**Thermodynamics and Heat Engines**
Corse credit	**4 (3 + 1)**
Objective of Course	1. To understand the basic concepts and laws of thermodynamics. 2. To get knowledge of working of different theories of thermodynamics. 3. To acquaintance with the knowledge of steam engines and other engines, their power measurement, heat balance calculations, engine efficiencies and performance. 4. To get knowledge of working of different type of boilers.
Course Content	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. Kelvin-Planck and Claussius statements. Reversible processes, Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, change of entropy of gases in thermodynamics processes. Difference between gas and vapour, change of phase during constant pressure process. Generation of steam, triple point and critical point. Internal energy and entropy of steam. Use of steam tables and Mollier chart, heating and expansion of vapour in non-flow processes, measurement of dryness fraction. Classification of steam boilers, Cochran, Lancashire, locomotive and BabcockWilcox boilers. Boiler mountings and accessories. Desirable properties of working fluid used for power plants. Rankine cycle. Expansive and non-expansive working. Saturation curve and missing quantity, governing. Calculations of cylinder dimensions, Introduction to compound steam engines. Air Standard efficiency, other engine efficiencies and terms. Otto, diesel and dual cycles. Calculation of efficiency, mean effective pressure and their comparison. Measurement of IP, BP and heat balance calculations (not involving combustion). Engine efficiencies and performance.
References:	**Reference Books** • Engineering Thermodynamics, By: C.P. Gupta & Rajendra Prakash • Thermal Engg. , By: P.L. Ballaney • Elements of heat engines (Vol II) , By: R.C. Patel & C.J. Karamchandani • Basic Mechanical Engg , By: R.P. Arora, B.K. Raghunath, J.P. Patel • Basic Engg. Thermodynamics, By: T. Roy Choudhary • Internal combustion Engines,By: H.B. Keswani
Course Outcomes	At the end of the course, learners will be able to **CO1**: Uunderstand the basic concepts and laws of thermodynamics. **CO2**: Know the working of different theories of thermodynamics. **CO3**: Understand working of steam engines and other engines, their power measurement, heat balance calculations, engine efficiencies and performance. **CO4**: Know the working of different type of boilers.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**PFE - 201**
Course title	**Engineering Properties of Biological Materials and Food Quality**
Corse credit	**3 (2 + 1)**
Objective of Course	4. To enable the students to understand the principles and concepts of various properties of biological materials 5. To understand the physical laws governing the response of the biological materials to various physical treatments so that the machines, processes and handling operations can be designed for maximum efficiency and the highest quality of the end products
Course Content	Importance of engineering properties of biological materials, Study of different physical and thermal characteristics of important biological materials like shape, size, volume, density, roundness, sphericity, surface area, specific heat, thermal conductivity, thermal diffusivity, etc. measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition. Rheological characteristics like stress, strain time effects, rheological models and their equations. Aerodynamic characteristics and frictional properties. Application of engineering properties in handling processing machines and storage structures. Concept, objectives and need of quality, quality control, methods of quality control, sampling; purpose, sampling techniques, requirements and sampling procedures for liquid, powdered and granular materials, sensory quality control, panel selection methods, interpretation of sensory results in statistical quality control, TQM and TQC, consumer preferences and acceptance, Food Laws and Regulations in India. Food grades and standards BIS,AGMARK, PFA, FPO, CAC (Codex Alimantarious Commission), sanitation in food industry, GMP, HACCP (Hazard analysis and critical control point) and ISO 9000 Series.
References:	• Physical properties of plant and animal materials. , By: Mohsenin, N. N. • Physical properties of food, By: Hallstrom, B., Meffert, H. F. Th., Speiss, W. E.L. and G. Vos. • Physical properties of foods -2, By: Jowitt, R. Escher, F., Kent, M., Mckenna, B. and M. Roqueas. • Engineering properties of foods , By: Rao M. A. and SH Rizvi • Mechanics of agricultural materials. , By: Sitkej. G. • Physical Properties of foods and food processing systems, By: Lewis, M.J. • Thermal Properties of Food and Agricultural Materials, By: Mohenin, Nuri N. (1980).
Course Outcomes	At the end of the course, learners will be able **CO1**: Demonstrate knowledge of various engineering methods to measure engineering properties like physical, thermal, rheological properties and quality control in biological materials. **CO2**: Knowledge of methods to determine various engineering properties of biological materials and its physical, thermal and rheological properties. **CO3**: Knowledge of methods to determine various methods of quality control and sampling procedures for liquid, powdered and granular materials **CO4:** Knowledge of methods to determine various methods of Food Laws and Regulations in India. Food grades and standards BIS, AGMARK, PFA, FPO, CAC

Mapping between COs with POs and PSOs
Please refer mapping of PO and PSO for the style of mapping.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	SWE-201
Course title	**Soil Mechanics**
Corse credit	**3 (2+1)**
Objective of Course	**Objective 1**: Understanding Soil Characteristics and Behavior To familiarize students with the fundamental principles of soil mechanics, including physical properties, phase diagrams, and index properties, to comprehend soil behavior and characteristics. **Objective 2**: Knowledge of Stress Conditions and Shear Strength To educate students about stress conditions in soils, effective stress principles, and theories such as Mohr stress circles and Mohr-Coulomb failure theory to analyze and determine shear strength. **Objective 3**: Proficiency in Soil Testing and Analysis Techniques To enable students to perform and interpret various soil tests like direct shear tests, compaction tests (Proctor, Abbott, Jodhpur mini compaction), and consolidation tests in laboratory settings, alongside analyzing the obtained data for engineering applications. **Objective 4**: Mastery in Earth Pressure and Slope Stability Analysis To equip students with knowledge and analytical skills related to earth pressure theories (such as Rankine's theory) and stability analysis techniques (friction circles, Taylor's stability number) for assessing and predicting the stability of slopes and soil structures. **Objective 5:** Application-Oriented Learning and Problem Solving To develop students' abilities to apply theoretical concepts learned in class to solve real-world engineering problems related to soil mechanics, including soil classification, compaction, consolidation, and slope stability analysis.
Course Content	Theory Introduction of soil mechanics, field of soil mechanics, phase diagram physical and index properties of soil classification of soils, general classification based on particles size, textural classification and I.S. soil classification system stress condition in soils, effective and neutral stress, elementary concept of Bousinesque and Wester guards analysis, newmark influence chart. 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 perameters by direct shear to be circle, theoretical test. Numerical exercise based on various types of tests. Compaction composition of soils standard and modified protector test, abbot compaction and Jodhpur mini compaction text field compaction method and control. Consolidation of soil: Consolidation of soils, one dimensional consolidation spring analogy, Terzaghi' s theory Laboratory consolidation text, calculation of void ratio and coefficient of volume change, Taylor' s and Casagrand' s method, determination of coefficient of consolidation. Earth pressure: Plastic equilibrium in soils, active and passive states, Rankine' s theory of earth pressure active and passive earth pressure for cohesive soils, simple numerical exercise.Stability of slopes: Introduction to stability analysis of infinite and finite slopes friction circles method Taylor' s stability number. Practical • Determination of water content of soil. (Various methods) • Determination of specific gravity of soil. • Determination of field density of soil by core cutter method. • Determination of field density by sand replacement method. • Grain size analysis by sieving (Dry sieve analysis) • Grain size analysis by hydrometer method. • Determination of liquid limit by Casagrande's method. • Determination of liquid limit by cone penetrometer and plastic limit. • Determination of shrinkage limit. • Determination of permeability by constant head method. • Determination of permeability by variable head method. • Determination of compaction properties by standard proctor test. • Determination of shear parameters by direct shear test.

	• Determination of unconfined compressive strength of soil. • Determination of shear parameters by Tri-axial test. • Determination of consolidation properties of soils.
References:	• Soil Mechanics and Foundation Engineering , By: B. C. Punmia, • Soil Mechanics and Foundation Engineering , By: K.R. Arora, • Soil Mechanics and Foundation Engineering , By: V. N. S. Murthy
Course Outcomes	At the end of the course, learners will be able CO1: Soil Understanding and Classification Students will differentiate soil types based on physical properties and classification systems, demonstrating an understanding of soil mechanics principles. CO2: Stress Conditions and Shear Strength Mastery Upon completion, students will comprehend stress conditions in soils and apply theories like Mohr stress circles and Mohr-Coulomb failure theory to analyze shear strength. CO3: Soil Parameter Determination and Compaction Proficiency Students will determine shear parameters through practical tests and demonstrate proficiency in various compaction techniques used in soil engineering. CO4: Consolidation and Earth Pressure Analysis By course end, students will understand soil consolidation theories, perform laboratory tests, and analyze earth pressures for cohesive soils. CO5: Slope Stability Analysis Proficiency Students will analyze slope stability using various methods, such as friction circles and Taylor's stability number, to assess and predict slope stability.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**SWE - 203**
Course title	**Fluid Mechanics**
Corse credit	**3 (2 + 1)**
Objective of Course	Objective 1: Understanding Fundamental Concepts of Fluid Mechanics To impart a comprehensive understanding of ideal and real fluids, pressure measurement, Pascal's law, and pressure forces on various surfaces, forming the foundation for fluid behavior analysis. Objective 2: Exploring Fluid Kinematics and Dynamics To educate students on the kinematics of fluid flow, encompassing descriptions such as Lagrangian and Eulerian, streamlines, and types of fluid motion (translation, rotation, vortex), as well as dynamics involving Bernoulli's theorem and flow measurement devices. Objective 3: Analyzing Laminar and Turbulent Flow in Pipes To enable students to differentiate between laminar and turbulent flow, comprehend stress-strain relationships, analyze flow between parallel plates and through pipes using Darcy's equation and Moody's diagram, and calculate hydraulic losses through pipe networks. Objective 4: Understanding Dimensional Analysis and Similitude To introduce students to dimensional analysis and similitude methods (such as Raleigh's and Buckingham's Pi theorem), emphasizing the importance of dimensionless numbers and types of similarities in solving practical fluid mechanics problems. Objective 5: Introduction to Fluid Machinery

<table>
<tr><td></td><td>To provide a basic understanding of fluid machinery principles, introducing students to the operation and application of various fluid machines in engineering systems.</td></tr>
<tr><td>Course Content</td><td>Theory
Properties of fluids Ideal and real fluid. Pressure and its measurement, Pascal’s law, pressure forces on plane and curved surfaces, centre of pressure, buoyancy, metacentre and metacentric height, condition of floatation and stability of submerged and floating bodies; Kinematics of fluid flow Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flow net. Types of fluid flow, translation, rotation, circulation and vorticity, Vortex motion; Dynamics of fluid flow, Bernoulli’s theorem, venturimeter, orifice-meter and nozzle, siphon; Laminar flow Stressstrain relationships, flow between infinite parallel plates - both plates fixed, one plate moving, discharge, average velocity, shear stress and pressure gradient; 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, power transmission through pipe; Dimensional analysis and similitude Raleigh’s method and Buckingham’s Pi theorem, types of similarities, dimensional analysis, dimensionless numbers. Introduction to fluid machinery.
Practical
Study of manometers and pressure gauges.
Verification of Bernoulli's theorem.
Determination of coefficient of discharge of venturi meter
Determination of coefficient of discharge of orifice meter
Determination of coefficient of friction in pipeline.
Determination of coefficient of discharge for rectangular notch.
Determination of coefficient of discharge for triangular notch.
Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice.
Determination of coefficient of discharge for mouth piece
Measurement of force exerted by water-jets on flat and hemispherical vanes</td></tr>
<tr><td>References:</td><td>Hydraulics and Fluid Mechanics , By: Modi & Sheth,
Fluid Mechanics , By: V. L. Streeter
Engineering Fluid Mechanics , By: D. S. Kumar,
Fluid Mechanics and Hydraulic Machines , By: Dr. R K. Bansal,
Hydraulics and Fluid Mechanics, By: Dr Jagdishlal,
Engineering Fluid Mechanics , By: K. L. Kumar,
Hydraulics and Fluid Mechanics, By: S Khurmi ,</td></tr>
<tr><td>Course Outcomes</td><td>At the end of the course, learners will be able
CO1: Understanding Fluid Properties and Principles
Demonstrate comprehension of fundamental concepts, including ideal and real fluids, pressure measurement, Pascal’s law, and buoyancy principles.
CO2: Proficiency in Fluid Kinematics and Dynamics
Apply knowledge of fluid motion descriptions (Lagrangian, Eulerian), streamlines, and dynamics (Bernoulli’s theorem, flow measurement devices) to analyze various fluid flow scenarios.
CO3: Analysis of Laminar and Turbulent Flows
Differentiate between laminar and turbulent flows, analyze stress-strain relationships, and apply equations like Darcy's and Moody’s diagram to calculate hydraulic losses in pipes.
CO4: Application of Dimensional Analysis and Similitude
Apply dimensional analysis techniques (Raleigh’s method, Buckingham's Pi theorem) to solve fluid mechanics problems and understand the significance of dimensionless numbers.
CO5: Introduction to Fluid Machinery Principles</td></tr>
</table>

	Gain familiarity with basic fluid machinery principles, providing a foundational understanding of fluid machines and their engineering applications.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP - 201**
Course title	**Farm Machinery and Equipment - I**
Course credit	**3 (2 + 1)**
Objective of Course	1) To understand the concept of farm mechanization, status, scope and its utility. 2) To get the knowledge about tillage, types of tillage and equipment used for it. 3) To get the knowledge about sowing and planting machineries, its components, adjustments and calibration. 4) To acquaintance with calculations of field capacities and field efficiency of various agricultural machineries 5) To familiarize about the material of construction used for development of components of agricultural machineries.
Course Content	Objectives of farm mechanization. Classification of farm machines. Materials of construction & heat treatment. Principles of operation and selection of machines used for production of crops. Field capacities & economics. Tillage; primary and secondary tillage equipment. Forces acting on tillage tools. Hitching systems and controls. Draft measurement of tillage equipment Earth moving equipment - their construction & working principles viz Bulldozer, Trencher, Elevators etc.; sowing, planting & transplanting equipment - their calibration and adjustments. Fertilizer application equipment. Weed control and Plant protection equipment - sprayers and dusters, their calibration, selection, constructional features of different components and adjustments.
References	• Principle of farm machinery, By: R.A. Kepner, Roy Bainer & E.L. Berger • Farm machines & equipment, By: C. P. Nakra • Agricultural Engg. (through worked examples), By: R. Lal and A.C. Datta • Farm machine, By: Claude Cuplin • Elements of Agril. Engg., By: J. Sahay • Elements of farm machinery, By: A.C. Srivastava • Farm Machinery & Equipment, By: H.P. Smith & L.H. Wilkey • Principles of Agricultural Engineering, By: A.M. Michael & T.P. Ojha, • Farm Machinery, By: Claude Culpin Granada, • Elements of Farm Machinery, By: A.C. Srivastava, • Agricultural Machines, By: N.I. Kelnin, I.F.Popov, A.V.A. Sakur
Course Outcomes	At the end of the course, learners will be able **CO1**: Know about status and scope farm mechanization in India. **CO2**: Understand the concept of tillage and equipment used for it. **CO3**: Understand the working/calibration/ adjustments of sowing and planting machineries. **CO4**:Able to calculate field capacities and field efficiency various agricultural machineries **CO5**: Able to select the proper material development of components of agricultural machineries.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP - 203**
Course title	**Farm Power**
Course credit	**3 (2 + 1)**
Objective of Course	1)To get the knowledge about the sources of power available on the farm. 2) To acquaintance with IC engine, its principle & laws, components and working. 3)To get technical knowledge about different systems of IC engine. 4) To get familiar about basics of engine testing.
Course Content	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. Study of engine components their construction, operating principles and functions. Engine systems valves & valve mechanism. Fuel & air supply, cooling, lubricating, ignition, starting and electrical systems. Study of constructional details, adjustments & operating principles of these systems. IC engine fuels - their properties & combustion of fuels, gasoline tests and their significance, diesel fuel tests and their significance, detonation and knocking in IC engines, study of properties of coolants, anti freeze and anti-corrosion materials, lubricant types & study of their properties. Engine governing systems.
References	• Elements of Agril. Engg. By: J. Sahay • Tractors & their power units, By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith, Makota Hoki • Farm machines & equipment, By: C.P. Nakra
Course Outcomes	At the end of the course, learners will be able **CO1**: Able to select and use of proper farm source for doing various farm operations. **CO2**: Get in depth knowledge about IC engine components and it's working. **CO3**: Become technically sound about working of different systems of IC engine.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															

Course code	**SWE - 205**
Course title	**Watershed Hydrology**
Corse credit	**3 (2 + 1)**
Objective of Course	**Objective 1**: Grasping Hydrological Fundamentals Provide students with a foundational understanding of key hydrological concepts such as the hydrologic cycle, precipitation measurement, hydrograph analysis, and frequency estimation of rainfall events. **Objective 2:** Analyzing Hydrological Processes and Factors Explore the mechanisms of interception, infiltration, evaporation, and evapotranspiration, emphasizing measurement techniques, their roles in the hydrological cycle, and factors influencing runoff generation. **Objective 3:** Understanding Watershed Characteristics and Runoff Estimation Educate students on geomorphological aspects of watersheds, including stream characteristics, Horton's laws, and their relation to runoff, along with various methods for estimating peak runoff rates and volumes. **Objective 4:** Application of Hydrological Models and Techniques Enable students to apply unit hydrograph theory, comprehend dimensionless unit hydrographs, synthetic unit hydrographs, and their use in flood routing, watershed management, and drought classification. **Objective 5:** Synthesizing Hydrological Knowledge for Practical Solutions Encourage students to integrate their knowledge of hydrological processes, watershed characteristics, and runoff estimation techniques to address real-world water management challenges and formulate effective strategies for sustainable water resource utilization and planning.

