NEW COURSE CURRICULUM

Disciplinewise credit hours distribution

S.No.	Discipline Course	Credit	Weightage (%)
1	Basic Sciences & Humanities	26	14
2	Agricultural Sciences	4	2
3	Basic Engineering	53	29
4.	Agricultural Engineering	102	55
	Total	185	100

Semesterwise credit hours distribution

Semester	Credit	Semester	Credit
I	23	V	23
II	23	VI	21
III	24	VII	22
IV	24	VIII	25
		Total	185

SEMESTERWISE COURSES OFFERED FOR THE DEGREE OF
B.Tech. (Agril. Engg.)

FIRST YEAR

Semester - I

S.No.	Course Name	Course No.	Credit	L	P	T
1	Engineering Mathematics-I	Maths (E)-101	3 (2 + 1)	2	0	1

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).

Planning of lectures

S.No.	Topics to be covered in Lecture / Tutorial	Proposed No. of Lectures / Tutorials
1	Taylor's & Maclaurin's expansion	2
2	Indeterminate forms	2
3	Partial differentiation, Homogeneous function, Euler's theorem, Composite function	3
4	Total derivative, Jacobian, Error evaluation, Maxima-Minima	2
5	Reduction formulae	2
6	Rectification, Volume & Surface of revolution	2
7	Double integration, Triple integration, Area & Volume using double and triple integration	3
8	Gamma function , Beta function	2
9	Differential equation: Exact, Bernoulli's differential equations, Use of integrating factor	2
10	Equation of first order and higher degree, Clairaut's equation	1
11	Differential equations of higher order, Methods of finding C.F. and P.I.	4

12	Method of Variation of parameters	1
13	Cauchy and Legendre differential equations	2
14	Simultaneous linear differential equation with constant coefficients	1
15	Series solution technique	2
16	Bessel's and Legendre's differential equations	2
17	Vector calculus: Scalar and vector point functions, Del, Gradient, Divergence, Curl and their physical interpretations	2
18	Identities involving Del, Second order differential operator	2
19	Line, Surface and Volume integrals	2
20	Gauss, Stoke, Green's theorems(Without proof)	2
21	Asymptotes	2
22	Tracing of curves	4
	Total	**47**

Reference Books

- Higher Engineering Mathematics, Vol-I,II , By: Dr. K. R. Kachot
- A Text book of Practical Mathematics Vol-I,II, By: I. B. Prasad
- Higher Engineering Mathematics, By: Dr. B. S. Grawal
- A Text Book of Engineering Mathematics, By: N. P. Bali and Ashok Saxena
- Schaum's Outline Series: Theory and Problems of Vector analysis, By: Murray R. Spigel
- Schaum's Outline Series: Theory and Problems of Advance Calculus, By: Murray R. Spigel
- Advance Engineering Mathematics , By: Erwin Kreyszing

S.No.	Course Name	Course No.	Credit	L	P	T
2	**Engineering Physics**	**Phy (E)-101**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

Dia, Para and ferromagnetism-classification. Langevin theory of dia and paramagnetism. Adiabatic demagnetization, Weiss molecular field theory and ferromagnetism. Curie-Weiss law. Wave particle quality, de-Broglie concept, uncertainty principle. Wave function, Time dependent and time independent Schrodinger wave equation, Qualitative explanation of Zeeman effect, Stark effect and Paschan Back effect, Raman spectroscopy. Statement of Bloch's function, Bands in solids, velocity of Bloch's electron and effective mass. Distinction between metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, law of mass action, Determination of energy gap in semiconductors, Donors and acceptor levels. Superconductivity, critical magnetic field, Meissner effect, Isotope effect, Type-I and II superconductors, Josephson's effect DC and AC, Squids, Introduction to high T_c 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Dia, Para and Ferromagnetism- Classification, Langevin theory of Dia. and	2

	Para magnetism	
2	Adiabatic demagnetization, Weiss molecular field theory and Ferromagnetism	2
3	Curie- Weiss law, Wave particle duality, De-Broglie concept	2
4	Uncertainty principle. Wave function, Time dependent Schrodinger wave Equation	2
5	Time Independent Schrodinger wave Equation	2
6	Qualitative explanation of Zeeman effect, Stark effect	2
7	Paschan Back effect, Raman Spectroscopy	2
8	Statement of Bloch's function, Bands in solids, Velocity of Bloch's electron	2
9	Effective mass, Distinction between metals, Insulators and semiconductors	1
10	Intrinsic and extrinsic Semiconductors, Laws of mass action	1
11	Determination of energy gap in semiconductors, Donors and acceptors levels	1
12	Super conductivity, critical magnetic field, Meissner effect	1
13	Isotope effect, Type I and II super conductors	1
14	Josepsson's effect DC and AC, Squids	1
15	Introduction to High Tc superconductors	1
16	Spontaneous and Stimulated emission, Einstein A and B coefficients	1
17	Population inversion, He-Ne and Ruby lasers	1
18	Ammonia and Ruby masers, Holography Note.	1
19	Optical fibre, Physical structure, basic theory	1
20	Mode type, Input output characteristics of optical fibers and applications	1
21	Illumination Laws of Illumination, luminous flux, luminous intensity, Candle power, brightness	1
	Total	29

Practicals

S.No.	Topic	No. of Practicals
1	To find the frequency of A.C. supply using an electrical vibrator.	1
2	To find the low resistance using Carey Foster bridge without calibrating the bridge wire.	1
3	To determine dielectric constant of material using De Sauty's bridge	1
4	To determine the value of specific charge (e/m) for electrons by helical method.	1
5	To study the induced e.m.f. as a function of velocity of the magnet.	1
6	To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities.	1
7	To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to determine the radius of the coil.	1
8	To determine the energy band gap in a semiconductor using a PN Junction diode.	1
9	To determine the slit width from Fraunhofer diffraction pattern using laser beam.	1
10	Determination of ultrasonic wave velocity in a liquid medium.	1
11	To find the numerical aperture of optical fiber.	1
12	To set up the Fiber optic analog and digital link.	1
13	To study the phase relationships in L.R. circuit.	1
14	To study LCR circuit.	1