Course Content

Theory

Introduction; hydrologic cycle; precipitation - forms, rainfall measurement, mass curve, hydrograph, mean rainfall depth, frequency analysis of point rainfall, plotting position, estimation of missing data, test for consistency of rainfall records; interception; infiltration; evaporation; evapo-transpiration - estimation and measurement; geomorphology of watersheds - stream number, stream length, stream area, stream slope and Horton' s laws; runoff - factors affecting, measurement; stage and velocity, rating curve, extension of rating curve; estimation of peak runoff rate and volume; rational method, Cook' s method, SCS method, Curve number method; hydrograph; components, base flow separation, unit hydrograph theory - unit hydrograph of different durations, dimensionless unit hydrograph, distribution hydrograph, synthetic unit hydrograph, uses and limitations of unit hydrograph; head water flood control - methods, retards and their location; flood routing - graphical methods of reservoir flood routing; hydrology of dry land areas - drought and its classification; introduction to watershed management and planning.

Practical

- Visit to meteorological observatory
- Study of different types of rain gauges
- Exercise on analysis of rainfall data
- Double mass curve technique
- Determination of average depth of rainfall and frequency analysis
- Study of stage recorders and current meters
- Exercise on estimation of peak runoff rate and runoff volume
- Exercises on hydrograph and unit hydrograph
- Exercises on design and location of retards for channel improvement
- Exercises on flood routing problems
- Visit to watershed

References:

- Water Shed Hydrology, By: R Suresh
- Hydrology, By: H M Raghunath
- Daryaganj, New Delhi-110002
- Statistical methods in Hydrology, By: C T Haan,
- Land and water management; Principles and Practices, By: V V N Murthy
- Principles of Hydrology, By: K Subramaniyam

Course Outcomes

At the end of the course, learners will be able

CO1: Understanding Hydrological Principles

Demonstrate comprehension of the hydrologic cycle, including precipitation forms, rainfall measurement techniques, mass curve analysis, hydrograph creation, and frequency analysis for rainfall events.

CO2: Assessing Hydrological Processes

Analyse key hydrological processes such as interception, infiltration, evaporation, and evapotranspiration, understanding their estimation methods and importance within the hydrologic cycle.

CO3: Evaluating Watershed Characteristics

Evaluate the geomorphological aspects of watersheds, including stream number, length, area, slope, and their correlation with Horton's laws, contributing to an understanding of runoff generation.

CO4: Quantifying Runoff and Flood Control

Quantify factors influencing runoff, measure stage and velocity, estimate peak runoff rates and volumes using various methods (Rational, Cook's, SCS, Curve number), and comprehend hydrograph components, base flow separation, and flood control techniques.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course code	**Math (E)-201**
Course title	**Engineering Mathematics-III**
Corse credit	**3(2+1)**
Objective of Course	1. This course is designed to cover topics such as Numerical analysis and Laplace transform. 2. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. 3. The various methods of complex analysis can be used for efficiently solving the problems that occur in agricultural engineering. 4. The Fourier Series finds its application in agricultural engineering for measuring the acceleration of its vehicles, gauging distance covered, and estimating fuel consumption. 5. Partial differential equations are used to model many physical phenomena, including fluid dynamics, heat transfer, and structural mechanics
Course Content	**Numerical analysis :** Finite differences, various difference operators and their relationships, factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae, Bessel's and Stirling's central difference interpolation formulae, interpolation with unequal intervals, Newton's divided difference formula, Lagrange's interpolation formula; numerical differentiation, differentiation based on equal interval interpolation, first and second order derivatives by using Newton's forward and backward, Stirling's and Bessel's formulae; maxima and minima of a tabulated function, numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Difference equations, order of a difference equation, solution of linear difference equation, rules for finding complimentary function and particular integral; numerical solution of ordinary differential equations by Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method. **Laplace transforms:** Definition of Laplace transform, Laplace transforms of elementary functions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, integrals, transform of function multiplied by tn, transform of function divided by t, convolution theorem; application of Laplace transforms to solve ordinary differential equations and simultaneous differential equations, Laplace transforms of unit step function, unit impulse function, periodic function.
References:	
Course Outcomes	At the end of the course, learners will be able **CO1:** Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices. **CO2:** Analytic functions, C-R equations and harmonic function. **CO3:** to apply various techniques to solve fourier series**.** **CO4:** to apply various techniques in solving partial differential equations.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**Eco(E)-201**
Course title	**Agribusiness Management and Trade**
Corse credit	**3 (3 + 0)**
Objective of Course	1. To introduce students to the Business management and its application in agriculture 2. To make students aware of theories of international trade, WTO provisions for trade in agricultural and food commodities 3. To instil idea of becoming entrepreneure
Course Content	Management concepts and principles, process of management, functions of management, concept of agribusiness and application of management principles to agribusiness, production, consumption, and marketing of agricultural products, agricultural processing, meaning and theories of international trade, WTO provisions for trade in agricultural and food commodities, India's contribution to international trade in food and agri - commodities
References:	• Agri-Business Management, By: W. David Downey and Steven P. Erickson • Introduction to Agri-Business Management, By:Davis J. and Eddberg • Essential of Management , By:Harald Koontz and Heinz Weshrich • Organizational Behaviour: Texts and Causes, By:R. K. Puri and Sanjeev Verma • Introduction to Management Accounting, By: Harngren, Swaden and , Stratten
Course Outcomes	At the end of the course, learners will be able to **CO1:** have understanding about business management **CO2:** understand management and apply its concepts in agriculture **CO3:** to understand entrepreneurship

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															

Course code	**FMP - 202**
Course title	**Farm Machinery and Equipment – II**
Course credit	**3 (2 + 1)**
Objective of Course	1) To get the knowledge about types and components of plant protection, intercultural, harvesting and threshing equipments. 2) To get the knowledge about working, adjustments and calibration of above equipments. 3) To familiarise about some special type of equipments used for harvesting of cash crops, root crops, fruits and vegetable crops.
Course Content	Principles & types of cutting mechanisms. Construction & adjustments of shear & impact-type cutting mechanisms. Crop harvesting machinery mowers, windrowers, reapers, reaper binders and forage harvesters. Forage chopping & handling equipment. Threshing mechanics & various types of threshers. Threshers, straw combines & grain combines, maize harvesting & shelling equipment, Root crop harvesting equipment - potato, groundnut etc., Cotton picking & Sugarcane harvesting equipment. Principles of fruit harvesting tools and machines. Horticultural tools and gadgets. Testing of farm machine. Test codes & procedure. Interpretation of test results. Selection and management of farm machines for optimum performance.
References	• Principle of farm machinery,By: R.A. Kepner, Roy Bainer & E.L. Berger • Farm machines & equipments,By: C. P. Nakra • Farm machinery & equipment,By: Smith H.P. & Wilked L.H. • Agricultural Engg. (through worked examples),By: R. Lal & A.C. Datta • Farm machine,By: Claude Cuplin • Elements of Agril. Engg.,By: J. Sahay • Elements of farm machinery,By: A.C. Srivastava

Course Outcomes	At the end of the course, learners will be able **CO1:** Identify types and components of plant protection, intercultural, harvesting and threshing equipments. **CO2:** Find and repair trouble shooting coming during the operation of above equipment. **CO3: S**elect and identify proper equipment used for harvesting of cash crops, root crops, fruits and vegetable crops.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															

Course code	**RE-202**
Course title	**Renewable Energy Sources**
Corse credit	**3 (2+1)**
Objective of Course	1. To provide knowledge of solar energy concept and applications. 2. To impart knowledge of geothermal, ocean and tidal energy and their applications. 3. To understand the design of wind mills and applications. 4. To understand the turbines and generators for small scale hydroelectric generation. 5. To understand the important parts of a biogas plant, design and principle of bio-diesel.
Course Content	**Theory:** Classification of energy sources; Introduction to renewable energy sources; characterization of biomass; Types, construction, working principle, uses and safety/environmental aspects of different renewable energy devices like gasifiers, biogas plants, solar passive heating devices, photovoltaic cells and arrays; Brief introduction to wind energy, hydroelectric energy, ocean energy, briquetting and baling of biomass, biomass combustion, biodiesel preparation and energy conservation in agriculture. **Practicals:** Introduction of various laboratory facilities of SESA; Preparation of biomass sample; Determination of calorific value; Estimation of ash content of biomass; Estimation of moisture content of biomass; Estimation of fixed carbon and volatile matter of biomass; Demonstration of down draft throatless rice husk gasifier; Demonstration of down draft gasifier with throat; Demonstration of rice husk gasifier for thermal use; Demonstration of working of a fixed dome type biogas plants; Demonstration of working of a floating drum type biogas plants; Demonstration of biodiesel preparation; Measurement of basic solar parameters; Demonstration of solar water heater; Demonstration of PVC; Demonstration of solar cooker; Determination of fuel properties.
References:	1. Duffie, J. A., & Beckman, W. A. (2013). Solar engineering of thermal processes, fourth edition, Wiley. 2. Tiwari, G. N., & Ghosal, M. K. (2007). Fundamentals of renewable energy sources. Alpha Science International Limited. 3. Mukherjee, D., & Chakrabarti, S. (2004). Fundamentals of renewable energy systems. New Age International. 4. Sukhatme, S. P. (2005). Solar Energy Principles of Thermal Collection and storage Tata McGraw Hill Publishing Company Ltd. New Delhi. 5. Kothari, D. P., Singal, K. C., & Ranjan, R. (2011). Renewable energy sources and emerging technologies. PHI Learning Pvt. Ltd. 6. Energy Technology Non-conventional, Renewable and Conventional ,By: S.S. Rao and B.B. Parulekar. 7. Handbook of Biomass Downdraft Gasifier Engine System, ,By: Thomas B Reed and Aqua Das. 8. Small scale producer gas engine systems,,By: A Kaupp & J.R.Goss.

	9.Biogas Systems (Principles & Applications) ,By: K.M. Mittal
Course Outcomes	At the end of the course, learners will be able **CO1:** To explain the basic principles of various renewable energy conversion processes and devices used therein **CO2**: To identify various parameters that influences the performance of renewable energy devices/processes. **CO3**: To undertake the field projects in the area of solar thermal, solar PV, wind, biomass, ocean energy, geothermal etc. **CO4**: To identify suitable renewable source and technology for a given requirement **CO5:** To develop the integrated renewable energy technology for decentralized power sector.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**SWE - 202**
Course title	**Soil and Water Conservation Engineering**
Corse credit	**3 (2 + 1)**
Objective of Course	• Understanding Soil Erosion: Comprehend the various causes, types, and agents of soil erosion, focusing on water and wind erosion mechanisms and their impacts on land degradation. • Soil Loss Estimation and Control: Learn the application of erosion estimation models such as the Universal Soil Loss Equation (USLE) and Modified Soil Loss Equation (MUSLE) to assess soil loss factors and devise effective erosion control strategies. • Erosion Control Measures: Explore and analyze agronomic and mechanical erosion control measures, including contour cropping, strip cropping, terracing (level, graded, and bench terraces), bunds, and their designs for effective soil conservation. • Gully Reclamation and Wind Erosion Control: Understand principles related to gully control, temporary structures, and vegetation for gully and ravine reclamation. Evaluate factors influencing wind erosion, its mechanics, and explore preventive measures like vegetative covers, mechanical barriers, windbreaks, and shelter belts for sand dune stabilization. • Water Quality and Sedimentation: Introduce the concepts of stream water quality, pollution, and sedimentation in reservoirs and streams. Analyze methods for estimating sedimentation, sediment delivery ratio, trap efficiency, and its impact on water resources management. These objectives aim to provide a comprehensive understanding of erosion processes, loss estimation techniques, erosion
Course Content	Theory Introduction; soil erosion - causes, types and agents of soil erosion; water erosion - forms of water erosion, mechanics of erosion; gullies and their classification, stages of gully development; soil loss estimation - universal soil loss equation and modified soil loss equation, determination of their various parameters; erosion control measures - agronomical measures - contour cropping, strip cropping, mulching; mechanical measures - terraces - level and graded broad base terraces and their design, bench terraces & their design, layout procedure, terrace planning, bunds - contour bunds, graded bunds and their design; gully and ravine reclamation - principles of gully control - vegetative and temporary structures; wind erosion - factors affecting wind erosion, mechanics of wind erosion, soil loss estimation, wind

	erosion control measures - vegetative, mechanical measures, wind breaks & shelter belts, sand dunes stabilization; sedimentation - sedimentation in reservoirs and streams, estimation and measurement, sediment delivery ratio, trap efficiency; characteristics of contours and preparation of contour maps; land use capability classification; grassed water ways and their design; introduction to water harvesting techniques; introduction to stream water quality and pollution. Practical • Study of soil loss measurement techniques. • Study of details of Coshocton wheel • Study of details of multi-slot runoff samplers. • Determination of sediment concentration through oven dry method. • Problems on Universal Soil Loss Equation. • Preparation of contour map of an area and its analysis. • Design of vegetative waterways. • Design of contour bonding system. • Design of graded bonding system. • Design of various types of bench terracing systems. • Determination of rate of sedimentation and storage loss in reservoir. • Design of Shelter belts. • Design of wind breaks.
References:	• Land and water management; Principles and Practices, By: V V N Murthy • Soil and water Conservation engineering, By: R Suresh
Course Outcomes	At the end of the course, learners will be able in CO1: Comprehensive Understanding of Soil Erosion: Students will demonstrate a thorough understanding of the causes, mechanisms, and various types of soil erosion, encompassing water and wind erosion processes, gully formation, and stages of gully development. CO2: Proficiency in Soil Loss Estimation and Control: Students will gain expertise in utilizing models such as the Universal Soil Loss Equation (USLE) and Modified Soil Loss Equation (MUSLE) to estimate soil loss parameters. They will demonstrate knowledge of erosion control measures, including agronomic and mechanical techniques, to mitigate soil erosion effectively. CO3: Application of Erosion Control Techniques: Students will be able to apply and evaluate erosion control strategies practically, including the implementation of agronomic measures like contour cropping, strip cropping, and mulching, alongside mechanical measures such as terraces (level, graded broad base, and bench terraces) and bunds. CO4: Competency in Gully and Ravine Reclamation: Students will demonstrate proficiency in the principles and methodologies associated with gully erosion control, including the application of vegetative methods and temporary structures. They will apply techniques for reclaiming gullies and ravines to restore degraded areas. CO5: Understanding of Wind Erosion and Sedimentation Management: Students will exhibit an understanding of wind erosion factors, mechanics, and estimation techniques. They will demonstrate knowledge of various erosion control measures, including vegetative and mechanical methods, and sedimentation management in reservoirs and streams.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**SWE - 204**
Course title	**Irrigation Engineering**
Corse credit	**4 (3 + 1)**
Objective of Course	• Understanding Irrigation Principles: Grasp the fundamentals of irrigation, including its purpose, impact on the environment, and an overview of major irrigation schemes in India, alongside the exploration of water resources and their current utilization status. • Proficiency in Irrigation Measurement and Conveyance: Acquire expertise in measuring irrigation water using weirs, notches, flumes, orifices, and other methods, and comprehend water conveyance through channels, underground pipes, and the design of irrigation structures and channel lining. • Mastery of Soil-Water Dynamics: Comprehend the relationship between soil, water, and plants, focusing on soil water movement, infiltration, evapotranspiration, soil moisture constants, and parameters determining irrigation depth, frequency, and efficiency. • Exploration of Irrigation Techniques: Study and compare various surface irrigation methods like border, check basin, furrow, and contour irrigation, as well as advanced methods such as sprinkler and drip irrigation, understanding their advantages, drawbacks, and selection criteria. • Understanding Participatory Irrigation Management and Economic Aspects: Explore participatory irrigation management models and the economic dimensions of water resource utilization, including cost estimation, to comprehend the socio-economic aspects of water resource utilization and management. These objectives aim to cover diverse aspects of irrigation engineering, ranging from foundational principles to contemporary techniques, management models, and economic considerations in water resources utilization.
Course Content	**Theory** Irrigation Engineering Irrigation, impact of irrigation on Human Environment, some 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; Measurement of irrigation water, weir, notches, flumes and orifices and other methods; water conveyance, design of irrigation field channels, underground pipe conveyance system, irrigation structures, channel lining; land grading, different design methods and estimation of earth work and cost; soil water plant relationship, soil water movement, infiltration, evapotranspiration, soil moisture constants, depth of irrigation, frequency of irrigation, irrigation efficiencies; surface irrigation methods of water application, border, check basin, furrow and contour irrigation; sprinkler and drip irrigation method, merits, demerits, selection and design; Participatory irrigation management. Economics of water resources utilization. **Practical** • Measurement of soil moisture by different soil moisture measuring instruments. • Measurement of irrigation water • Measurement of infiltration rate • Computation of evaporation and transpiration • Land grading exercises • Design of underground pipe line system • Infiltration-advance in border irrigation • Measurement of advance and recession in furrow irrigation and estimation of irrigation efficiency. • Measurement of uniformity coefficient of sprinkler irrigation method • Measurement of uniformity coefficient of drip irrigation method