15	To study the variations of thermo e.m.f. of a copper-constantan thermocouple with temperature.	1
16	To find the wave length of light by prism.	1
	Total	**16**

Reference Books

- Engineering Physics , By: Uma Mukherji
- Solid State Physics , By: A.J. Dekker
- Physics for Engineers , By: S.P. Taneja

S.No.	Course Name	Course No.	Credit	L	P	T
3	**Engineering Chemistry**	**Chem (E)-101**	**3 (2 + 1)**	**2**	**1**	**0**

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 radio active 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Phase rule its application to one and two component systems	2
2	Fuels Classification, Calorific value	2
3	Colloids Classification, properties	2
4	Corrosion Causes, type and methods of prevention	2
5	Water Temporary and permanent hardness, disadvantages of hard water	2
6	Scale and sludge formation in boilers, boiler corrosion	2
7	Analytical methods like thermo gravimetric, polarographic analysis,	2
8	Nuclear radiation, detectors and analytical application of radio active materials	3
9	Enzymes and their use in manufacturing of ethanol and acetic acid by fermentation methods	3
10	Principles of food chemistry, introduction to lipids, proteins, carbohydrates, vitamins, Food preservators , colouring and flavouring reagents of food	7
11	Lubricants properties, mechanism, classification and tests	2
12	Polymers type of polymerization, properties, uses and methods for the determination of molecular weight of polymers	4
	Total	**33**

Practicals

S.No.	Topic	No. of Practicals
1	Determination of temporary and permanent hardness of water by	1

	EDTA method.	
2	Estimation of chloride in water.	1
3	Estimation of dissolved oxygen in water.	1
4	Determination of BOD in water sample.	1
5	Determination of COD in water sample.	1
6	Estimation of available chlorine in bleaching powder.	1
7	Determination of viscosity of oil.	1
8	Estimation of activity of water sample.	1
9	Estimation of alkalinity of water sample.	1
10	Determination of carbonate and non-carbonate hardness by soda seagent.	1
11	Determination of coagulation of water and chloride ion content.	1
12	Determination of specific rotation of an optically active compound.	1
13	Determination of λ_{max} and verification of Beer Lambert Law.	1
14	Determination of calorific value of fuel.	1
15	Identification of functional groups (alcohol aldelyde, keline, carbonylic acid and amide) by IR.	1
16	Chromatographic analysis.	1
17	Determination of molar refraction of organic compounds.	1
	Total	**17**

Reference Books

- Engineering Chemistry , By: PC Jain and Monika Jain
- Analytical Chemistry Theory and Practical , By: R.M. Verma
- Physical Chemistry , By: Puri and Sharma
- Quantitative Inorganic Chemistry , By: V.I. Vogel
- Comprehensive Engineering Chemistry, By: Dhiraj Sud
- Principles of Food Chemistry , By: Johan M Deman

S.No.	Course Name	Course No.	Credit	L	P	T
4	**Workshop Practice**	**FMP - 101**	**1 (0 + 1)**	0	1	0

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.

Practicals

S.No.	Topic	No. of Practicals
1	Study of shop lay-out fitting shop, carpentry shop, black smithy shop.	1
2	To prepare a single piece pattern by wood working operation	1
3	To prepare half lap joint by wood working operation	1
4	To prepare Dove-tail joint by wood working operation	1
5	To prepare Mortised joint by wood working operation	1
6	To prepare Tennon joint by wood working operation	1
7	To prepare square bar out of cylindrical bar by cold working process	1
8	To prepare hexagonal chisel by hot working process	1
9	To prepare chipping hammer by hot working process	1
10	To prepare khurpi by hot working process	1

11	To prepare I hook by hot working process	1
12	To prepare a lap joint of galvanized/ M.S. sheet by punching , drilling, and riveting operation	1
13	To prepare m.s. square plates by filing, cutting, with hacksaw, drilling, ramming, threading with tap and die and assembly processes	2
14	To prepare male and female (C & T) parts by different fitting operations	2
	Total	**16**

Reference Books

- Workshop Technology Vol. I & II , By: S.K. Hajra Chaudhary
- Workshop Technology , By: Chapman
- Workshop Technology , By: S.K. Gupta
- Manufacturing Technology, By: S. Dalela

S.No.	Course Name	Course No.	Credit	L	P	T
5	**Surveying and Leveling**	**R E - 101**	**3 (1 + 2)**	**1**	**2**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Surveying Introduction	1
2	classification and basic principles Linear measurements	1
3	Chain Surveying. Compass survey	2
4	Errors in measurements, their elimination and correction	1
5	Plane table surveying.	2
6	Levelling.	2
7	Contouring,	3
8	Computation of area and volume	1
9	Theodolite traversing..	2
10	Introduction to setting of curves	1
	Total	**15**

Practicals

S.No.	Topic	No. of Practicals
1	Chain survey of an area and preparation of map	6
2	Compass survey of an area and Plotting of compass survey	4
3	Plane table surveying	5
4	Leveling. L section and X-sections and its plotting	5
5	Contour survey of an area and preparation of contour map	4
6	Introduction of software in drawing contour	1
7	Theodolite surveying	3

8	Ranging by theodolite, Height of object by using theodolite	1
9	Setting out curves by theodolite	2
10	Minor instruments	1
	Total	**32**

Reference Books

- Surveying , By: C.L. Kochher, Kataria
- Surveying and Levelling Vol.1&2 , By: T.P. Kanetkar and S.V. Kulkarni,
- Surveying Vol.1&2 , By: B.C. Punmia,

S.No.	Course Name	Course No.	Credit	L	P	T
6	**Engineering Drawing**	**FMP - 103**	**2 (0 + 2)**	**0**	**2**	**0**

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.