	• Field problems and remedial measures for sprinkler and drip irrigation method.
References:	• Irrigation Theory and Practice ,By: A M Michael, • Irrigation Engineering and Hydraulic Structures, By: S K Garg, • Irrigation, water resources and water Power Engineering ,By: P N Modi, • Agricultural Engineering through solved Examples ,By: Radhey Lal, • Land and water management; Principles and Practices ,By: V V N Murthy, • Discharge Measurement Structures ,By: M G Bos,
Course Outcomes	At the end of the course, learners will be able in • Analyze irrigation's impact on environment and society, major schemes in India. • Design irrigation water measurement & conveyance systems using weirs, channels, pipes. • Implement land grading, evaluate soil-water-plant relationship for irrigation planning. • Design and compare surface & pressurized irrigation systems (border, furrow, sprinkler, drip). • Analyze water resource economics and implement participatory management for efficient irrigation.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**PFE - 202**
Course title	**Crop Process Engineering**
Corse credit	**3 (2 + 1)**
Objective of Course	6. To understand the scope and importance of various food processing operations. 7. To understand the laws of size reduction, theory of mixing and importance of material handling devices. 8. Student give more emphasis on explaining practical application of construction of related structures efficiently and economically and encouraged to study those processes which may find practical application in future career. 9. To give emphasis for conservation, storage and adding value to the agricultural produce.
Course Content	Scope and importance of food processing, principles and methods of food processing. Processing of farm crops; cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed. Processing of animal products, Principal of size reduction, grain shape, size reduction machines; crushers, grinders, cutting machines etc. - operation, efficiency and power requirement – Rittinger's, Kick' s and Bond' s equation, fineness modulus. Theory of mixing, types of mixtures for dry and paste. Materials, rate of mixing and power requirement, mixing index. Theory of separation, size and un sized separation, types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation. Theory of filtration, study of different types of filters, rate of filtration, pressure drop during filtration. Scope & importance of material handling devices, study of different types of material handling systems; belt, chain and screw conveyor, bucket elevator, pneumatic conveying, gravity conveyor- design consideration, capacity and power requirement.
References:	• Unit operations of Agricultural Processing By: Sahay, K. M. & K.K. Singh. • Post harvest technology of cereals, pulses and oilseeds. ,By: Chakraverty, A. • Agricultural process engineering. By: Henderson, S. M. and R. L. Perry.

	• Unit operations of chemical engineering. By: McCabe, W. L. J.C. Smith and Peter Harriott. • The fundamental of food engineering By: Charm, S. E.
Course Outcomes	At the end of the course, learners will be able **CO1**: To acquaint the students with various post harvest operations of cereal, pulses and oil seeds. **CO2**: Explain the functions of various unit operations and working of size reduction equipments for processing of fibrous and dry size reduction in processing of agriculture produce. **CO3:** Explain the design and working of mixing equipments for powder, high and low viscosity liquids. **CO4:** Classify separator equipment based on physical characteristics of grains. **CO5:** Explain the importance, design and working of milling and material handling devices.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP - 204**
Course title	**Theory of Machines**
Corse credit	**3 (2+1)**
Objective of Course	1. To explain the principles of kinematic chain, pairs, 3&4 bar mechanisms, Inversion, Compute velocity and acceleration in mechanisms. 2. To study various power transmissions drives gears, gear trains, gear profiles, belt drives, chain drives, friction. 3. To study different types of governors and classification 4. To study balancing, classification of balancing
Course Content	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 centers. 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 epicyclic trains. Determining velocity ratio by tabular method. Turning moment diagrams, co-efficient of fluctuation of speed and energy, weight of flywheel, flywheel applications. Belt drives, types of drives, belt materials. Length of belt, power transmitted, velocity ratio, belt size for flat and V belts. Effect of centrifugal tension, creep and slip on power transmission, Chain drives. Types of friction, laws of dry friction. Friction of pivots and collars. Single disc, multiple disc, and cone clutches. Rolling friction, anti friction bearings. 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. Static and dynamic balancing. Balancing of rotating masses in one and different planes. Partial primary balancing of reciprocating measures. **Practicals** 1. Study and demonstration of different kinematic mechanism 2. Analysis of 4-bar mechanism and its inversions 3. Graphical solution of velocity diagram of Practical linkage mechanism. 4. Graphical solution of Acceleration diagram of Practical linkage mechanism. 5. Design and drawing of spur gear train. 6. Design and drawing of epicyclic gear train. 7. Study of cam and follower, its Practical utility 8. Study and demonstration of flywheel and governor

	9. Study and demonstration of static and dynamic balancing.
References:	Theory of Machine ,By: R.S. Kurmi & Gupta Theory of Machine ,By: B. L. Ballani Theory of Machine ,By: Green Engg. Dynamics ,By: Thomas J.M.
Course Outcomes	At the end of the course, learners will be able. **CO1**: To explain the principles of kinematic chain, pairs, mechanisms, Compute velocity and acceleration in planar 3 & 4 bar mechanisms. Apply the concepts of kinematics in predicting motion mechanism for given application. **CO2**: Compute the gear terminology suitable for given application, gear profiles, power transmission and drives. **CO3:** Apply the concept of governor and its terminology. **CO4:** Apply the concepts of static and dynamic balancing for different conditions.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**PFE - 204**
Course title	**Heat & Mass Transfer**
Corse credit	**2+0**
Objective of Course	1. To develop a foundational understanding of introductory concepts in heat transfer. 2. To gain proficiency in solving the general differential equation of conduction, convection, and radiation. 3. To investigate convection processes, covering free and forced convection. 4. To develop a comprehensive understanding of radiation principles, including absorptivity, reflectivity, and transmissivity of radiation. 5. Apply heat transfer principles to analyse heat exchangers, considering fouling factors, LMTD, heat exchanger performance, and transfer units.
Course Content	Introductory concepts, modes of heat transfer, thermal conductivity of materials, measurement. General differential equation of conduction. One dimensional steady state conduction through plane and composite walls, tubes, and spheres with and without heat generation. Electrical analogy. Insulation materials, critical thickness of insulation. Fins, Free and forced convection. Newton' s law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Useful non dimensional numbers and empirical relationships for free and forced convection. Equation of laminar boundary layer on flat plate and in a tube. Laminar forced convection on a flat plate and in a tube. Combined free and forced convection. Introduction. Absorptivity, reflectivity, and transmissivity of radiation. Black body and monochromatic radiation, Planck' s law, Stefan-Boltzmann law, Kirchoff' s law, grey bodies and emissive power, solid angle, intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection, and radiation by networks. Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Flick's law, mass transfer coefficients. Reynold' s analogy.
References:	1. Heat transfer, By: Holman, J. P. 2. Process Heat Transfer ,By: Kern. 3. Heat Transfer ,By: Pitts and Sissom (1983). 4. Heat and Mass Transfer By: Eckert E.R.G. and Drake, R.M. (1972).. 5. Mass Transfer operations By: Treybal, R.E. (1981). 6. Fundamentals of Engineering heat transfer By: Sachdeva (1986). 7. Introduction to Heat Transfer. ,By: Incropera, F.P. (2001).

	8. Convective Heat Transfer. ,By: Bejan, A. (1994). 9. Radiation Heat Transfer., By: Sparrow, E.M. and Cess, R.D. (1978).
Course Outcomes	At the end of the course, learners will be able **CO1**: **Applied Understanding of Heat Transfer Fundamentals:** Graduates will demonstrate an applied understanding of introductory heat transfer concepts, including modes of heat transfer and thermal conductivity, utilizing appropriate measurement techniques in practical scenarios. **CO2: Proficiency in Solving Conduction Problems:** Students will exhibit proficiency in solving the general differential equation of conduction, particularly in one-dimensional steady-state scenarios through various geometries, employing the electrical analogy for effective problem-solving. **CO3: Competence in Convection Analysis:** Graduates will showcase competence in analysing convection phenomena, understanding, and applying Newton's law of cooling, determining heat transfer coefficients through dimensional analysis, and employing non-dimensional numbers and empirical relationships in both free and forced convection scenarios. **CO4: Comprehensive Understanding of Radiation Principles:** Students will demonstrate a comprehensive understanding of radiation principles, including concepts like absorptivity, reflectivity, and transmissivity, and their application in real-world scenarios involving radiation exchange between surfaces. **CO5: Applied Knowledge in Heat Exchanger Analysis and Mass Transfer:** Graduates will apply heat transfer principles to analyse heat exchangers, considering factors like fouling, log mean temperature difference, and heat exchanger performance. Additionally, they will demonstrate an understanding of steady-state molecular diffusion in fluids, Fick's law, and mass transfer coefficients, applying this knowledge to real-world scenarios in heat exchanger design and mass transfer processes.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**PFE - 206**
Course title	**Database Management and Internet Applications**
Corse credit	**2 (0 + 2)**
Objective of Course	1. To understand the basic concepts of Database and its components. 2. To learn usage of database functions and SQL concepts. 3. To impart the knowledge of the Internet & HTML. 4. To understand database connectivity in website.
Course Content	Basic database concepts, introduction to RDBMS, SQL Commands, Data constraints, Joins, set operations, working with forms, Basics of HTML, developing web pages using mata tags, dynamic pages using Java scripts, connectivity with RDBMS, Project. Basic database concepts; Introduction to RDBMS; SQL Commands DDL, DML; Select command, Joins and functions; Group functions, Set functions; Working with Forms; Basic of HTML; Development of Web pages using mata tags; Dynamic pages using Java Scripts; Connectivity of Web pages with databases; Project.
References:	▪ Commercial application Development ,By: Ivan Bayross ▪ SQL / PL SQL ,By: Ivan Bayross ▪ Absolute beginner's Guide to Creating Web Pages ,By: Todd Stauffer ▪ Java Scripts & DHTML Cookbook ,By: Danny Goodman ▪ Dynamic Web Forms Professional Projects ,By: Dan Ransom
Course Outcomes	At the end of the course, learners will be able **CO1**: explain the concepts of database **CO2**: perform database operations and expertise in SQL. **CO3**: knowledge of Internet & develop web pages using HTML **CO4**: knowledge of database web connectivity.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course code	**FMP-206**
Course title	**Field Operation and Maintenance of Tractors and Farm Machinery - I**
Course credit	**1 (0 + 1)**
Objective of Course	1) To get familiarise various systems of a tractor. 2) To get knowledge about tractor controls & learning procedure of tractor driving. 3) To do the driving practice of tractor alone and tillage tool and their adjustment, hitching in the field. 4) To do the practice of operation and field adjustments of various agricultural operations.
Course Content	Introduction to various systems of a tractor viz. fuel, lubrication, cooling, electrical, transmission, hydraulic & final drive system. Familiarization with tractor controls & learning procedure of tractor starting and stopping. Driving in forward and reverse gears.Driving safety rules. Hitching, adjustments, settings and field operation of farm machinery. Familiarization with different makes & models of 4- wheeled tractors. Starting & stopping practice of the tractor. Familiarization with instrumentation panel & controls; Road signs, traffic rules, road safety, driving & parking of tractor; Tractor driving practice forward & reverse driving practice; Tractor driving practice with two wheeled tractor trailer forward & reverse; Study and practicing the hitching and dehitching of implements; Study operation and field adjustments of m.b. plough & disk plough; Field operation of trailing & mounted disk harrow; Field operation and adjustments of seed drill/planter/sprayer.
References	• Elements of Agril. Engg.,By: J. Sahay • A course in Industrial safety, By: K.U. Mistry • Farm machines and equipment, By: C.P. Nakra
Course Outcomes	At the end of the course, learners will be able **CO1:** Become familiar of various systems of a tractor. **CO2:** Know about tractor controls & learn the procedure of tractor driving. **CO3:** Drive tractor alone and with tillage tool and be capable to do hitching in the field. **CO4:** Capable to do field adjustments of various agricultural operations.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course code	**FMP-301**
Course title	**Machine Drawing and CAD/CAM Commuter Graphics**
Corse credit	**1+2**
Objective of Course	1. To familiarize students with the principles and applications of the First and Third Angle Methods of projection. 2. To develop proficiency in creating working drawings from models and isometric views, missing views, and methods of dimensioning. 3. To introduce the concept of sectioning in technical drawings, covering revolved and oblique sections. 4. To explore different types of rivet heads and riveted joints, processes for producing leak-proof joints. 5. To introduce design process and the application of computers in Computer-Aided Design (CAD) system.
Course Content	First and third angle methods of projection. Preparation of working drawing from models and isometric views. Drawing of missing views. Different methods of dimensioning. Concept of sectioning. Revolved and oblique section. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints. Nomenclature, thread profiles, multi-start threads, left and right hand thread. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts. Design process, application of computers for design, definition of CAD, benefits of CAD, CAD system components. Computer hardware for CAD. Display, input and output devices. Graphic primitives, display file, frame buffer, display control, display processors, Line generation, graphics software. Points and lines, Polygons, filling of polygons. Text primitive. Other primitives. Windowing and clipping, view port. Homogeneous coordinates. Transformations. Planar and space curves design. Analytical and synthetic approaches. Parametric and implicit equations. Bspline and Beizer curves. Geometric modeling techniques. Wire frames. Introduction to solid modeling. Introduction to numerical control, basic components of NC system, NC coordinates and motion control systems. Computer numerical control, direct numerical control, combined CNC/DNC. NC machine tools and control units. Tooling for NC machines, part programming, punched tape, tape coding and format, manual and computer assisted part programming.
References:	1. Quality in Design and Manufacturing (CAD/CAM) ,By: Dalela Suresh 2. Mechatronics – K. Adinarayana 3. CAD/CAM Robotics & factories of the future ,By: S. Narayan, K. J. Reddy, P. Kuppan K. 4. CAD/CAM ,By: Rao P.N. 5. CAD/CAM : Computer-Aided Design And Manufacturing , By: Groover, M, Zimmers. 6. CAD/CAM Theory And Practice, By: Zeid, Ibrahim.
Course Outcomes	At the end of the course, learners will be able **CO1**: **Proficient Projection Techniques:** Graduates will demonstrate proficiency in utilizing both First and Third Angle Methods of projection, showcasing their ability to create accurate and standardized technical drawings. **CO2: Effective Working Drawing Preparation:** Students will produce working drawings from models and isometric views, including the generation of missing views, employing various dimensioning methods for clear and precise technical documentation. **CO3: Competence in Sectional Drawing:** Graduates will exhibit competence in conceptualizing sectioning, creating detailed sectional drawings of simple machine parts with emphasis on clarity, accuracy, and adherence to standards. **CO4: Expertise in Fastening and Joint Techniques:** Students will showcase expertise in understanding and representing various fastening and joint techniques, including riveted joints, welded joints, and the design and representation of different types of nuts, bolts, screws, and foundation bolts. **CO5: Proficiency in Computer-Aided Design (CAD):** Graduates will possess a foundational understanding of CAD, including knowledge of system components,