Practicals

S.No.	Topic	No. of Practicals
1	Familiarization with drawing instruments and their uses	1
2	Study of different type of scales and related terminology	3
3	Construction of different scales	2
4	Study of useful terminology of projections	1
5	Problems on projection of points lying in different quadrant with respect to two reference plains	2
6	Problems on projection of straight line lying in different quadrant with respect to two reference plains	3
7	Study of useful terminology of different types of planes and their traces	1
8	Problems on projection of planes lying in different quadrant with respect to two reference plains	2
9	Study of useful terminology of different types of solids	1
10	Problems on projection of solids lying in different quadrant with respect to two reference plains	3
11	Study of useful terminology of section of solids	1
12	Problems on section of solids lying in different quadrant with respect to two reference plains	3
13	Problems on intersection of different solids with respect to two reference plane	3
14	Study of different methods of development and problem on development of surfaces of diff. solids	3
15	Study of useful terminology of isometric projection	1
16	Problems on isometric view . isometric projection of different solids with	3

	their diff. position with respect to two reference plane	
	Total	**33**

Reference Books

- 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

S.No.	Course Name	Course No.	Credit	L	P	T
7	**Environmental Science**	**ES - 101**	**3 (3 + 0)**	**3**	**0**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Definition, Scope and Importance	2
2	Ecosystem Types, structure and functions	5
3	Bio-diversity Value, threats and conservation	6
4	Natural Resources Forest, mineral, soil and water –Their uses and abuses.	6
5	Environmental pollution –Causes, effects and control measures of air, Water, soil, marine, thermal and noise pollution	6
6	Nuclear hazards	3
7	Bio-safety and risk assessment	3
8	Rural and urban waste management	4
9	Global Warming	3
10	Environmental act and related issues	5
11	Human population, health and social welfare	5
	Total	**48**

Reference Books

- 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.

S.No.	Course Name	Course No.	Credit	L	P	T
8	**Electrical Circuits**	**APE - 101**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

Average and effective value of sinusoidal and linear periodic wave forms. Independent and dependent sources, loop current and loop equations (Mesh current method), node voltage and node equations(Nodal voltage method), Network theorems Thevenin's, Norton's, Superposition, Reciprocity and Maximum power transfer, Star- Delta conversion Solution of DC circuit by Network Theorems, Sinusoidal steady state response of circuits, Instantaneous and average power, power factor, reactive and apparent power, Concept and analysis of balanced polyphase circuits, Laplace transform method of finding step response of DC circuits, Series and parallel resonance, Classification of filters, constant-k, m-derived, terminating half network and composite filters.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Average and effective value of sinusoidal and linear periodic wave forms.	3
2	Independent and dependent sources, loop current and loop equations (Mesh current method).	3
3	Node voltage and node equations (Nodal voltage method).	3
4	Network theorems Thevenin' s, Norton' s, Superposition.	2
5	Reciprocity and Maximum power transfer.	2
6	Star- Delta conversion solution of DC circuit by Network theorems.	2
7	Sinusoidal steady state response of circuits.	3
8	Instantaneous and average power, power factor, reactive and apparent power.	3
9	Concept and analysis of balanced polyphase circuits.	3
10	Laplace transform method of finding step response of DC circuits.	3
11	Series and parallel resonance.	2
12	Classification of filters.	2
13	Constant-k, m-derived, terminating half network and composite filters.	3
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	To familiarize with the components and equipments used in Laboratory	**1**
2	To verify Krichhoff's current laws	**1**
3	To verify Krichhoff's voltage laws	**1**
4	To verify Thevenin theorems., and Norton's theorems.	**2**
5	To verify Superposition theorem and reciprocity theorem	**2**
6	To Study the sinusoidal response of RL series circuit	**1**
7	To study the sinusoidal response of RC series circuit	**1**
8	To study the step response of RL series circuit	**1**
9	To study the step response of RC series circuit	**1**

10	To study the response of constant K-filters.	**1**
11	To study the response of m-derived filters	**1**
12	To study power consumed in a three phase circuit	**1**
	Total	**14**

Reference Books

- Electrical Engineering Fundamentals , By: Vincent Del Toro, PHI
- A text book of Electrical Engineering , By: B.L Theraja & A.K Theraja, Chand publisher
- A course in Electrical Technology , By: J.B Gupta, Kataria Sons
- Electrical Technology , By: Edward Hughes

S.No.	Course Name	Course No.	Credit	L	P	T
9	**English**	**Eng (E) - 101**	**2 (1 + 1)**	**1**	**0**	**1**

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, intonation Pattern. Composition letter, Application, Summary and report writing.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Grammar Tenses,	6
2	Voice-Change,	1
3	Direct/Indirect narration,	1
4	Prepositions and Determiners,	1
5	Word-formation with parts of Speech,	2
6	Types of sentences	2
7	Elementary Knowledge of English	1
8	Sound with Word-stress, intonation Pattern.	1
9	Composition - Letter, Application, Summary and report writing.	1
	Total	**16**

Details of Tutorials

S.No.	Topic	No. of Tutorials
1	Grammar Tenses,	6
2	Voice-Change,	1
3	Direct/Indirect narration,	1
4	Prepositions and Determiners,	1
5	Word-formation with parts of Speech,	2
6	Types of sentences	2
7	Elementary Knowledge of English	1
8	Sound with Word-stress, intonation Pattern.	1
9	Composition - Letter, Application, Summary and report writing.	1
	Total	**16**

Reference Books

- 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

Semester - II

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	**Engineering Mathematics-II**	**Maths (E)-102**	**3 (2+1)**	**2**	**0**	**1**

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).