	hardware requirements, graphic primitives, display control, and basic graphics software concepts. They will be prepared to apply CAD techniques in the design process, leveraging computer-assisted tools for efficient and accurate technical drawings.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP-303**
Course title	**Machine Design**
Corse credit	**2+1**
Objective of Course	1. To understand the role and significance of design in engineering. 2. To familiarize students with common engineering materials and their mechanical properties. 3. To provide knowledge on types of loads and stresses, theories of failure, and the concept of factor of safety. 4. To instruct on the design principles of various mechanical components, including cotter joints, knuckle joints, pinned joints, turnbuckles, and welded joints subjected to static loads. 5. To enable students to use application of design principles in real world.
Course Content	Meaning of design, Phases of design, design considerations. Common engineering materials and their mechanical properties. Types of loads and stresses, theories of failure, factor of safety, selection of allowable stress. Stress concentration. Elementary fatigue and creep aspects. Cotter joints, knuckle joint and pinned joints, turnbuckle. Design of welded subjected to static loads. Design of threaded fasteners subjected to direct static loads, bolted joints loaded in shear and bolted joints subjected to eccentric loading. Design of shafts under torsion and combined bending and torsion. Design of keys. Design of muff, sleeve, and rigid flange couplings. Design of helical and leaf springs. Design of flat belt and V-belt drives and pulleys. Design of gears. Design of brackets, levers, columns, thin cylindrical and spherical shells. Design of screw motion mechanisms like screw jack, lead screw, etc. Selection of antifriction bearings. Design of curved beams; Crane hooks, circular rings, etc.
References:	
Course Outcomes	At the end of the course, learners will be able **CO1**: **Comprehensive Design Understanding:** Graduates will demonstrate a comprehensive understanding of design principles, including the meaning of design, the phases involved, and key considerations, providing a solid foundation for engineering design processes. **CO2: Informed Material Selection:** Students will exhibit the ability to make informed decisions about material selection, considering the mechanical properties of common engineering materials, ensuring optimal choices based on the requirements of the design. **CO3: Analysis of Loads and Stresses:** Graduates will be proficient in analyzing loads and stresses, applying theories of failure, calculating factors of safety, and making suitable selections of allowable stress, while understanding stress concentration, fatigue, and creep aspects in materials. **CO4: Competence in Mechanical Component Design:** Graduates will showcase competence in designing a variety of mechanical components, including joints, fasteners, shafts, keys, couplings, springs, belt drives, pulleys, gears, brackets, levers, columns, and various motion mechanisms, applying design principles effectively. **CO5: Application of Design Principles to Real-world Scenarios:** Students will demonstrate the ability to apply design principles to real-world scenarios, including the selection of antifriction bearings and the design of curved beams, crane hooks,

	circular rings, and screw motion mechanisms. This ensures that graduates are prepared to address practical engineering challenges across a range of applications.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**PFE - 301**
Course title	**Dairy and Food Engineering**
Corse credit	**3 (2 + 1)**
Objective of Course	1. To understand the scope and importance of dairy process operations. 2. To understand the laws of deterioration in products and their controls. 3. To understand the food components during processing, evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing
Course Content	Dairy development in India. Engineering, thermal and chemical properties of milk and milk products, unit operation of various dairy and food processing systems, process flow charts for product manufacture, working principles of equipment for receiving, pasteurization sterilization, homogenisation, filling & packaging, butter manufacture, dairy plant design and layout, composition and proximate analysis of food products. Deterioration in products and their controls. Physical, chemical and biological methods of food preservation, changes undergone by the food components during processing, evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing, plant utilities requirement.
References:	• Dairy plant engineering and management, By: Tufail Ahmed.. • Engineering for dairy and food products, By: Farrall, A. W. • Food processing Technology: Principle and Practice, By: Fellow, P • Introduction to Food Engineering, By: Singh, R.P. and Heldman, D.R. • The Technology of milk processing, By: Khan A. Q. and Padmanabhan, P.N. • Food Engineering Brennam, By: J. G., Butters J.R., Cowell N.D and Lilly, A.E.I. • Food process engineering, By: Heldman, D. R and Singh, R.P. (1981).
Course Outcomes	At the end of the course, learners will be able **CO1**: To acquaint the students with various milk properties. **CO2**: Illustrate heat treatment processes used in milk preservation. **CO3:** Determine the energy required to process the fresh milk. **CO4:** Demonstrate the working of homogenizer and cream separator. **CO5:** Examine the design and layout of dairy plant.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course Code	**FMP - 305**
Course Title	**Tractor Systems and Controls**
Course Credit	**3 (2 + 1)**
Objective of Course	1) To get knowledge about different systems of tractor- its need, types, functional requirements, construction and principle of operation. 2) To acquaintance with tractor mechanics 3) To understand the concept of traction and weight transfer phenomenon of tractor. 4) To understand use of ergonomic considerations and operational safety in tractor design.
Course Content	Study of transmission systems, clutch, gear box, differential and final drive mechanism. Familiarization of brake mechanism. Ackerman steering and hydraulic systems. Tractor power outlets: P.T.O., belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability. Ergonomic considerations and operational safety.
References	• Tractors & their power units, By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki • Tractor, By: Oleg Sapunon • Theory of machines, By: P.L. Ballaney • Human factors in Engg, & Design, By: Mark S., Sanders & Ernet J. McCormick • Automobile Engineering Vol. I , By: Kirpal Singh • Tractors and their Power Units. , By: Barger E.L., Bainer & Liljedhal. • Theory, Maintenance and Repair. , By: Gupta RB and Gupta BK. Tractor Mechanics. • Testing and Evaluation of Agricultural Machinery.By: Mehta ML, Verma SR, Mishra SK and Sharma VK. National Agricultural Technology Information Centre, Ludhiana. • Farm Tractor – Maintenance and repair, By: Jain SC and Rai CR. Tractor and Auto mobiles. , By: Rodichev V and Rodicheva G. • Principles and Practices. , By: Heitner J. Automotive Mechanics – • Agricultural Engineers Hand Book, By: Richey C.W., Jacobson P. and Hall C.W. • John Deere. Fundamentals of Service Hydraulics. • Relevant Tractor Test Codes -I.S.E. OECD, etc.
Course Outcomes	At the end of the course, learners will be able **CO1**: Able to identify and repair trouble shooting coming during operation of the tractor **CO2**: Design different systems of tractor **CO3**: Able to develop different components of the tractor system. **CO4**:Able to design comfortable and less hazardous work station for tractor.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**PFE-303**
Course title	**Electrical Machines and Power Utilization**
Corse credit	**3 (2+1)**
Objective of Course	1. To impart the basic knowledge about the DC, AC and Magnetic circuits. 2. To comprehend the working of various Electrical Machines. 3. To know about various power converters and electrical installations.
Course Content	**Theory:** Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses, Transformer: principle of working, construction of single phase transformer, EMF

	equation, phasor diagram on load, leakage reactance, transformer on load, equivalent circuit, voltage regulation, power and energy efficiency, open circuit and short circuit tests, principles, operation and performance of DC machine (generator and motor), EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics, DC motor characteristics, starting of shunt and series motor, starters, speed control methods-field and armature control, polyphase induction motor: construction, operation, equivalent circuit, phasor diagram, effect of rotor resistance, torque equation, starting and speed control methods, single phase induction motor: double field revolving theory, equivalent circuit, characteristics, phase split, shaded pole motors, disadvantage of low power factor and power factor improvement, various methods of single and three phase power measurement. **Practicals:** To get familiar with AC, DC machines and measuring instruments; To perform Open circuit and short circuit tests on a single phase transformer and hence find equivalent circuit , voltage regulation and efficiency; To study the constructional details of D.C. machine and to draw sketches of different components ; To obtain load characteristics of d.c. shunt/series /compound generator; To study characteristics of DC shunt/ series motors; To study d.c. motor starters; To Perform load-test on 3 ph. Induction motor & to plot torque V/S speed characteristics; To Perform no-load & blocked –rotor tests on 3 ph. Induction motor to obtain equivalent ckt. Parameters & to draw circle diagram;To study the speed control of 3 ph. Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor; To study star- delta starters physically and to draw electrical connection diagram to start the 3 ph. Induction motor using it to reverse the direction of 3 ph. I.M. To start a 3 phase slip –ring induction motor by inserting different levels of resistance in the rotor ckt. And to plot torque –speed characteristics; To perform no-load & blocked – rotor test on 1 ph. Induction motor & to determine the parameters of equivalent ckt. Drawn on the basis of double revolving field theory; To Perform load –test on 1 ph. Induction motor.
References:	1. Thareja B L & Theraja AK. 2005. A text book of Electrical Technology. Vol. I S. Chand & Company LTD., New Delhi. 2. Theraja B L & Theraja AK 2005. A text book of Electrical Technology. Vol. II S.Chand & Company LTD., New Delhi. 3. Vincent Del Toro. 2000. Electrical Engineering Fundamentals. Prentice-Hall of India Private LTD., New Delhi. Anwani M L. 1997. Basic Electrical Engineering. Dhanpat Rai & Co.(P) LTD. New Delhi
Course Outcomes	At the end of this course students will demonstrate the ability to CO1. Describe the basic terminologies of DC, AC circuits. CO2. Define the basic concepts of Magnetic circuits and transformers. CO3. Predict and analyze the behavior of any circuits. CO4. Identify the type of electrical machine used for required application. CO5. Classify various means of power conversion methodologies. CO6. Plan electrical wiring, earthing for household and commercial purposes.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP-307**
Course title	**Field Operation and Maintenance of Tractors and Farm Machinery - II**
Course credit	**2 (1 + 1)**
Objective of Course	1) To get knowledge about regular and periodical maintenance of tractor. 2) To get knowledge about safety rules/ Safety hints and precautions to be observed while driving a tractor. 3) To familiarise with care and maintenance procedure of agricultural machinery during operation and off-season.
Course Content	Introduction to tractor maintenance procedure and troubleshooting. Scheduled maintenance after 10, 50, 100, 250, 500 and 1000 hrs of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance workshop requirements.
References	• Repair & maintenance of tractors, By: Jain & Rai • Farm Machines and equipment, By: CP Nakra, Dhanpar Rai & sons, New Delhi • Operator’s service manuals of each tractors, farm machinery. • Farm machine, By: Jagdishwar Sahaye
Course Outcomes	At the end of the course, learners will be able **CO1**: Do regular and periodical maintenance of the tractor. **CO2**: Drive the tractor safely and with precautions. **CO3**: Become a familiar with care and maintenance procedure of agricultural machinery during operation and off-season.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															

Course code	**RE-301**
Course title	**Strength of Materials**
Course credit	**3 (2 + 1)**
Objective of Course	1. Master methods for analyzing slope and deflection of beams, including integration techniques and moment area theorems. 2. Understand the behavior and analysis of columns, struts, and different types of connections like riveted and welded connections. 3. Grasp the stability principles and analysis techniques for masonry dams. 4. Learn advanced beam analysis methods, including statically intermediate beams, propped beams, and fixed/continuous beam analysis using various methods. 5. Apply theoretical knowledge to practical scenarios, evaluating structural stability and behavior of different beam configurations
Course Content	Slope and deflection of beams using integration techniques, moment area theorems and conjugate beam method. Columns and Struts. Riveted and welded connections. Stability of masonry dams. Analysis of statically indeterminate beams. Propped beams. Fixed and continuous beam analysis using superposition, three moment equation and moment distribution methods.
References:	• Mechanics of Materials , By: E. P. Popov • Strength of Material , By: Ramamrutham • Strength of Materials and Mechanics of Structures , By: B. C. Punmia, • Analysis of Structures Vol.-I and Vol.-II , By: V. N. Vazirani & M. M. Ratwani • Theory of Structures , By: S. Ramamrutham and R. Narayan,
Course Outcomes	At the end of the course, learners will be able CO1: Proficiency in analyzing beam deflection and slope using integration, moment area theorems, and conjugate beam methods.

	CO2: Competency in analyzing columns, struts, and various connections in structural systems. CO3: Understanding of stability principles and analysis methods for masonry dams. CO4: Mastery of advanced beam analysis techniques for various beam configurations. CO5: Application of theoretical knowledge to assess structural stability and behavior in real world scenarios.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**SWE - 301**
Course title	**Ground Water, Wells and Pumps**
Corse credit	**3 (2 + 1)**
Objective of Course	• Understanding Groundwater Dynamics: Gain insight into the occurrence, movement, and various types of aquifers, delve into the classification of wells, and analyze the concepts of steady and transient flow into different types of wells. • Proficiency in Well Design and Drilling Techniques: Familiarize with bore well types prevalent in the state, learn the design aspects of open wells, and explore groundwater exploration techniques, drilling methods (percussion, rotary, reverse rotary), well screen installation, and completion. • Aquifer Parameter Determination and Groundwater Modeling: Learn methodologies to determine aquifer parameters using approaches like Theis, Jacob, and Chow's methods, along with understanding Theis recovery method, well interference, multiple well systems, surface, and subsurface exploitation for estimating groundwater potential. • Groundwater Quality and Artificial Recharge: Assess the quality of groundwater, study artificial groundwater recharge planning, and engage in groundwater project formulation and modeling for sustainable utilization. • Pumping Systems and Machinery Design: Explore water lifting devices and diverse pumping machinery, including centrifugal pumps, hydraulic ram, propeller pumps, mixed flow pumps, and their design aspects, selection criteria, installation, performance curves, and troubleshooting methodologies for different types of pumps. These objectives aim to cover a broad range of topics in groundwater engineering, including aquifer dynamics, well design, drilling techniques, groundwater modeling, quality assessment, artificial recharge, and pumping systems, providing a comprehensive understanding of groundwater exploration and utilization.
Course Content	**Theory** Occurrence and movement of ground water, aquifer and its types, classification of wells, steady and transient flow into partially, fully and non-penetrating and open wells, familiarization of various types of bore wells common in the state, design of open well, groundwater exploration techniques, methods of drilling of wells, percussion, rotary, reverse rotary, design of assembly and gravel pack, installation of well screen, completion and development of well, groundwater hydraulicsdetermination of aquifer parameters by different method such as Theis, Jacob and Chow’ s etc. Theis recovery method, well interference, multiple well systems, surface and subsurface exploitation and estimation of ground water potential, quality of ground water, artificial groundwater recharge planning, modeling, ground water project formulation. Pumping Systems: Water lifting devices; different types of pumping machinery, classification of pumps, component parts of centrifugal pumps; pump selection, installation and trouble shooting; design of centrifugal pumps, performance curves, effect of speed on head capacity, power capacity and efficiency

curves, effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics; priming, self-priming devices, rotodynamic pumps for special purposes such as deep well turbine pump and submersible pump.

Practical

Verification of Darcy' s Law

- Study of different drilling equipments
- Sieve analysis for gravel and well screens design
- Estimation of specific yield and specific retention
- Testing of well screen
- Drilling of a tubewell
- Measurement of water level and drawdown in pumped wells
- Estimation of aquifer parameters by Thies method, Coopers- Jacob method , Chow method, Theis Recovery method
- Well design under confined and unconfined conditions, well losses and well efficiency
- Estimating ground water balance
- Study of artificial ground water recharge structures
- Study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pumps, turbine, propeller and other pumps
- Installation of centrifugal pump
- Testing of centrifugal pump and study of cavitations
- Study of performance characteristics of hydraulic ram
- Study and testing of submersible pump

References:

- Wells and Pumps Engineering, By: S D Khepar and A M Michael,
- Pump: Theory & Practices, By: Jain V K
- Ground water Hydrology, By: H M Raghunath

Course Outcomes

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

- Understand groundwater occurrence, aquifer types and well classification.
- Analyze steady and transient flow into wells, design open wells and explore groundwater.
- Master well drilling methods, including percussion, rotary and reverse rotary.
- Determine aquifer parameters using various methods (Theis, Jacob, Chow) and assess well interference.
- Plan and design artificial groundwater recharge and pumping systems, including centrifugal pumps.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**PFE - 302**
Course title	**Agricultural Structures and Environment Control**
Corse credit	3 (2 + 1)
Objective of Course	1. To impart knowledge on need of environmental control, environmental control systems, farm structures, storage of grain, traditional and modern storage structures, rural water supply, sewage system etc. 2. To enable the students to acquire skills and to understand farm structures, design grain storage etc, and rural development activities
Course Content	Planning and layout of farmstead. Physiological reactions of livestock to solar radiation and other environmental factors, livestock production facilities, BIS. Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc. Design and construction of rural grain storage system Engineering for 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. Site and orientation of building in regard to sanitation, community sanitation system; sewage system- its design, cost and maintenance, design of septic tank for small family. Estimation of power requirement for domestic and irrigation, source of power supply, use of alternate source of energy, electrification of rural housing. Scope, importance and need for environmental control, renewable and non-renewable resources and their equitable use, concept of eco system, biodiversity of its conservation, environmental pollution and their control, solid waste management system, BOD and COD of food plant waste, primary and secondary treatment of food plant waste.
References:	• Ventilation of Agricultural Structures, By: Hellickson, M.L. and Walker, J.N. • Farm Structures in tropical climates. FAO, By Bengtsson, L.P. • Agricultural buildings and structures. National Food & Energy, By Whitaker, J.H Farm buildings: From planning to completion, By Phillips, R.E. • Practical farm buildings: A textbook & Handbook, By Boyd, J.S. • Environmental control for animals and plants. ASAE Textbooks., By ALbright, L.D.
Course Outcomes	At the end of the course, learners will be able **CO1**: To acquaint the students with various aspects of agricultural structures such as farm stead and dairy barn. **CO2:** To acquaint the students with various aspects of environmental control, renewable and non-renewable resources of energy **CO3**: Graps the ramifications of the agricultural structural solution within around and awareness for sustainable development **CO4**: Design solutions for engineering aspects of agricultural structures and environmental part to fulfil the requirements, giving due regards to public health and safety and environmental factors.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

<table>
<tr><td>Course code</td><td>PFE - 304</td></tr>
<tr><td>Course title</td><td>Drying and Storage Engineering</td></tr>
<tr><td>Corse credit</td><td>4 (3 + 1)</td></tr>
<tr><td>Objective of Course</td><td>10. To enable the students to understand concepts of equilibrium moisture content and models.
11. To apply knowledge of engineering principles to drying rates and drying methods
12. To understand need of storage and various indigenous storage practices.
13. To become aware modern storage structures</td></tr>
<tr><td>Course Content</td><td>Theory
Moisture content and methods for determination, importance of EMC and methods of its determination, EMC curve and EMC model, principle of drying, theory of diffusion, mechanism of drying- falling rate, constant rate, thin layer, deep bed and their analysis, critical moisture content, drying models, calculation of drying air temperature and air flow rate, air pressure within the grain bed, Shred' s and Hukill' s curve, different methods of drying including puff drying, foam mat drying, freeze drying, etc. Study of different types of dryers- performance, energy utilization pattern and efficiency, study of drying and dehydration of agricultural products. Types and causes of spoilage in storage, conditions for storage of perishable products, functional requirements of storage, control of temperature and relative humidities inside storage, calculation of refrigeration load; modified atmospheric storage and control of its environment, air movement inside the storage, storage of grains: destructive agents, respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through natural ventilation, mechanical ventilation, artificial drying, grain storage structures such as Bukhari, Morai, Kothar, silo, CAP, warehouse - design and control of environment. Storage of cereal grains and their products, storage of seeds, hermetically sealed and air-cooled storages-refrigerated, controlled atmosphere, modified atmospheric and frozen storages. Storage condition for various fruits and vegetables under cold and CA storage system. Economic, aspects of storage.
Practical
Study of mechanics of bulk solids affecting cleaning, drying and storage of grains; Measurement of moisture content during drying and aeration; Measurement of relative humidity during drying and aeration using different techniques; Measurement of air velocity during drying and aeration; Drying characteristic and determination of drying constant; Determination of EMC and ERH; Study of various types of dryers; To study the effect of relative humidity and temperature on grains stored in gunny bags; Design and layout of commercial bag storage facilities; Design and layout of commercial bulk storage facilities; Study of different domestic storage structures; Visits to commercial handling and storage facilities for grains.</td></tr>
<tr><td>References:</td><td>• Drying and storage of grains and oilseeds, By: Brooker D. B. F. W. BakkeeArkema and C. W. Hall.
• Unit operations of Agricultural Processing, By: Sahay, K. M. & K.K. Singh.
• Post-harvest technology of cereals, pulses and oilseeds, By: Chakraverty, A.
• Handling and storage of food grains in tropical and subtropical area~, By: FAO
• Pub.
• Preservation and storage of grains, seeds and their by-products, By: Multon, J. L.
• Grain storage Engineering and Technology, By Vijayaraghavan, S.
• Dehydration of foods C.V-By Barbosa -ca,novas and H, Vega;. Mercado.
• Applied numerical methods for food and Agricultural engineers. , By :Chandra P. K, Singh R.P</td></tr>
<tr><td>Course Outcomes</td><td>At the end of the course, learners will be able
CO1: Get knowledge of utility of drying and factors affecting the drying rates
CO2: Identify various drying methods suitable to different agricultural produce.
CO3: Understand the need of storage and various factors responsible for deterioration of agricultural produce.
CO4: Acquire the knowledge of advanced storage practices in warehouses.</td></tr>
<tr><td colspan="2">Mapping between Cos, POs and PSOs</td></tr>
</table>

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course code	**RE-302**
Course title	**Design of Structure**
Corse credit	**3 (2 + 1)**
Objective of Course	1. Gain knowledge related to BIS code application for structural design and analysis in steel members, connections, and trusses. 2. Analyze and design critical elements like reinforced sections, considering shear, bond, and torsion. 3. Apply design principles to create safe and efficient structural elements including beams, slabs, columns, foundations. 4. Integrate structural design expertise into agricultural structures like cattle sheds, poultry houses, rural water supply systems, and farm fencing. 5. Develop proficiency in diverse structural designs, incorporating agricultural and rural infrastructure requirements.
Course Content	**Course content: Theory** Loads and use of BIS Codes. Design of connections. Design of structural steel members in tension, compression and bending. Design of steel roof truss. Analysis and design of singly and doubly reinforced sections, Shear, Bond and Torsion. Design of Flanged Beams, Slabs, Columns, Foundations, Retaining walls and Silos, Cattle shed, Poultry House, Rural Water Supply, Farm fencing. **Practical** Design and drawing of single reinforced beam, double reinforced beam, Design and drawing of steel roof truss; Design and drawing of one way, two way slabs, Design and drawing of RCC building; Design and drawing of Retaining wall. To measure workability of cement by slump test.
References:	
Course Outcomes	At the end of the course, learners will be able **CO1**: Apply BIS codes to design various structural elements and connections. CO2: Master the design of steel members, trusses, and critical structural sections. CO3: Engineer diverse structures like beams, slabs, columns, foundations, walls, silos, sheds, and fencing. CO4: Implement theoretical knowledge into practical solutions for rural infrastructure, including water supply systems. CO5: Develop expertise in standardized structural design for innovative construction in agricultural and rural settings.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**SWE - 302**
Course title	**Drainage Engineering**
Corse credit	**2 (1 + 1)**
Objective of Course	• Understanding Drainage Objectives and Problems: Explore the primary objectives of drainage and gain familiarity with specific drainage issues prevalent in the state to address them effectively. • Surface and Subsurface Drainage Design: Delve into surface drainage concepts, including drainage coefficient, types of surface drainage, and open channel design, and understand the purpose, benefits, and design parameters of subsurface drainage systems like hydraulic conductivity, drainable porosity, and water table. • Design and Implementation of Drainage Systems: Learn about the types and utilization of subsurface drainage systems, surface drain design, interceptor and relief drains, and derive ellipse (Hooghoudt's) and Ernst's drain spacing equations. Study the design, materials, construction, and installation aspects of subsurface drainage systems and drainage structures. • Drainage Techniques for Specific Conditions: Explore specialized drainage techniques such as vertical drainage, bio-drainage, tile drains, and strategies for draining irrigated and humid areas. Study salt balance, reclamation of saline and alkaline soils, leaching requirements, and conjunctive use of fresh and saline waters. • Economic and Environmental Aspects of Drainage: Analyze the economic aspects related to drainage projects and comprehend the environmental impacts associated with drainage, focusing on sustainability and optimal resource utilization. These objectives aim to cover a comprehensive range of topics in drainage engineering, including surface and subsurface drainage design, specialized drainage techniques, economic considerations, and environmental sustainability for effective management of drainage-related challenges.
Course Content	Theory Drainage, objectives of drainage, familiarization with the drainage problems of the state, Surface drainage, drainage coefficient, types of surface drainage, design of open channel, sub-surface drainage purpose and benefits, investigations of design parameters, hydraulic conductivity, drainable porosity, water table etc., types and use of subsurface drainage system, Design of surface drains, interceptor and relief drains. Derivation of ellipse (Hooghoudt' s) and Ernst' s drain spacing equations. Design of subsurface drainage system. Drainage materials, drainage pipes, drain envelope. Layout, construction and installation of drains. Drainage structures. Vertical drainage. Bio-drainage. Tile Drains. Drainage of irrigated and humid areas. Salt balance, reclamation of saline and alkaline soils. Leaching requirements, conjunctive use of fresh and saline waters. Economic aspects of drainage. Practical • In-situ measurement of hydraulic conductivity • Determination of drainage coefficients • Installation of piezometer and observation well • Preparation of iso-bath and isobar maps • Measurement of hydraulic conductivity and drainable porosity • Design of surface drainage systems • Design of subsurface drainage systems • Determination of chemical properties of soil and water • Fabrication of drainage tiles • Testing of drainage tiles • Determination of gypsum requirement for land reclamation • Installation of sub-surface drainage system Cost analysis of surface and sub-surface drainage system

References:	• Land and water management; Principles and Practices, By: V V N, Murthy • •Horizontal Drainage System design, By: Dr Cheddi Lal • •Principles of Agricultural Engineering Vol-II,, By: A M Michael & T P Ojha
Course Outcomes	At the end of the course, learners will be able to • Understand drainage objectives and design open channels for surface drainage. • Analyze subsurface drainage benefits and design subsurface drainage systems. • Derive and apply Hooghoudt's and Ernst's equations for drain spacing. • Select appropriate drainage materials, pipes, and envelopes for construction. • Implement various drainage techniques for irrigated and humid areas, including salt balance and reclamation.

Mapping between COs with POs and PSOs

Please refer mapping of PO and PSO for the style of mapping.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	SWE - 304
Course title	**Soil and Water Conservation Structures**
Corse credit	**3 (2 + 1)**
Objective of Course	• Understanding Soil Erosion Control Structures: Comprehend the classification and functional requirements of soil erosion control structures, emphasizing their significance in mitigating erosion effects. • Mastery of Open Channel Flow Principles: Gain a comprehensive understanding of flow dynamics in open channels by exploring different types, states, and regimes of flow. Focus on energy and momentum principles, specific energy, specific force, hydraulic jump, and energy dissipation. • Familiarization with Runoff Measuring Structures: Learn about the various runoff measuring structures such as Parshall flumes, H-flumes, and weirs, their functionalities, design considerations, advantages, and disadvantages. • Design Principles of Spillways: Understand the design, components, and functional aspects of straight drop spillways, chute spillways, and drop inlet spillways. Focus on hydrologic and hydraulic design, safety considerations against various structural failures, energy dissipation techniques, and limitations of SAF (Standard Approach Flow) stilling basins. • Structural Design of Earth Embankments and Reservoirs: Explore the design principles and types of small earth embankments, farm ponds, and reservoirs. Learn cost estimation methods for these hydraulic structures, emphasizing their significance and application in water resource management. • These objectives aim to provide a comprehensive understanding of the principles, design, and functional aspects of various hydraulic structures, emphasizing erosion control, open channel flow, runoff measurement, spillway design, and earth embankment design principles.
Course Content	**Theory** Introduction; classification of structures, functional requirements of soil erosion control structures; flow in open channels-types of flow, state of flow, regimes of flow, energy and momentum principles, specific energy and specific force; hydraulic jump and its application, type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of energy; runoff measuring structures-parshall flume, H - flume and weirs; straight drop spillway - general description, functional use, advantages and disadvantages, structural parts and functions; components of spillway, hydrologic and hydraulic design, free board and wave free board, aeration of weirs, concept of free and submerged flow, structural design of a drop spillway-loads on

headwall, variables affecting equivalent fluid pressure, determination of saturation line for different flow conditions, seepage under the structure, equivalent fluid pressure of triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, over turning, crushing and tension; chute spillway general description and its components, hydraulic design, energy dissipaters, design criteria of a SAF stilling basin and its limitations, drop inlet spillway- general description, functional use, design criteria; design of diversions; small earth embankments-their types and design principles, farm ponds and reservoirs, cost estimation of structures.

- Practical
- Design of H-flume
- Design of Parshall flume
- Construction of specific energy and specific force diagram
- Measurement of hydraulic jump parameters and amount of energy dissipation
- Hydrologic and hydraulic design of a straight drop spillway
- Determination of uplift force and construction of uplift pressure diagram
- Determination of loads on headwall and construction triangular load diagram
- Stability analysis of a straight drop spillway
- Design of drop inlet spillway
- Hydraulic design of a chute spillway;
- Design of small earth embankments
- Design of a SAF energy dissipater
- Design of water harvesting structures;
- Cost estimation of structures.
- Visit to watershed

References:

- Land and water management; Principles and Practices, By V V N Murthy
- Soil and water Conservation Engineering , By R Suresh,

Course Outcomes

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

- Understanding Structural Classification and Functional Requirements: Gain an understanding of soil erosion control structures, their classification, and functional necessities to effectively manage soil erosion issues.
- Proficiency in Open Channel Flow Principles: Master the principles governing flow in open channels, encompassing diverse flow types, states, regimes, energy, and momentum principles, specific energy, specific force, hydraulic jumps, and their application.
- Application of Runoff Measuring Structures: Apply knowledge of runoff measuring structures like Parshall flumes, H-flumes, and weirs, understanding their operational aspects, functional utilities, and design considerations.
- Comprehensive Spillway Design and Structural Analysis: Acquire proficiency in the design, analysis, and assessment of various spillway types, including straight drop spillways, chute spillways, and drop inlet spillways. Understand their components, hydrologic, hydraulic design, and structural considerations to ensure safety against diverse failure modes.
- Design Principles of Hydraulic Structures: Develop design principles for diversions, small earth embankments, farm ponds, and reservoirs. Gain an understanding of cost estimation techniques for these hydraulic structures, emphasizing their purpose, types, and design methodologies.
- These outcomes aim to equip students with a deep understanding of hydraulic structures, erosion control techniques, open channel flow principles, spillway design, structural analysis, and the design intricacies of various hydraulic structures used in water resource management.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
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CO5															
CO6															

Corse code	**FMP- 302**
Course title	**Refrigeration and Air Conditioning**
Corse credit	**3 (2+1)**
Objective of Course	1. To Explain the basic concepts and laws of thermodynamics Processes. 2.To explain the working of Carnot, Otto, Diesel & Dual cycles 3. To Explain VCRS, VARS and refrigeration cycles, duct. 4.Solve problems in psychrometric processes, airconditiong, Cooling load, humidification .and dehumidification
Course Content	Principles of refrigeration, second law of thermodynamics applied to refrigeration, carnet-cycle, reversed carnot cycle, coefficient of performance, unit of refrigeration. Refrigeration in food industry, types of refrigeration system, mechanical vapour compression, vapour absorption system, components of mechanical refrigeration, refrigerant, desirable properties of ideal refrigerant, Centrifugal and steam jet refrigeration systems, thermoelectric refrigeration systems, vortex tube and other refrigeration systems, ultra-low temperature refrigeration, cold storages, insulation material, design of cold storages, defrosting. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process. Air conditioning – principles- Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods, fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling and calculations, types of air conditioners – applications. **Practicals** 1. Study of vapour compression and vapour absorption systems. 2. Study of Electrolux refrigerator. 3. Solving problems on refrigeration on vapour absorption system. 4. Experiments with the refrigeration tutor to study various components of refrigeration. 5. Determination of the coefficient of performance of the refrigeration tutor. 6. Experiment on humidifier for the determination of humidifying efficiency. 7. Experiment on dehumidifier for the determination of dehumidifying efficiency. 8. Experiment on the cooling efficiency of a domestic refrigerator. 9. Experiments on working details of a cold storage plant and air conditioning unit. 10. Experiments with air conditioning tutor to study various components. 11. Determination of the coefficient of performance of air conditioning tutor. 12. Estimation of refrigeration load. 13. Estimation of cooling load for air conditioner. 14. Estimation of humidification and dehumidification load. **15.** Design of complete cold storage system.
References:	Refrigeration & Air conditioning , By: R.S. Khurmi & J.K. Gupta Principles of refrigeration , By: Roy J. Dossat • Refrigeration & Air conditioning , By: Dom Kululwar • Refrigeration & Air condition , By: Jain V.K. A text book of Refrigeration and Air Conditioning, By: Gupta, R. K. & J Food preservation by Refrigeration , By: Lorentze
Course Outcomes	At the end of the course, learners will be able. **CO1**: To Explain basic concepts and laws of thermodynamics, processes, refrigeration, and Air conditioning. **CO2**: To understand the working principals of various power cycles and refrigeration cycles. **CO3:** To solve numerical on VCRS, VARS and refrigeration cycles. **CO4:** Solve the numerical problems on psychrometric processes, airconditiong, Cooling load, humidification .and dehumidification

Mapping between Cos, POs and PSOs

CO	PO												PSO		
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CO1															
CO2															
CO3															
CO4															