Planning of lectures

S.No.	Topics to be covered in Lecture / Tutorial	Proposed No. of Lectures/ Tutorials
1	Elementary transformation and rank of a matrix, reduction to normal form, Gauss-Jordan method to find inverse of a matrix	3
2	Solution of system of linear equations	3
3	Eigen value and vectors, Cayley-Hamilton theorem	2
4	Linear and orthogonal transformations	1
5	Diagonalization of matrices, Bilinear ,Quadratic forms	2
6	Complex variable : Limit, continuity, derivative of function of complex variable	3
7	Analytical function, C-R equations, conjugate function, harmonic functions	2
8	Fourier series:Infinite series and its convergence, periodic function, Euler's formulae for calculating Fourier coefficients, Dirichlet's conditions	2
9	Fourier series of functions with period 2	2
10	Fourier series of functions with arbitrary period	3
11	Fourier series of odd and even functions	2
12	Half range sine and cosine series, Harmonic analysis	3
13	Partial differential equations: Formation of partial differential equations	4
14	Lagrange's linear equation	2
15	Higher order linear partial differential equation with constant coefficients	4
16	Solution of non-linear partial differential equation (Charpit's method)	3
17	Application of partial differential equations: One dimensional wave e.q, one dimensional heat equation, two dimensional steady state heat equation i.e. Laplace equation	6
	Total	**47**

Reference Books

- Higher Engineering Mathematics, Vol-I,II , By: Dr. K. R. Kachot
- Higher Engineering Mathematics , By: Dr. B. S. Graval
- A Text Book Of Engineering Mathematics , By: N. P. Bali and Ashok Saxena
- Schaum's Outline Series: Theory and Problems of Complex variable , By: Murray R. Spigel
- Schaum's Outline Series:Theory and Problems of Matrices , By: Frank Ayres
- Advance Engineering Mathematics , By: Erwin Kreyszing
- Schaum's Outline Series:Theory and Problems of Advance calculus , By: Murray R. Spigel
- Text book of matrices, By: Shanti Narayan and P. K Mittal

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	**Computers Programming and Data Structures**	**APE - 102**	**3 (1 + 2)**	**1**	**2**	**0**

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to high-level languages.	1
2	Primary data types and user defined data types.	2
3	Variables, typecasting, Operators.	1
4	Building and evaluating expressions.	2
5	Standard library functions.	1
6	Managing input and output.	1
7	Decision-making, Branching, Looping, Arrays.	2
8	User defined functions, String functions.	1
9	Passing arguments and returning values.	1
10	Recursion, scope and visibility of a variable.	1
11	Structures and union.	1
12	Pointers, Stacks, Push/Pop operations.	1
13	Queues, Insertion and deletion operations, linked lists.	1
	Total	**16**

Practicals

S.No.	Topic	No. of Practicals
1	Familiarizing with Turbo C ID	2
2	Building an executable version of C program	1
3	Debugging a C program	4
4	Developing and executing simple programs	3
5	Creating programs using Decision making statements such as if, go to	2

	& switch	
6	Developing program using loop statements while, do & for	3
7	Using nested control structures	1
8	Familiarizing with one and two dimensional arrays.	2
9	Using string functions	3
10	Developing structures and union	1
11	Creating user defined functions	1
12	Using local, global & external variables	1
13	Using pointers	1
14	Implementing Stacks	1
15	Implementing push/pop functions	1
16	Creating Queues	1
17	Developing linked lists in C language	1
18	Insertion/Deletion in data structures	1
	Total	**30**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
3	**Applied Electronics and Instrumentation**	**RE - 102**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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 OP-AMP (adder, subtractor, integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator), zener diode voltage regulator, transistor series regulator, current limiting, OP-AMP voltage regulators, Basic theorem of Boolean algebra, Combinational logic circuits(basic gates, SOP rule and 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Semiconductors, P-N junction, V-I characteristics of P-N junction	2
2	Diode as a circuit element, rectifier	2
3	Clipper, clamper	2

4	Voltage multiplier, Capacitive filter	2
5	Diode circuits for OR & AND gate	2
6	Bipolar junction Transistor; operating point	2
7	Classification of amplifier, various biasing methods	2
8	h-parameter model of a transistor, analysis of small signal	2
9	CE amplifier, phase shift oscillator	2
10	Analysis of different amplifier using transistor	2
11	Ideal OP-AMP characteristics	2
12	Linear and Non-linear application of AMP.	2
13	Linear and Non-linear application of AMP.	2
14	Zener diode Voltage Regulator, transistor series regulator	1
15	Current limiting, OP-AMP Voltage regulator	1
16	Basic theorem of Boolean algebra	1
17	Combinational logic circuits	1
18	Binary ladder D/A converter	1
19	Successive approximation A/D converter	1
20	Generalized instrumentation, measurement of displacement, temperature using potentiometer	2
21	Velocity, force and pressure measurement using potentiometer	1
22	Resistance thermometer, thermocouple	1
23	Bourden tube, LVDT	1
24	Strain gauge and tacho generator	1
	Total	**36**

Practicals

S.No.	Topic	No. of Practicals
1	To study V-I characteristics of PN junction diode	1
2	To study Half wave, full wave and Bridge Rectifier.	1
3	To study transistor characteristics in CE configurations.	1
4	To design study fixed and self bias transistor.	1
5	To design study potential divider bias transistor.	1
6	To study a Diode as clipper and clamper.	1
7	To study a OP-AMP IC 741 as inverting and non-inverting amplifier	1
8	To study a OP-AMP IC 741 as differentiator amplifier	1
9	To study a differential amplifier using two transistor	1
10	To study a OP-AMP IC 741 as differential amplifier	1
11	To study a zener regulator circuit	1
12	To study a OP-AMP IC 741 as a active rectifier	1
13	To study a OP-AMP IC 741 as a comparator	1
14	To familiarize with various types of transducers	1
	Total	**14**

Reference Books /

- Electronic Principles , By: Albert Paul Malvino, TMH..
- Electrical Engineering Fundamentals , By: Vincent Del Toro, PHI..
- A course in electrical and electronic measurements & instrumentation, By: A.K Sawhney, Dhanpat Rai.
- Electronic Devices & Circuit Theory , By: Boylestad, PHI.
- Electronic Devices & Circuits , By: Allen Mottershead, PHI.