Course code	**AEE - 302**
Course title	**Entrepreneurship Development and Communication Skills**
Corse credit	**3 (2 + 1)**
Objective of Course	1. To develop and strengthen the entrepreneurial quality and motivation of learners. 2. To impart the entrepreneurial skills and traits essential to become successful entrepreneurs. 3. To apply the principles and theories of entrepreneurship and management in technology-oriented businesses to empower the learners to run a Technology business efficiently and effectively 4. To improve the communicative competence of learners by using basic grammatic structures in suitable contexts 5. To help learners use language effectively in professional contexts 6. To read and write definitions, descriptions, narrations and essays on various topics
Course Content	Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to horticulture sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Characteristics of Indian farm machinery industry. Social Responsibility of Business. Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences
References:	▪ Extension Communication and Management , By: G. L. Ray ▪ Communication and Instructional Technology, By: Indu Grover, Shusma Kaushik, Lali Yadav, Deepak Grover & Shashikanta Verma ▪ Extension Management, By: Indu Grover, Lali Yadav & Deepak Grover ▪ Communication through Farm Literature, By: G.K. ▪ Agricultural Extension , By: A.W. Van den Ban & H.S .Hawkins ▪ Education and Communication for Development, By: O.P. ▪ Trainers Manual on Developing Entrepreneurial Motivation, By: Akhouri, M.M.P., Mishra, S.P. and Sengupta, Rita ▪ Entrepreneurship, Playing to Win, By: Betty Gordan B ▪ The Entrepreneurs Handbook Vol.1 & 2 , By: Mancuso, ▪ Development of an Entrepreneur : A Behaviouristic Model, Technical paper No. 51, (Mimeographed), Ahmedabad, Indian Institute of Management, By: Rao, ▪ T.V.(1974) ▪ Teaching Oral Communication , By: Donn Byrne ▪ Communicative Language Teaching-An Introduction, By: Francoise Grellet ▪ Developing Reading Skills, By: Janice Yalden ▪ React-Interact Situation for Communications, By: Penny Ur and Andrew Wright

Course Outcomes	At the end of the course, learners will be able to **CO1**: Learn the basics of Entrepreneurship **CO2**: Understand the business ownership patterns and environment **CO3**: Learn about applications of tehnopreneurship and successful technopreneurs and acquaint with the recent and emerging trends in entrepreneurship **CO4**: effectively communicate and articulate in English Communications **CO5:** read and interpret information presented in tables, charts and other graphic forms to write reports, research papers, dissertations, etc.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**AE-401**
Course title	**Project**
Corse credit	**6**
Objective of Course	• To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. • To train the students in preparing project reports and to face reviews and viva voce examination.
Course Details	Students in a group of 2 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.
Course Outcomes	At the end of the course, learners will be able CO1: Identify agricultural engineering problems reviewing available literature. CO2: Identify appropriate techniques to analyse complex agricultural engineering problems. CO3: Apply engineering and management principles through efficient handling of project, have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															

Course code	**AE-403**
Course title	**Seminar**
Corse credit	**6**
Objective of Course	• To develop the ability to present a specific problem right from its identification and literature review till the successful solution of the same. • To train the students in preparing project reports and to face reviews and viva voce examination.
Course Details	Seminar
Course Outcomes	At the end of the course, learners will be able **CO1:** Identify agricultural engineering problems reviewing available literature.

	CO2: Identify appropriate techniques to analyse complex agricultural engineering problems from the topic selected for seminar presentation. **CO3:** Present a specific problem right from its identification and literature review till the successful solution of the same.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															

Course code	**RE-401**
Course title	**Renewable Energy Technology**
Corse credit	**3 (2+1)**
Objective of Course	1. To aware about renewable and non-renewable energy. 2. To give brief idea about types of energy and conversion technologies, processes, systems and devices. 3. To work with different types instruments used for measurements of different parameters related to renewable energy gadgets design. 4. Implementation of renewable energy in project and development.
Course Content	**Theory:** Design and operational parameters, performance evaluation and maintenance aspects of different renewable technologies like gasifiers, biogas plants, solar passive heating devices, photovoltaic cells and arrays, briquetting machines and balers; bio-diesel utilization in CI engines. **Practicals:** Performance evaluation of solar water heater; Performance evaluation of solar cooker; Characteristics of solar photovoltaic panel; Evaluation of solar air heater/dryer; Performance evaluation of a rice husk throatless gasifier engine system; Performance evaluation of down draft gasifier with throat for thermal application; Performance evaluation of a fixed dome type biogas plant; Performance evaluation of floating drum type biogas plant; Estimation of calorific value of producer gas; Testing of diesel engine operation using biodiesel; Evaluation of briquetting machine using biomass material; evaluation of rice straw briquette.
References:	1. Renewable Energy: Power for sustainable future, By: Godfrey Boyle. 2. Energy Technology: Non-conventional, Renewable and Conventional , By: S.S. Rao and B.B. Parulekar 3. Handbook of Biomass Downdraft Gasifier Engine System, By: Thomas B Reed and Aqua Das. 4. Small scale producer gas engine systems, By: A Kaupp & J. R. Goss. 5. Biogas Systems (Principles & Applications) , By: K.M. Mittal, 6. Hand book of biogas technology, By: N.S. Grewal, S. Ahluwalia, S. Singh and G. Singh. 7. Solar Energy Fundamentals and Applications, By: H.P. Garg and J. Prakash, 8. Solar energy, By: S.P. Sukhatme, 9. Principles of Solar Energy. , By: D. Yogi Goswami et al. 10. Renewable Energy, By: P.D. Dunn. Peter Peregrinus Ltd., London
Course Outcomes	At the end of the course, learners will be able **CO1:** To explain the basic principles of various renewable energy conversion processes and devices used therein. **CO2:** To understand the relationships between natural resources, consumption, population, economics of consumerism, etc in an environmental context. **CO3:** Identify various parameters that influence the performance of devices/processes. **CO4:** To aware the environmental problems faced by the modern man in terms of energy.

	CO5: To make a thought in terms of scientific and technological advancement in the spirit of a sustainable energy.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
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CO3															
CO4															
CO5															

Course code	**PFE - 401**
Course title	**Food Packaging Technology**
Corse credit	3 (2 + 1)
Objective of Course	1. To provide knowledge on spoilage of food materials, various packaging systems, different packaging materials and their properties 2. To acquaint knowledge about testing of packaging materials and their packaging equipments. 3. To enable the students to acquire skills and to understand the packaging technology
Course Content	Factors affecting shelf life of food material during storage; spoilage mechanism during storage; definition, requirement, importance and scope of packaging of foods; types and classification of packaging system; advantage of modern packaging system. Different types of packaging materials used. Different forms of packaging, metal container, glass container, plastic container, flexible films, shrink packaging, vacuum & gas packaging. Packaging requirement & their selection for the raw & processed foods. Advantages & disadvantages of these packaging materials; effect of these materials on packed commodities, Package testing, Printing, labelling and lamination. Economics of packaging; performance evaluation of different methods of packaging food products; their merits and demerits; scope for improvements; disposal and recycle of packaging waste.
References:	• Handling and storage of food grains in tropical and suntropical areas , By: Hall, C. W. • Preservation and storage of grains, seeds and their by-products , By: Multon J.L. • Food packaging materials. , By: Mahadeviah, M. and R. V .Gowramma. • Post-harvest physiology, handling and utilization of tropical and sub-tropical fruits and vegetables. , By: Pantastico,, E.C.B. • Agricultural process engineering, By: Handerson, S. and Perry, S.M. • Post-harvest handling-A systems approach. , By: Shewfelt, R.L. and Prussi., S.E.
Course Outcomes	At the end of the course, learners will be able **CO1**: To acquaint the students with various food packaging materials, **CO2:** To acquaint the students with various aspects of packaging methods and technology. **CO3:** To acquaint the students about testing of packaging materials and their packaging equipments. CO4: To strength industry-institute linkage with leading institutes for promoting entrepreneurship among students.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
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CO1															
CO2															
CO3															
CO4															

Course code	**RE-403**
Course title	**Design and Maintenance of Greenhouse**
Corse credit	**3 (2+1)**
Objective of Course	1. To expose the fundamental knowledge of greenhouse. 2. To study different types of greenhouse based on the different criteria. 3. To study hi tech greenhouse systems. 4. To study design parameters and their maintenance criteria.
Course Content	**Theory:** History and types of greenhouse; importance, function and features of green house; scope and development of greenhouse technology. Location, Planning and various component of greenhouse; design criteria and calculation; constructional material and methods of construction; covering materials and its characteristics, solar heat transfer, solar fraction for green house, steady state analysis of green house, Greenhouse heating, cooling, shedding and ventilation systems; Carbon Dioxide generation and monitoring and lighting systems, instrumentation & computerized environmental Control Systems. Watering, fertilization, root substrate and its pasteurization, containers and benches, plant nutrition. Alternative cropping systems; plant tissue culture, chemical growth regulation; disease control; integrated pest management; postproduction quality and handling Cost analysis of greenhouse production; Applications of green house & its repair & maintenance. **Practicals:** Study / visit to a functional green house; planning and layout of green house & associated utilities; Material selection for the construction of green house ; Economic analysis of green house; Visit to a commercial green house; Measurement of temp. using thermometer, thermistor & thermocouples inside the green house; Measurement of humidity & air velocity using various methods; Measurement of solar radiations inside the green house; Application of psychometric charts; estimation of cooling requirements in a greenhouse; estimation of ventilation requirements; Thermal performance of green house; Application of data loggers for simultaneous estimation & control of different parameters like temp., RH, solar radiations etc; Calculations of environment indices inside a greenhouse ; Structural analysis of green house
References:	1. Solar Engineering Thermal Process, By: Duffie J.A. and Beckman W.A. 2. Greenhouse Advanced Technology, By: Hanan 3. Greenhouse Operation & Management., By: Nelson P.V. 4. Handbook of Greenhouse technology, By: Radhamanohar 5. Greenhouse Technology, By: Tiwari G.N and Goyal R.K. Renewable Energy, By: P.D. Dunn. Peter Peregrinus Ltd., London
Course Outcomes	At the end of the course, learners will be able **CO1:** To study importance of greenhouse with respect to different climate and crop. **CO2:** To design of greenhouse according the climate and requirements of the crop. **CO3:** To study climate control inside greenhouse. **CO4:**To study economics of greenhouse and selection criteria for efficient management

Mapping between Cos, POs and PSOs

CO	PO												PSO		
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CO1															
CO2															
CO3															
CO4															

Course code	**PFE - 403**
Course title	Waste and Byproduct Utilization
Corse credit	2 (1 + 1)
Objective of Course	1. The student will be able to learn about the types and formation of byproducts and waste. 2. To understand the waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts. 3. To understand the advanced waste water treatment process.
Course Content	Types and formation of byproducts and waste; magnitude of waste generation in different food processing industries; concept scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization, waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermi-composting, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation.
References:	• Manure Production and Characteristics, By:ASAE Standards (1984). • Managing Livestock Waste , By:Markel, I. A. (1981). • Agricultural Waste Management Field Handbook. , By: USDA (1992). • Compost Engineering: Principles and Practices. , By: Huang, R.T.
Course Outcomes	At the end of the course, learners will be able **CO1:** Summarize the importance of sanitation and waste water management. **CO2:** Estimate the rate of sewage flow and storm water drainage **CO3:** Identify the various characteristics of sewage and plan the treatment system. **CO4:** Outline various waste water treatment technologies. **CO5:** Explain the different treated effluent disposal methods.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**

Course code	**PFE - 405**
Course title	**Development of Processed Products and Equipments**
Corse credit	3 (2 + 1)
Objective of Course	1. To provide conceptual knowledge about the mass and energy balance used in food processing operations 2. To acquire knowledge about technology of various value-added food products. 3. To acquaint students with the process technology involved in extruded products fruit juice and candy manufacturing. 4. To enable the students to understand the recent trends in food processing e.g. cryogenic grinding, critical fluid extraction etc.
Course Content	Applications of unit operations to the food industry, analytical processing concepts with regards to mass and energy balances, equipment involved in the commercially important food processing methods and unit operations; value addition to cereals like rice, wheat etc. Parboiling of rice, quality of processed products of rice & wheat. Processing of pulses, spices and condiments; extruded food product, fermented food product, frozen and dried product, technology of meat, fish and poultry products, technology of milk and milk products. Technology of oilseeds and fat products, snack foods, Fruits and vegetables product: candy, nutraceuticals, food product development trends, food additives and labeling. Process equipment for thermal processing evaporation, dehydration, drying, blenching, pasteurization, distillation; mechanical separationfiltration, sieving, centrifugation, sedimentation; mechanical handling-conveying and elevation; size reduction and classification-mixing; kneading, blending.
References:	• Unit operations of Agricultural Processing, By: Sahay, K. M. & K.K. Singh. • Post-harvest technology of cereals, pulses and oilseeds , By: Chakraverty, A
Course Outcomes	At the end of the course, learners will be able **CO1**: To acquaint the students with various value-added food products. **CO2:** To acquaint the students with various aspects of food processing technology. **CO3:** To acquaint the students about advanced food processing technologies. **CO4:**To study the flow charts and understand the different food processing techniques.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course code	**PFE - 407**
Course title	**Food Processing Plant Design and Layout**
Corse credit	2 (1 + 1)
Objective of Course	1. To provide introductory knowledge about the process equipment design 2. To acquire knowledge material selection. 3. To acquaint students with design of various food processing equipment e.g. heat exchangers, elevators etc. 4. To enable the students to preparing computer added designs.
Course Content	Meaning and definition of plant layout. Objectives and principles of layout. Types of layout. Salient features of processing plants for cereals, pulses oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products. Location selection criteria, selection of processes, plant capacity, project design, flow diagrams, selection of equipments, process and controls, handling equipments, plant layout, Plant elevation, requirement of plant building and its components, labour requirement, plant installation, power and power transmission, sanitation. Cost analysis, preparation of feasibility report.
References:	• Physical Properties of foods and food processing systems, By: Lewis, M.J. • Dairy technology and engineering, By: Harper, W.J. and Hall, C.W. • Mass Transfer Operations, By: Treybal, R. E. • Process Modeling Simulation and Control for Chemical Engineers, By:Luyben, W.L.

Course Outcomes	At the end of the course, learners will be able **CO1:** To acquaint the students with principles of process equipment design for development of process equipment. **CO2:** To acquaint the students about various design codes. **CO3:** To design various food production processes. **CO4:** To learn CAD the different food processing techniques.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course code	**SWE - 401**
Course title	**Micro Irrigation System Design**
Corse credit	**3 (2 + 1)**
Objective of Course	• Understanding Micro-Irrigation Fundamentals: Explore the historical evolution and current relevance of micro-irrigation systems, including the future prospects and requirements for sustainable implementation. • Analyzing Micro-Irrigation Techniques and Components: Examine the role of government initiatives in promoting micro-irrigation in India and assess the merits, demerits, types, and components integral to micro-irrigation systems. • Design, Installation, and Maintenance: Comprehend the design principles, synthesis, installation procedures, and essential maintenance practices of micro-irrigation systems, emphasizing the specifics of sprinkler and drip irrigation. • Fertigation and Quality Control: Explore the integration of fertilization and irrigation processes (fertigation), focusing on fertilizer application criteria, suitable compounds, mixing techniques, injection parameters, and quality control aspects. • Application and Economic Analysis: Evaluate the applicability of micro-irrigation techniques in various landscapes like hills, semi-arid regions, coastal areas, and water-scarce zones while conducting benefit and cost analyses to understand their viability and impact. Also, delve into polyhouse design, its significance, and the associated maintenance requirements.
Course Content	Theory Past, present and future need of micro-irrigation systems, Role of Govt. for the promotion of micro-irrigation in India, Merits and demerits of micro-irrigation system, Types and components of micro-irrigation system, Micro-irrigation system- design, design synthesis, installation, and maintenance. Sprinkler irrigation - types, planning factors, uniformity and efficiency, laying pipeline, hydraulic lateral, sub-mains and main line design, pump and power unit selection. Drip irrigation – potential, automation, crops suitability. Fertigation – Fertilizer application criteria, suitability of fertilizer compounds, fertilizer mixing, injection duration, rate and frequency, capacity of fertilizer tank. Quality control in micro-irrigation components, design and maintenance of polyhouse; prospects, waste land development – hills, semi-arid, coastal areas, water scarce areas, Benefit and Cost analysis. Practical • Study of different types of micro-irrigation systems and components; Field visit of micro-irrigation system; • Study of water filtration unit; Discharge measurement study of different micro-irrigation systems; • Study of water distribution and uniformity coefficient; • Study of wetted front and moisture distribution under various sources of micro-irrigation system; • Design of micro-irrigation system for an orchard;

	• Design of micro-irrigation system for row crops design of spray type micro-irrigation system; • Design of micro-irrigation system for hilly terraced land; Study of automation in micro-irrigation system; • Study of micro climate inside a Polyhouse • Study of maintenance and cleaning of different components of various systems; • Design of sprinkler irrigation system; Design of landscape irrigation system
References:	• Principles of Sprinkler Irrigation, By: M S Mane, B L Ayare, • Principles of drip irrigation System , By: M S Mane, B L Ayare, S S Magar • Text Book of Irrigation Engineering and Drainage, By: R.K. Sharma and T.K. Sharma • Irrigation Engineering, By: R. Lal • Sprinkler Irrigation, By: R.K. Sivanappan • Irrigation Principles and Practices, By: O.W. Israelsen, V.T. Hansen and Stringhem • Irrigation System: Design and Operation, By:D. Karmeli, G. Peri and M. Todes
Course Outcomes	At the end of the course, learners will be able to • Analyze past, present, and future needs of micro-irrigation in India and the role of government in its promotion. • Compare the merits and demerits of micro-irrigation and identify various types and components of the system. • Design, install, and maintain micro-irrigation systems, including sprinkler and drip irrigation. • Apply automation and evaluate crop suitability for drip irrigation. • Plan and manage fertigation, analyze water quality, design polyhouses, and assess economic feasibility of micro-irrigation.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**SWE - 403**
Course title	**Watershed Planning and Management**
Corse credit	**3 (2 + 1)**
Objective of Course	• Understanding Watershed Management Principles: Explore the challenges and potential in watershed management, analyzing watershed-based land use planning, and comprehending the characteristics and factors influencing effective watershed management. • Hydrological and Hydraulic Aspects: Learn hydrological data collection methods, delineation techniques for priority watersheds, water yield assessment, and measurement, and understand the hydrologic and hydraulic design essentials for earthen embankments and diversion structures. • Sediment Yield and Rainwater Conservation: Explore sediment yield estimation, measurement models, and conservation techniques like in-situ and storage-based rainwater harvesting. Learn the design aspects of water harvesting tanks and ponds for effective watershed management. • Impact of Agricultural Practices: Analyze the influence of cropping systems, land management techniques, and cultural practices on watershed hydrology and water budgeting within a watershed context. • Evaluation, Participation, and Project Planning: Study the evaluation methods and monitoring protocols for watershed programs, emphasizing people's participation in such programs. Learn to formulate project proposals, conduct cost-benefit analyses, and explore optimal land use models through real-world case studies.