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	**Agriculture for Engineers**	**Agri (E) - 102**	**4 (3 + 1)**	**3**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
	Soils	
1	Nature and origin of soil; soil forming rocks and minerals, their classification and composition	2
2	Soil forming processes, classification of soils – soil taxonomy orders; important soil physical properties; and their importance; soil particle distribution	3
3	Soil inorganic colloids – their composition, properties and origin of charge; ion exchange in soil and nutrient availability	3
4	soil organic matter – its composition and decomposition, effect on soil fertility; soil reaction – acid, saline and sodic soils	3
5	Quality or irrigation water	2
6	Essential plants nutrients – their functions and deficiency symptoms in plants	2
7	Important inorganic fertilizers and their reactions in soils	2
	Agronomy	
8	Definition and scope of agronomy	2
9	Classification of crops	2
10	Effect of different weather parameters on crop growth and development	2
11	Principles of tillage, tilth and its characteristics	2
12	Soil water plant relationship and water requirement of crops	2
13	weeds and their control	2
14	Crop rotation, cropping systems, Relay cropping and mixed cropping.	2
	Horticulture	
15	Scope of horticultural and vegetable crops	1

16	Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties	2
17	Criteria for site selection, layout and planting methods, nursery raising	2
18	Macro and micro propagation methods,	3
19	Plant growing structures, pruning and training	2
20	Fertilizer application, fertigation, irrigation methods	1
21	Harvesting, grading and packaging, post harvest practices	2
22	Garden tools, management of orchard	1
23	Extraction and storage of vegetables seeds.	1
	Total	**48**
Practicals		
S.No.		No. of Practicals
1	Identification of rocks and minerals;	1
2	Examination of soil profile in the field;	1
3	Determination of bulk density; particle density and porosity of soil;	1
4	Determination of organic carbon of soil	1
5	Identification of crops and their varieties seeds and weeds;	1
6	Fertilizer application methods;	1
7	Different weed control methods;	1
8	Judging maturity time for harvesting of crop	1
9	Study of seed viability and germination test;	1
10	Identification and description of important fruit; flowers and vegetables crops;	3
11	Study of different garden tools;	1
12	Preparation of nursery bed;	1
13	Practices of pruning and training in some important fruit crops.	1
	Total	**15**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	**Workshop Technology**	**FMP - 102**	**3 (2 + 1)**	**2**	**1**	**0**

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to welding, types of welding, oxyacetylene gas welding, types of flame	3
2	Arc welding technologies and equipments	3
3	Casting process	3
4	Classification, construction details of center lathe, main accessories and attachment	3
5	Main operations and tools used in centre lathe	3
6	Type of shaper, construction details of standard shaper, work holding devices shaper tools, operation	2
7	Type of drilling machines, construction details of pillar type and radial drilling machine	3
8	Work holding and tool holding device and main drilling operations	3
9	Twist drills, drill angles and sizes	2
10	Classification of different types of milling machine	1
11	Constructional details and principle of operation of column and knee type milling machine	2
12	Types of milling cutter and operation on milling machines	2
	Total	**30**

Practicals

S.No.	Topic	No. of Practicals
1	Study of shop lay-out fitting shop, carpentry shop, black smithy shop.	1
2	To prepare a single piece pattern by wood working operation	1
3	To prepare half lap joint by wood working operation	1
4	To prepare Dove-tail joint by wood working operation	1
5	To prepare Mortised joint by wood working operation	1
6	To prepare Tennon joint by wood working operation	1
7	To prepare square bar out of cylindrical bar by cold working process	1
8	To prepare hexagonal chisel by hot working process	1
9	To prepare chipping hammer by hot working process	1
10	To prepare khurpi by hot working process	1
11	To prepare I hook by hot working process	1

12	To prepare a lap joint of galvanized/ M.S. sheet by punching , drilling, and riveting operation	1
13	To prepare m.s. square plates by filing, cutting, with hacksaw, drilling, ramming, threading with tap and die and assembly processes	1
14	To prepare male and female (C & T) parts by different fitting operations	1
	Total	**14**

Reference Books

- Workshop Technology Vol. I & II , By: S.K. Hajra Chaudhary
- Workshop Technology , By: Chapman
- Workshop Technology , By: S.K. Gupta
- Manufacturing Technology , By: S. Dalela

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	**Engineering Mechanics**	**FMP - 104**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Basic concept of engineering mechanics	2
2	Force system, free body diagram and equilibrium of forces	4
3	Centroid moment of inertia	4
4	Friction and frictional forces	4
5	Analysis of simple frames structure using method of joints, method of section and graphical method	4
6	Simple stresses, shear force and bending moment diagrams	5
7	Stresses in beams, torsion	4
8	Analysis of plane and complex stresses	3
	Total	**30**

Practicals

S.No.	Topic	No. of Practicals
1	To study and verify law of parallelogram of forces	1
2	To study and verify Lami's theorem	1
3	To study and verify the law of Polygon of forces	1
4	To determine the co-efficient of friction between two surfaces for horizontal plane	1
5	To determine the co-efficient of friction between two surfaces for incline plane	1
6	To determine moment of inertia of a flywheel	1
7	To study the machine and verify the law of triangle of forces on jib crane	1
8	To determine mechanical advantage, velocity ratio, efficiency and friction	1

	present in simple screw jack machine	
9	To carry out torsion test on circular specimen and to find out modulus of rigidity	1
10	To determine the law of machine on single purchase crab and to find efficiency of the machine	1
11	To study the problem on simple supported beams and roller and hinged supported beams by analytical and graphical methods.	1
	Total	**11**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	**Thermodynamics and Heat Engines**	**FMP - 106**	**4 (3 + 1)**	**3**	**1**	**0**

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 Babcock-Wilcox 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Thermodynamics properties, closed and open system, flow and non flow processes	2
2	Gas laws, laws of thermodynamics, internal energy	2
3	Application of 1st law in heating and expansion of gases in non flow processes	2

4	1st law applied to steady flow processes	2
5	Kelvin-Plank and Claussius Statements, reversible processes, Carnot cycle, Carnot theorem	2
6	Entropy, physical concept of entropy, change of entropy of gases in thermodynamics processes	2
7	Difference between gas and vapour, change of phase during constant pressure process	2
8	Generation of steam, triple point and critical point, internal energy and entropy of stream	2
9	Use of steam tables and moiler charts, heating and expansion of vapour	2
10	Non flow processes, measurement of dryness fraction	2
11	Classification of steam boilers, cocharan, Lancashire, locomotive and babcock – Wilcox boilers	2
12	Boiler mountings and accessories	2
13	Desirable properties of working fluid used for power plants non expansive working	2
14	Saturation curve and missing quantity governing	2
15	Calculations of cylinder dimensions,	2
16	Introduction to compound steam engines	2
17	Air standard efficiency, other engines efficiencies and terms	3
18	Otto, diesel and dual cycle, calculation of efficiency	3
19	Mean effective pressure and their comparison	2
20	Measurement of IP, BP and heat balance calculations (not involving combustion	2
21	Engine efficiencies and performance	2
22	Revision and doubts	2
	Total	**46**
	Practicals	
S.No.	Topic	No. of Practicals
1	Study of boilers	1
2	Study of various mountings and accessories of boilers	1
3	Study of steam engines	1
4	To measure dryness fraction of steam	1
5	Study of performance test of steam engine	1
6	Study of I.C. engines-	2
7	Study of valve timing diagram of 2 – stroke engines	1
8	Study of valve timing diagram of 4- stroke engines	1
9	Performance test on 2 cylinder diesel engines	1
10	Performance test and heat balance test on a four cylinder horizontal diesel engine	1
11	To study about Morse test on multi cylinder petrol engine	1
12	Comparison of different temperature measuring methods	1
13	To verify inverse square law of radiation and Stefan- Boltzmann relationship	1
14	To study about the emissivity of a given material	1
	Total	**15**

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

SECOND YEAR

Semester - III

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	**Engineering Properties of Biological Materials and Food Quality**	**APE - 201**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lecturess
1	Importance of engineering properties of biological materials.	2
2	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.	4
3	Rheological characteristics like stress, strain time effects, rheological models and their equations.	3
4	Aerodynamic characteristics and frictional properties.	2
5	Application of engineering properties in handling processing machines and storage structures.	3
6	Concept, objectives and need of quality, quality control.	2
7	Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition.	3
8	Methods of quality control, sampling; purpose, sampling techniques, requirements and sampling procedures for liquid, powdered and granular materials.	3
9	Sensory quality control, panel selection methods, interpretation of sensory results in statistical quality control.	4
10	TQM and TQC, consumer preferences and acceptance.	3
11	Food Laws and Regulations in India. Food grades and standards BIS, AGMARK, PFA, FPO,	2

12	CAC (Codex Alimentations Commission). GMP, HACCP (Hazard analysis and critical control point) and ISO 9000 Series.	2
13	Sanitation in food industry.	1
	Total	**34**
	Practicals	
S.No.	Topic	No. of Practicals
1	To find the shape and size of grains and fruits and vegetables.	1
2	To determine bulk density and angle of repose of grains	1
3	To determine the particle density/true density and porosity of solid grains.	1
4	To find out the co-efficient of external and internal friction of different crops.	1
5	To study the separating behaviour of a grain sample in a vertical wind tunner (Aspirator column).	1
6	To find the thermal conductivity of different grains	1
7	To determine specific heat of some food grains	1
8	To determine cooking quality of rice	1
9	To determine impurities and invisible stress cracks in grains	1
10	Preparation of a ready re-ckoner of change in unit weight of food grains as affected by change in its moisture content (w.b.) (5% - 25%).	1
11	Milling quality of paddy;	1
12	Determination of hardness of food material.	1
13	Detection of adulteration in food products viz. milk, ghee, honey etc.	1
	Total	**13**

Reference Books

- 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).

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	Soil Mechanics	SWE-201	3 (2+1)	2	1	0

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction of soil mechanics, field of soil mechanics.	1
2	Phase diagram physical and index properties of soil.	2
3	Classification of soils, general classification based on particles size, textural classification and I. S. Soil classification system.	3
4	Stress condition in soils, effective and neutral stress.	2
5	Elementary concept of Bousinesque and Wester guards analysis, Newmark influence chart.	2
6	Shear strength Mohr stress circle, theoretical relationship between principle stress circle, theoretical relationship between principal stress	3
7	Mohr-coulomb failure theory, effective stress principle.	2
8	Determination of shear parameters by direct shear to the circle, theoretical test, numerical exercise based on various types of tests.	3
9	Compaction composition of soils standard and modified protector test Abbot Compaction and Jodhpur mini compaction text field compaction method and control.	3
10	Consolidation of soil Consolidation of soils, one dimensional consolidation spring analogy.	2
11	Terzaghi's theory Laboratory consolidation test, calculation of void ratio and coefficient of volume change,	2
12	Taylor's and Casagrande's method, determination of coefficient of consolidation.	2
13	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.	4