Course Content

Theory

Watershed management - problems and prospects; watershed based land use planning, watershed characteristics – physical and geomorphologic, factors affecting watershed management, hydrologic data for watershed planning, watershed delineation, delineation of priority watershed, water yield assessment and measurement from a watershed; hydrologic and hydraulic design of earthen embankments and diversion structures; sediment yield estimation and measurement from a watershed and sediment yield models; rainwater conservation technologies - in-situ and storage, design of water harvesting tanks and ponds; water budgeting in a watershed; effect of cropping system, land management and cultural practices on watershed hydrology; evaluation and monitoring of watershed programmes; people' s participation in watershed management programmes; planning and formulation of project proposal; cost benefits analysis of watershed programmes; optimal land use models; case studies.

Practical

- Study of watershed characteristic; analysis of hydrologic data for watershed management;
- Delineation of watershed and measurement of area under different vegetative and topographic conditions;
- Measurement of water and sediment yield from watershed;
- Study of different watershed management structures;
- Study of various water budget parameters; .
- Study of watershed management technologies;
- Preparation of a techno-economically effective project proposal

References:

- Watershed Management (For Dryland Agriculture) , By: Oswal M.C.
- Land Resources and Their Management for Sustainability in Arid Regions , By: Kolarkar A.S.
- Land and Water Management Engineering , By: V.V.N. Murthy
- Design of small canal structures, By: Aisenbrey A.J., Hayes R.B., Warren H.J., Winsett D.L. & Young R.B.
- Textbook of Irrigation Engineering and Hydraulic Structures, By: R.K. Sharma • River Basin Planning, Theory and Practices, By: Saha S.K. & Barrow C.J.
- Studies in Irrigation and Water Management B.D. Dhawan
- Watershed planning and management , By: Rajvir Singh

Course Outcomes

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

- Analyze problems and prospects of watershed management and apply land use planning.
- Identify physical and geomorphological characteristics of watersheds and assess factors affecting their management.
- Utilize hydrologic data for watershed planning, delineation, and water yield assessment.
- Design earthen embankments, diversion structures, and water harvesting systems.
- Evaluate sediment yield, water budgeting, and impact of land management practices.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															
Avg.															

<table>
<tr><td>Course code</td><td colspan="2">SWE - 405</td></tr>
<tr><td>Course title</td><td colspan="2">Minor Irrigation and Command area Development</td></tr>
<tr><td>Corse credit</td><td colspan="2">3 (2 + 1)</td></tr>
<tr><td>Objective of Course</td><td colspan="2">
Understanding Irrigation Project Performance: Evaluate and compare the performance of major, medium, and minor irrigation projects, assessing their development and utilization in the context of water resources.
Exploring Command Area Development Fundamentals: Explore the fundamental concepts of command areas, delving into their definition, historical context, and the role of command area development authorities in planning and execution.
Interrelation of Water Use Efficiency and Agricultural Production: Understand the interconnectedness between irrigation water use efficiency and agricultural output, examining strategies for improving efficiency and enhancing agricultural productivity
On-Farm Development and Remote Sensing Techniques: Study the planning and execution of on-farm development activities within the command area context, utilizing remote sensing techniques for better planning and management.
Case Studies and Farmer Participation: Analyze case studies of selected command areas, focusing on their development, successes, and challenges. Explore the significance of farmers' active participation in command area development initiatives.
</td></tr>
<tr><td>Course Content</td><td colspan="2">Theory

Major, medium and minor irrigation projects – their comparative performance; development and utilization of water resources through different minor irrigation schemes. Basic concepts of command area – definition, need, scope, and development approaches: historical perspective, command area development authorities; Interaction/collaboration of irrigation water use efficiency and agricultural production. Planning and execution of on farm development activities within the scope of command area development; Use of remote sensing techniques for command area development; case studies of some selected commands; Farmers participation in command area development.

Practical
Topographic survey and preparation of contour map.
Preparation of command area development layout plan;
Land leveling design for a field;
Earthwork and cost estimation.
Irrigation water requirement of crops;
Preparation of irrigation schedules; .
Planning and layout of water conveyance system;
Design of Irrigation systems
Conjunctive water use planning;
Application of remote sensing for command area development;
Technical Feasibility and economic viability of a command area project.
Study tour to minor irrigation and command area development projects
</td></tr>
<tr><td>References:</td><td colspan="2">
Principles of farm irrigation System design, L G James,
Irrigation Hydraulics, By: R Lal,
Hydrologic Modelling of Small watersheds , By: Haan, C T
Land and Water Management Engineering, By: V.V.N. Murthy
Design of small canal structures, By: Aisenbrey A.J., Hayes R.B., Warren H.J., Winsett D.L. & Young R.B.
Textbook of Irrigation Engineering and Hydraulic Structures, By: R.K. Sharma
Studies in Irrigation and Water Management, By: B.D. Dhawan
Irrigation System : Design and Operation, By: D. Karmeli, G. Peri and M. Todes
</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">At the end of the course, learners will be able to
Compare the performance of major, medium, and minor irrigation projects.
Analyze the development and utilization of water resources through minor irrigation schemes.
</td></tr>
</table>

	• Understand key concepts of command area, including definition, need, scope, and development approaches. • Plan and execute on-farm development activities within the command area. • Utilize remote sensing techniques for command area development and analyze case studies.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															
Avg.															

Course code	**SWE - 407**
Course title	**Gully and Ravine Control Structures**
Corse credit	**3 (2 + 1)**
Objective of Course	• Comprehend the fundamental causes of floods, encompassing the classification of floods into probable maximum flood, standard project flood, and design flood, to establish a comprehensive understanding of flood occurrences. • Investigate various methods for flood estimation, including Rational method, empirical methods, and Unit hydrograph method, to analyze and predict flood peak with accuracy and precision. • Explore the application of statistical models such as Log normal, Gumbel's extreme value, and Log-Pearson type-III distribution for flood frequency analysis, enabling the evaluation of potential flood occurrences based on historical data. • Examine the depth-area-duration analysis technique to assess the relationship between flood depth, area affected, and duration, providing crucial insights for effective flood management strategies. • Evaluate diverse flood routing methods including channel routing, Muskingum method, reservoir routing, and modified Pul's method, to comprehend the mechanisms involved and their application in controlling flood propagation. • These objectives encapsulate key facets of the course content on floods, hydrology, flood estimation, statistical analysis, flood forecasting, control measures, erosion, and project planning, fostering a comprehensive understanding of flood dynamics and management strategies.
	•
Course Content	**Theory** Introduction; floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, flood estimation - methods of estimation; estimation of flood peak - Rational method, empirical methods, Unit hydrograph method; Statistics in hydrology, flood frequency methods - Log normal, Gumbel' s extreme value, Log-Pearson type-III distribution; depth-area-duration analysis; flood forecasting, flood routing - channel routing, Muskingum method, reservoir routing, modified Pul' s method; flood control - history of flood control, structural and non-structural methods of flood control measures, storage and detention reservoirs, levees, channel improvement; Gulley erosion and its control; soil erosion and sediment control measures; river training works, planning of flood control projects and their economics. **Practica**l • Determination of flood stage-discharge relationship in a watershed. • Determination of flood peak-area relationships. • Determination of frequency distribution functions for extreme flood values using Gumbel' s method.

	• Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution. • Determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution. • Determination of probable maximum flood. • Standard project flood and spillway design flood; • Design of levees for flood control. • Design of jetties. • Study of vegetative and structural measures for Gulley stabilization. • Designing and planning of a flood control project. • Cost and benefit analysis of a flood control project.
References:	• Manual of Soil and water conservation practices, By: Gurmel Singh, Vekataraman, Sasry G., Joshi B P • Design of Small Canal Structures, By: Aisenbrey A. J., Hayes R.B., Warren H. J., Winsett D. L. & Young R. B. • River Basin Planning, Theory and Practices, By: Saha S. K. & Barrow C. J. • Important Aspects of River Valley Project (Vol. I, II, III & IV) , By: J. F. Mistry
Course Outcomes	At the end of the course, learners will be able to • CO1: Describe the various causes and types of floods, including probable maximum floods, standard project floods, and design floods. • CO2: Apply different methods for estimating flood peak discharge, including the Rational method, empirical methods, and Unit hydrograph method. • CO3: Analyze and interpret flood frequency data using statistical methods like Log-normal, Gumbel's extreme value, and Log-Pearson type-III distributions. • CO4: Understand flood forecasting techniques and apply flood routing methods like channel routing (Muskingum method) and reservoir routing (modified Pul's method). • CO5: Evaluate different flood control measures (structural & non-structural) like storage reservoirs, levees, channel improvement, and soil erosion control techniques.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															
Avg.															

Course code	**SWE - 409**
Course title	**Remote Sensing & GIS Applications**
Corse credit	**3 (2 + 1)**
Objective of Course	• Differentiate modern remote sensing technology from conventional aerial photography, focusing on their respective stages and advancements in data acquisition. • Understand the principles governing image interpretation and factors influencing image quality and interpretability in remote sensing. • Explore the significance of digital image processing techniques in improving image quality and extracting useful information in remote sensing applications. • Evaluate the progress and potential of remote sensing in agriculture, particularly the utilization of microwave radiometry for crop monitoring and hydrologic forecasting. • Analyze the historical evolution of GIS, its components, standard packages, data types, structures, database management systems, and data entry techniques for effective spatial analysis and management.
Course Content	Theory Remote Sensing: Definition, stage in remote sensing, modern remote sensing technology versus conventional aerial photography; visual image interpretation, image interpretation,

	basic principles of image interpretation, factors governing the quality of an image; factors governing interpretability, visibility of objects, elements of image interpretation, techniques of image interpretation, digital image processing, digital image; remote sensing in agriculture progress and prospects, microwave radiometry for monitoring agriculture crops and hydrologic forecasting; aerial photo interpretation for water resources development and soil conservation survey. GIS: History of development of GIS definition, basic components, and standard GIS packages; data-entry, storage and maintenance; data types-spatial-non-spatial (attribute data), data structure, data format- point line vector-raster – polygon-object structural model, files, files organization-data base management systems (DBMS), entering data in computer digitizer- scanner-data compression. **Practical** • Familiarization with remote sensing and GIS hardware; • Use of instruments for aerial photo interpretation; • Interpretation of aerial photographs and satellite imagery; • Basic GIS operations such as image display; • Study the various features of GIS software package; • Scanning and digitization of maps; • Data base query and map algebra; • GIS supported case studies in water resources management
References:	• Principles of Remote Sensing, By: A.N. Patel & Surendra Singh • Remote Sensing and Geographic Information Systems in Irrigation and Drainage : • Methodological Guide and Applications (International Commission on Irrigation and Drainage) - Alain Vidal (Editor) • Advances in Remote Sensing & GIS Analysis, By: Atkinson P.M. • Introduction to Remote Sensing , By: James B. Campbell • Manual of Remote Sensing Vol. I & II , By: Colwell R.N • Remote Sensing : Principles and Interpretation , By: Sabins F.L • Geographic Information Systems, By: Antenucci J.C., Brown K., Croswell P.L., Kevary M.J
Course Outcomes	At the end of the course, learners will be able to CO1: Explain the fundamental principles, stages, and technologies of remote sensing, comparing modern methods with conventional aerial photography. CO2: Analyze and interpret visual and digital images using appropriate techniques, considering factors influencing image quality and interpretability. CO3: Apply remote sensing in agricultural applications like crop monitoring and hydrologic forecasting, focusing on the use of microwave radiometry. CO4: Utilize aerial photo interpretation for water resources development and soil conservation surveys, understanding the key principles and techniques involved. CO5: Describe the history, definition, components, and standard packages of GIS, demonstrating data entry, storage, and maintenance techniques.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															
Avg.															

Course code		**SWE - 413**
Course title		**System Engineering**
Corse credit		**3 (3 + 0)**
Objective of Course	• Understand the fundamental concepts of systems and the prerequisites for formulating linear programming problems, emphasizing mathematical representation and graphical solutions. • Analyze system responses and the role of computers in system analysis, focusing on their application as tools in modeling and solving real-world problems. • Explore advanced linear programming techniques such as the simplex method, degeneracy, duality, artificial variable techniques, Big M method, and two-phase methods for solving complex optimization problems. • Develop mathematical models for diverse physical systems, particularly in agricultural operations, emphasizing cost analysis, transportation problems, assignment problems, waiting line problems, and project management through PERT/CPM for effective resource scheduling and allocation.	
Course Content	**Theory** System concepts. Requirements for a Linear programming problems. Mathematical formulation of Linear Programming problems and its Graphical solution. Response of systems. Computer as a tool in system analysis. Simplex method. Degeneracy and Duality in linear programming. Artificial variable techniques, Big M method and two phase methods. Mathematical models of physical systems. Modeling of Agricultural Systems and operations. Cost analysis. Transportation problems. Assignment problems. Waiting line problems. Project management by PERT/CPM. Resource scheduling**.**	
References:	• Operations research, By: P K Gupta,& Hira , D.S • Optimization-Theory & Applications, By: S S Rao • Operations research, By: A P Verma • Operations research , By: Kanti Swarup, Gupta, P K and Man Mohan • Operations research, By: P K Gupta, & Hira , D. S • Operations research, By: Mittal and Goel • Operations research: An Introduction, By: H A Taha	
Course Outcomes	At the end of the course, learners will be able to CO1: Demonstrate a comprehensive understanding of system concepts, encompassing the prerequisites and mathematical formulation of linear programming problems, emphasizing graphical solutions and their applicability in real-world scenarios. CO2: Analyze system responses and employ computers as tools for system analysis, elucidating the role of technology in modeling and solving complex problems effectively. CO3: Apply advanced linear programming methods, including the simplex method, degeneracy and duality concepts, artificial variable techniques, Big M method, and two-phase methods, to optimize solutions for intricate real-world problems. CO4: Develop mathematical models for physical systems, particularly in agricultural operations, conducting cost analysis and addressing transportation, assignment, and waiting line problems within these systems. CO5: Utilize project management methodologies like PERT/CPM for effective resource scheduling and allocation, fostering a comprehensive understanding of managing complex projects within various system frameworks.	