14	Stability of slopes Introduction to stability analysis of infinite and finite slopes friction circles method Taylor's stability number.	3
	Total	**34**
	Practicals	
S.No.	Topic	No. of Practicals
1	Determination of water content of soil. (Various methods)	2
2	Determination of specific gravity of soil.	1
3	Determination of field density of soil by core cutter method.	1
4	Determination of field density by sand replacement method.	1
5	Grain size analysis by sieving (Dry sieve analysis)	1
6	Grain size analysis by hydrometer method.	1
7	Determination of liquid limit by Casagrande's method.	1
8	Determination of liquid limit by cone penetrometer and plastic limit.	1
9	Determination of shrinkage limit.	1
10	Determination of permeability by constant head method.	1
11	Determination of permeability by variable head method.	1
12	Determination of compaction properties by standard proctor test.	1
13	Determination of shear parameters by direct shear test.	1
14	Determination of unconfined compressive strength of soil.	1
15	Determination of shear parameters by Tri-axial test.	1
16	Determination of consolidation properties of soils.	1
	Total	**17**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
3	**Fluid Mechanics**	**SWE - 203**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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 Stress-strain 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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Properties of fluids.	3
2	Ideal and real fluid	1
3	Pressure and its measurement	3
4	Pascal's law	1
5	Pressure forces on plane and curved surfaces	2
6	Centre of pressure	1
7	Buoyancy, Metacentre and Metacentric height, Condition of floatation and stability of submerged and floating bodies	2
8	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,	3
9	Types of fluid flow	1
10	Translation, rotation	1
11	Circulation and vorticity, Vortex motion	1
12	Dynamics of fluid flow, Bernoulli's theorem,	2
13	Venturimeter, orifice-meter and nozzle, siphon	1
14	Laminar flow Stress-strain relationships, flow between infinite parallel plates - both plates fixed, one plate moving, Discharge, average velocity, Shear stress and pressure gradient	2
15	Laminar and turbulent flow in pipes	2
16	General equation for head loss-Darcy Equation	1
17	Moody's diagram	1
18	Minor and major hydraulic losses through pipes and fittings	1
19	Flow through network of pipes	1
20	Hydraulic gradient and energy gradient, power transmission through pipe	1
21	Dimensional analysis and similitude Rayleigh's method and Buckingham's 'Pi' theorem, Types of similarities, dimensional analysis, dimensionless numbers	2
22	Introduction to fluid machinery.	1
	Total	**34**
Practicals		
S.No.	Topic	No. of Practicals
1	Study of manometers and pressure gauges.	1
2	Verification of Bernoulli's theorem.	1
3	Determination of coefficient of discharge of venturi meter	1
4	Determination of coefficient of discharge of orifice meter	1
5	Determination of coefficient of friction in pipeline.	1
6	Determination of coefficient of discharge for rectangular notch.	1
7	Determination of coefficient of discharge for triangular notch.	1
8	Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice.	1
9	Determination of coefficient of discharge for mouth piece	1
10	Measurement of force exerted by water-jets on flat and hemispherical	1

	vanes	
11	Determination of meta centric height	1
12	Determination of efficiency of hydraulic ram	1
13	Performance evaluation of Pelton turbine	1
14	Performance evaluation of Francis turbine	1
15	Study of current meter velocity distribution in open channels	1
16	Determination of Manning's coefficient of rugosity	1
	Total	**17**

Reference Books

- 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 ,

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	**Farm Machinery and Equipment - I**	**FMP - 201**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Mechanization	2
2	Classification of farm machineries, materials of construction	2
3	Principles of operation and selection of machines used for production of crops	2
4	Field capacities and economics	2
5	Tillage, primary and secondary tillage equipments	6
6	Forces acting on tillage tools	2
7	Hitching systems and controls, draft measurement of tillage equipment	3
8	Earth moving equipment- their construction and working principles viz. bulldozer, trencher, elevator etc.	4
9	Sowing, planting and transplanting equipment – their calibration and adjustments, fertilizer application equipment	4

10	Weed control and plant protection equipment, sprayers and dusters, their calibration, selection, constructional features of different components and adjustments, test codes and their related uses	3
	Total	**30**
	Practicals	
S.No.	Topic	No. of Practicals
1	Introduction to various machines and implement available in lab.	1
2	Measurement of field capacity and field efficiency of M.B. plough	1
3	Measurement of field capacity and field efficiency of disc harrow	1
4	Measurement of draft and fuel consumption of agricultural implements	1
5	Constructional details, adjustment and working of M.B. Plough	1
6	Constructional details, adjustment and working of Disc Plough	1
7	Constructional details, adjustment and working of secondary tillage tools	1
8	Constructional details, adjustment and working of earth moving equipment	1
9	Constructional details, adjustment and working of rotavator and rotary tillers	1
10	Constructional details, adjustment and working of seed cum fertilizer drills / planter	1
11	Calibration of seed drill	1
12	Working of weeding equipment	1
13	Working of sprayer for nozzle discharge and field capacity	1
14	Working of duster	1
15	Working of transplanter	1
	Total	**15**

Reference Books

- Principle of farm machinery , By: R.A. Kepner, Roy Bainer & E.L. Berger
- Farm machines & equipments , 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	Farm Power	FMP - 203	3 (2 + 1)	2	1	0

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Conventional and non conventional sources of farm power	3
2	Classification of IC engines and tractors	3
3	Review of thermodynamic principles of IC engine and deviation from ideal cycles	3
4	Study of engine components, their construction, operating principles and functions	3
5	Engine system- valve and valve mechanism	2
6	Engine system- fuel and air supply	2
7	Engine system – Cooling and lubricating system	2
8	Engine system – ignition, starting and electrical system	2
9	IC engine, fuels, their properties, combustion of fuels	2
10	Gasoline tests and their significance	1
11	Diesel fuel test and their significance	2
12	Detonation and knocking of IC engines	2
13	Coolant properties, anti freeze, anti corrosion materials	2
14	Lubricant types and their properties	1
15	Governor system of engines	2
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Study on conventional and non conventional sources	1
2	Study of different types of engines and tractors	2
3	Acquaintance with engine components, their construction, operating principles and functions	1
4	Study on valve and valve mechanism	1
5	Assembly and dismantling of fuel and air supply system	2
6	Study on cooling system	1
7	Study on lubricating system	1
8	Study on electrical system (Ignition and lighting)	1

9	Study of fuel properties of different fuels	1
10	Testing of fuels (gasoline) and their significance	1
11	Testing of fuels (diesel) and their significance	1
12	Study on lubricants and their properties	1
13	Study on governor system of engines	1
	Total	**15**

Reference Books

- Elements of Agril. Engg. By: J. Sahay
- Tractors & their power untis , By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith, Makota Hoki
- Farm machines & equipment, By: C.P. Nakra