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

<table>
<tr><td>Course code</td><td>SWE - 411</td></tr>
<tr><td>Course title</td><td>Reservoir and Farm Pond Design</td></tr>
<tr><td>Corse credit</td><td>3 (2 + 1)</td></tr>
<tr><td>Objective of Course</td><td>
• Understand the functions, advantages, and disadvantages of earthen embankments, delineating between hydraulic fill and rolled fill dams and their respective classifications - homogeneous, zoned, and diaphragm type.
• Evaluate the foundation requirements, grouting techniques, and estimation methods for seepage discharge, emphasizing graphical and analytical methods to locate the seepage/phreatic line and analyze properties of flow nets in dam design.
• Analyze seepage pressure, the significance of drainage filters, and causes of piping in earthen dams, focusing on designing and constructing earthen dams while considering stability against potential failure modes like tension, overturning, and sliding.
• Explore slope stability analysis using the slice method, assessing different types of reservoirs, farm ponds, and techniques for designing and estimating earthwork, while incorporating cost analysis into dam construction and maintenance strategies.</td></tr>
<tr><td>Course Content</td><td>Theory

Earthen embankments - functions, advantages and disadvantages, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type; foundation requirements, grouting, seepage through dams - estimation of seepage discharge, location of seepage/phreatic line by graphical and analytical methods, flow-net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes; design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc; stability of slopes - analysis of failure by slice method; types of reservoirs and farm ponds, design and estimation of earth work; cost analysis.

Practical

• Study of different types and materials of earthen dams
• Determination of the position of phreatic line in earth dams for various conditions
• Stability analysis of earthen dams against head water pressure
• Stability analysis of earthen dams against foundation shear
• Stability analysis of earth dams against sudden draw down condition
• Stability of slopes of earth dams by friction circle method / different methods; Construction of flow net for isotropic and anisotropic medium
• Computation of seepage by different methods
• Determination of settlement of earth dam
• Input-output-storage relationships by reservoir routing
• Design of farm ponds
• Cost estimation of farm ponds and other structures.</td></tr>
<tr><td>References:</td><td>
• Soil and water Conservation engineering , By: R Suresh,
• Manual of Soil and Water Conservation Practices, By: Gurmel Singh, C. Venkatraman, C. Sastry and B.P. Joshi
• The flow of homogeneous fluids through porous media , By: Muskat M
• Flow of fluids through porous materials , By: Collins , R.E
• Hydrologic Modelling of Small watersheds , By: Haan, C T
• Soil and water Conservation Engineering , By: Scwab, G.o, Frevert, R.K. and Edminister</td></tr>
<tr><td>Course Outcomes</td><td>At the end of the course, learners will be able to
CO1: Demonstrate comprehensive knowledge of earthen embankments, encompassing their functions, classifications, and the advantages and disadvantages of various dam types, including hydraulic fill and rolled fill dams - homogeneous, zoned, and diaphragm types.
CO2: Apply theoretical and practical understanding of foundation requirements, grouting techniques, and methods for estimating seepage discharge, using graphical and analytical</td></tr>
</table>

	approaches to determine the location of the seepage/phreatic line and analyze flow-net properties. **CO3:** Analyze and evaluate factors contributing to seepage pressure, understanding the concept of seepage line in composite earth embankments, drainage filter mechanisms, and causes of piping, while emphasizing the design and construction of earthen dams. **CO4:** Assess the stability of earthen embankments against potential failure modes, including tension, overturning, sliding, and perform slope stability analysis using the slice method, ensuring a comprehensive understanding of failure mechanisms and preventive measures. **CO5:** Apply knowledge in designing different types of reservoirs, farm ponds, and estimating earthwork, incorporating cost analysis principles into dam construction projects, ensuring efficient resource management and cost-effective solutions.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															
CO5															

Course code	**FMP - 401**
Course title	**Tractor Design and Testing**
Course credit	**3 (2 + 1)**
Objective of Course	1) To understand design Procedure for design and development of agricultural tractor. 2) To get knowledge about tractor stability & weight distribution. 3) To get knowledge about design of various systems of tractor. 4) To familiarise tractor testing.
Course Content	Procedure for design and development of agricultural tractor, Study of parameters for balanced design of tractor for stability & weight distribution, hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors. Design of Ackerman Steering and tractor hydraulic systems. Study of special design features of tractor engines and their selection. Design of seat and controls of an agricultural tractor. Tractor Testing.
References	• Tractors & their power units, By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki • Tractor, By: Oleg Sapunon • Theory of machines, By: P.L. Ballaney Theory of machines v R.S. Khurmi
Course Outcomes	At the end of the course, learners will be able At the end of the course, learners will be able **CO1**: Use standard design procedure for design and development of agricultural tractor. **CO2**: Utilize the concept of stability & weight distribution in tractor design. **CO3**: Design various systems of tractor. **CO4**: Become familiar with procedure of tractor testing.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**FMP – 403**
Course title	**Hydraulic Drive & Controls**
Course credit	**3 (2 + 1)**
Objective of Course	1) To understand Hydraulic Basics laws. 2) To get knowledge about different hydraulic components. 3) To get knowledge about design, types and use of pumps and valves in hydraulic system. 4) To familiarise with use of pneumatics systems, Robotics systems in agricultural application.
Course Content	Hydraulic basics, Pascal's law, Flow, Energy, Work and Power. Hydraulic Systems, Color coding, reservoirs, Strainers and filters, Filtering materials and elements, Accumulators, Pressure gauges and Volume meters, Hydraulic circuits, Fittings and Connectors. Pumps, Pump classifications, Performances, Displacement, Designs, gear Pumps, vane pumps, Piston pumps, Pump operation. Hydraulic Actuators, Cylinders, Construction and Applicators, Maintenance, Hydraulic motors, Valves, Pressure control valves, Directional control valves, Flow control valves, Valve installation, Valve failures and remedies, Valve assembly, Trouble shooting, Valve Hydraulic circuit diagrams and troubleshooting, United states of American standard Institute, USASI Graphical symbols, Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units, Fail safe and safety systems, Robotics, Use of Hydraulic and Pneumatics drives in agricultural systems, PLCs (Programmable Logic Controls)
References	• Hydraulic control systems, By: Merritt H.E., John Willey & Sons, New York • Design of Agricultual Machines, By: Krutz G., John Willey & Sons, New York • Fluid mechanics and hydraulics with computer application, By: Dr. Jagdish Lal • A text book of Hydraulic fluid mechancis and hydraulic machines, By: R.S. Khurmi • Hydraulic and fluid mechanics, By: P.N. Modi and S. M. Sheth • Engineering Fluid mechanics, By: K.L. Kumar • Tractors & their power units, By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki
Course Outcomes	At the end of the course, learners will be able **CO1**: Use Hydraulic laws in hydraulic system design. **CO2**: Able to recognise different hydraulic components. **CO3**: Utilise various types of pumps and valves in hydraulic system. **CO4**: Become familiar f with use of pneumatics systems, Robotics systems in agricultural application.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**FMP - 405**
Course title	**Farm Power and Machinery Management**
Course credit	**3 (2 + 1)**
Objective of Course	1) To familiarise the role of mechanization and its relationship to productivity, employment, social and technological change. 2) 2) To get knowledge about the performance evaluation of farm machinery. 3) To get knowledge about cost analysis of farm machinery.
Course Content	The role of mechanization and its relationship to productivity, employment, social and technological change; performance and power analysis; cost analysis of machinery: fixed cost and variable costs, effect of inflation on cost; selection of optimum machinery and replacement criteria; Break-even analysis, reliability and cash flow problems; mechanization planning; case studies of agricultural mechanization in India.
References	• Farm machinery & management, By: Hunt D. • Principle of Agril. Engg. Vol I, By: Michel A.M. & T.P. Ojha • Principles of farm machinery, By: R.A. Kepner, Roy Bainer, E.L. Berger • Agril. Engg. (through worked examples), By: R. Lal & A.C. Datta • Farm machinery operation and care, By: J.C. Turner • Farm mechanization; costs & methods, By: Cuplin C. and Claude S.
Course Outcomes	At the end of the course, learners will be able **CO1**: Become familiar about the role of mechanization and its relationship to productivity, employment, social and technological change. **CO2**: Conduct performance evaluation of farm machinery. **CO3:** Calculate the cost analysis of farm machinery.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															

Course code	**FMP - 407**
Course title	**Human Engineering and Safety**
Course credit	**2 (1 + 1)**
Objective of Course	1) To get knowledge about human factors in human performance. 2) To understand the concept of biomechanics of human body part motion. 3) To acquaintance with Anthropometry. 4) To get familiarise regarding dangerous machine (Regulation) act and use of safety gadgets.
Course Content	Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance. Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications. Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems. Human motor activities, controls, tools and related devices. Anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, air pollution. Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.
References	• Human factors in Engg. & design – Sanders M.S. and McCormick E.J. • Fitting the task to the man, A text of occupational ergonomics – Grandjean E. • Related journals • AICRP reports of Ergonomics & safety in Agriculture
Course Outcomes	At the end of the course, learners will be able **CO1**: Use human factors in design of farm machinery. **CO2**: Able to design work space by using man-machine-environmental factors and anthropometric principles.

	CO3: Know the dangerous machine (Regulation) act and use of safety gadgets during working with farm machineries.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															

Course code	**FMP - 409**
Course title	**Production Technology for Agril. Machinery**
Course credit	**3 (2 + 1)**
Objective of Course	1) To get knowledge about Modelling and stress analysis of Machinery parts by using standard software. 2) To acquaintance with CNC tools and manufacturing techniques including powder metallurgy, EDM etc. 3) To familiarise production technologies and economics of production.
Course Content	Critical appraisal in production of Agricultural Machinery; Modeling and stress analysis of Machinery parts by using standard software; Advances in material used for tractor & Agril. Machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques like powder metallurgy, EDM (Electro-Discharge Machining), Heat Treatment of steels including pack carburizing, shot pining process, chemical vapor deposition (CVD) etc. Limits, Fits & Tolerances, Jigs & Fixtures, Microstructure Analysis. Industrial lay-out planning, Quality management. Economics of process selection. Techno-economic feasibility of Project Report. Selection of Standard/ critical components. Case studies of manufacturing of agril. Machinery. Servo motors, drives & controllers, CNC controllers for machine tools. CNC programming. Assembly and plant automation. Storage and transportation.
References	• Workshop Technology Vol. I & II, By: S.K. Hajra Chaudhary • Mechatronics, By: K. Adinarayana • Design of Machine Tools, By: S.K. Basu & D.K. Pal • Manufacturing Science and Technology, By: S. Dalela • Production Technology, By: Sharma P.C. • Workshop Technology, By: R.S. Khurmi & Gupta • Quality in Design and Manufacturing (CAD/CAM), By: Dalela Suresh
Course Outcomes	At the end of the course, learners will be able **CO1:** Able to do Modelling and stress analysis of Machinery parts by using standard software. **CO2:** Become familiar with CNC tools and manufacturing techniques including powder metallurgy, EDM etc. **CO3:** Become capable to use production technologies and economics of production in production of farm Machinery.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															

Course code	**FMP - 411**
Course title	**Mechanics of Tillage and Traction**
Course credit	**3 (2 + 1)**

Objective of Course

1) To get knowledge about mechanics of tillage tools.
2) To acquaintance with engineering properties of soil.
3) To learn about application of dimensional analysis in soil dynamics and traction prediction equation.
4) To familiarise with traction model and application of GIS in soil dynamics.

Course Content

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship, design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics performance of tillage tools. Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction, tyre size, tyre lug geometry and their effects, tyre testing, soil compaction and plant growth, variability and geo statistic, application of GIS in soil dynamics.

References

- Agricultural machines, By : N.I. Klenin, I.F. Popov & V.A. Sakum
- Tractors & their power units, By : J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki
- Tractor implement systems, By : Ralph Alcocl
- Farm machinery, By : S.C. Jain
- Design of Agril. Machinery, By : Garry Krutz
- Principles of Farm machinery, By : R.A. Kepner, Roy Bainer & E.L. Barger

Course Outcomes

At the end of the course, learners will be able
CO1: Understand the mechanics of tillage tools.
CO2: Design the tillage tools by using concept of soil mechanics.
CO3: Able to use engineering properties of soil in design of tillage tools.
CO4: Utilize the traction models and GIS applications in soil dynamics.

Mapping between Cos, POs and PSOs

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															
CO4															

Course code	**RE-405**
Course title	**Environmental Engineering**
Corse credit	**3 (2+1)**

Objective of Course

1. To provide a coherent development to the students for the courses in sector of engineering like Waste Water treatment, slid Waste Management, house drainage etc.
2. To analyze the Waste water sources and waste water characteristics.
3. To develop various waste water treatment process.
4. To give an experience in the implementation of engineering concepts which are applied in field of waste Water treatment process.
5. To present the foundations of many basic Engineering tools and concepts related Environmental Engineering.

Course Content

Theory:

Importance of safe water supply system. Domestic water requirements for urban and rural areas. Sources of Water supply. Intakes and transportation of water. Drinking water quality. Indian Standards of drinking water. Introduction to water treatment. Importance of sanitation. Domestic waste water: quantity, characteristics, disposal in urban and rural areas. Sewer: types, design discharge and hydraulic design. Introduction to domestic wastewater treatment. Design of septic tank. Solid waste: quantity, characteristics and disposal for urban and rural areas. Introduction to air pollution. Types of pollutants properties and their effects on living beings. ISI standards for pollutants in air and their abetments.

	Practicals: Determination of turbidity; pH of solution; Suspended solids; Dissolved solids; Total solids; Temporary hardness; Permanent hardness; Fluorides; Chlorides, Dissolved oxygen; BOD; Collection of air samples and their analysis; Numerical problems related to theory; Visit to treatment plant.
References:	1. Wastewater treatment for Pollution control, By: Soli J. Arceivala 2. Wastewater Engineering Treatment Disposal, By: Metcalf & Eddy 3. Environmental Engineering (Vol.I) , By: S.K.Garg 4. Environmental Engineering (Vol.II) , By: S.K.Garg 5. Elements of Environmental Engineering, By: K.N.Duggal, S. 6. Manual on Water Supply and treatment, Central Public Health & Environmental Engineering Organisation, New Delhi 7. Standard Methods for the Examination of Water & Wastewater, American Public Health Association 8. Manual on sewerage and sewage treatment, Ministry of Urban Development, New Delhi 9. Fundamentals of Air Pollution, By: B. S. N Raju,
Course Outcomes	At the end of the course, learners will be able **CO1:** To gain an experience in the implementation of environmental Engineering on engineering concepts which are applied in field. **CO2:** The students will get a diverse knowledge of environmental engineering practices applied to real life problems. **CO3:** The students will learn to understand the theoretical and practical aspects of environmental engineering along with the design and management applications.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															

Course code	**RE-407**
Course title	**Biomass Management for fodder and Energy**
Corse credit	**2 (1+1)**
Objective of Course	1. To establish the fundamental understanding on the characteristics of biomass resources. 2. To impart the fundamental knowledge on the importance of Bio resources,Bio energy and reactors. 3. To design and operations of the biomass energy systems. 4. To study environmental aspects of biomass energy, economics and life-cycle analysis with case studies on biomass energy production
Course Content	**Theory:** Introduction to biomass management, biomass resource assessment management techniques/supply chains, Processing of paddy straw, densification- Extrusion process, pellets, mills and cubers, Bailing-classification, uses; residue management for surface mulch and soil incorporation, Paddy Straw choppers and spreaders as an attachment to combine Harvester, Mulch seeder, Paddy Straw Chopper-cum-Loader, Balar for collection of straw; Processing of straw/ fodder for animal use; Agricultural and horticultural use, Cushioning material for fruits and vegetables, Mulching and Composting, Paper and cardboard manufacturing, Straw as a fuel. **Practicals:** Familiarization with different straw management techniques; On-farm and off-farm uses of straw ; Collection, loading and transport equipment's for unbruised loose straw; Briquetting machine and preparation of briquettes; Straw baler and making of bales in the field; Straw/ fodder chopping machines; Straw/ mulching & incorporating machinery; Machinery requirement for baling forage crops for silage

References:	1. Principles of Farm Machinery, 3rd Edition, By: R.A. Kepner, Roy Bainer & E.L. Barger, 2. Biomass Management Systems , By: Braden Allenby, 3. Biomass Resource Assessment California Biomass Collaborative Biological & Agricultural Engineering University of California, 1 Shields Avenue, Davis, CA 956165924
Course Outcomes	At the end of the course, learners will be able **CO1:** To describe the nature and principle of different biomass energy extraction systems and know how to choose the suitable biomass fuels for different bio-energy application. **CO2:** To Address the desirable features of these biomass energy sources and their advantages over traditional fuels such as coal and oil. **CO3:** To Identify their limited scope in terms of suitable sites, dependence on the elements, capital costs, and cost effectiveness compared with traditional sources.

Mapping between Cos, POs and PSOs

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1															
CO2															
CO3															