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	**Watershed Hydrology**	**SWE - 205**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction; hydrologic cycle; precipitation - forms	1
2	Rainfall measurement, hyetograph	2
3	Mass curve, mean rainfall depth	1
4	Frequency analysis of point rainfall, plotting position.	3
5	Estimation of missing data, test for consistency of rainfall records	1
6	Interception; infiltration; evaporation, evapotranspiration, transpiration, its estimation and measurement	3
7	Geomorphology of watersheds - stream number, stream length, stream area, stream slope) and Holton's laws	2
8	Runoff - factors affecting, measurement; stage and velocity, rating curve, extension of rating curve	3
9	Estimation of peak runoff rate and volume; rational method, Cook's method, SCS method, Curve number method	3
10	Hydrograph; components, base flow separation	2
11	Unit hydrograph theory - unit hydrograph of different durations	2
12	Dimensionless unit hydrograph, distribution hydrograph	1

13	Synthetic unit hydrograph	1
14	Uses and limitations of unit hydrograph	1
15	Head water flood control – methods	1
16	Retards and their location	1
17	Flood routing – graphical methods of reservoir, flood routing	2
18	Hydrology of dry land areas - drought and its classification	2
19	Introduction to watershed management and planning	2
	Total	**34**
Practicals		
S.No.	Topic	No. of Practicals
1	Visit to meteorological observatory	1
2	Study of different types of rain gauges	1
3	Exercise on analysis of rainfall data	1
4	Double mass curve technique	1
5	Determination of average depth of rainfall and frequency analysis	2
6	Study of stage recorders and current meters	1
7	Exercise on estimation of peak runoff rate and runoff volume	3
8	Exercises on hydrograph and unit hydrograph	3
9	Exercises on design and location of retards for channel improvement	1
10	Exercises on flood routing problems	2
11	Visit to watershed	1
	Total	**17**

Reference Books

- Hand Book of applied Hydrology, By: L R
- 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,

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	**Engineering Mathematics-III**	**Maths (E)-201**	**3 (2 + 1)**	**2**	**0**	**1**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture / Tutorial	Proposed No. of Lectures/ Tutorials
1	Numerical analysis: Finite differences ,various differential operators and their relationships, factorial notation	3
2	Interpolation with equal intervals: Newton's forward interpolation ,Newton's backward interpolation	5
3	Central difference interpolation: Bessel's interpolation, Stirling's interpolation	3
4	Interpolation with unequal intervals: Lagrange's interpolation, Newton's divided difference interpolation	4
5	Numerical differentiation: Differentiation based on equal interval interpolation formulae like Newton's forward interpolation formula, Newton's backward interpolation formula, Bessel's interpolation formula, Stirling's interpolation formula(calculate first and second derivative),Maxima-minima of tabulated functions	2
6	Numerical integration: Trapezoidal rule, Simpson's rule, Weddle's rule	3
7	Difference equation: Linear difference equation, rules for finding C.F. and P.I.	6
8	Numerical solution of ordinary differential equation: Picard's method, Taylor's method, Euler's method, Modified Euler's method, Runge-Kutta method	4
9	Laplace transform: Laplace transform of elementary functions, properties of laplace transform, inverse laplace transform	4
10	Laplace transform of derivatives, integrals, function multiplied by t^n, function divided by t	2

11	Convolution theorem and problems	3
12	Application of Laplace transform to solve ordinary differential equations	4
13	Applications of Laplace transform to solve simultaneous differential equations	2
14	Laplace transform of unit step function, unit impulse function, periodic function	3
	Total	**48**

Reference Books

- Higher engineering mathematics Vol-II , By: Dr. K R Kachot
- Numerical methods in Engineering and science , By: Dr. B S. Grewal
- A text book of engineering mathematics , By: N P Bali and Ashok Saxena
- Numerical mathematical analysis , By: James B Scarborough
- Introductory methods of Numerical analysis , By: S S Sastry
- Numerical Analysis, By: Dr. B S Goel and Dr S K Mittal
- Advanced Engineering Mathematics , By: Erwin Kreyszing

Sr. No.	Course Name	Course No.	Credit	L	P	T
8	**Agribusiness Management and Trade**	**Eco (E)- 201**	**3 (3 + 0)**	**3**	**0**	**0**

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Management concepts and principles	5
2	Process of management	4
3	Functions of management	5
4	Concept of agribusiness and application of management principles to Agribusiness	7
5	Production, consumption, and marketing of agricultural products	7
6	Agricultural processing, meaning and theories of international trade	5
7	WTO provisions for trade in agricultural and food commodities	7
8	India's contribution to international trade in food and agri - commodities	5
	Total	**45**

Reference Books

- 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

Semester - IV

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	**Farm Machinery and Equipment - II**	**FMP - 202**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Principles and types of cutting mechanisms	2
2	Construction and adjustment of shear and impact type acting mechanisms	2
3	Crop harvesting machinery- mowers, windrowers, reapers, reaper binders and forage harvesters	2
4	Forage chopping and handling equipments	2
5	Threshing mechanics and various types of threshers, straw combines and grain combines	4
6	Maize harvesting and shelling equipment	2
7	Root crop harvesting equipment – potato, groundnut etc.	3
8	Cotton picking and sugar cane harvesting equipment	4
9	Principles of fruit harvesting tools and machines	3
10	Horticultural tools and gadgets	3
11	Testing of farm machines, related test codes and their use, interpretation of test results	3
12	Selection and management of farm machines for optimum performance	2
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Familiarization with various farm machines related to harvesting, threshing, root harvesting and combine etc.	1
2	Study of different cutting mechanism	1
3	Construction and adjustment of shear and impact type cutting mechanism	1
4	Study the working of crop harvesting machines like mower, windrower and reaper	1
5	Study the working of combine harvester	1
6	Study of various thresher and their working	1
7	Study of maize harvesting and shelling equipment	1
8	Study the working of potato digger	1

9	Study the working of groundnut digger	1
10	Study the working of forage harvester	1
11	Study the working of sugarcane harvester	1
12	Study the cotton picker and harvester	1
13	Constructional details of various types of straw combine	2
14	Study of various types of harvesting equipment	1
15	Field testing of farm machines based on test code	1
	Total	**16**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	**Renewable Energy Sources**	**RE - 202**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Classification of energy sources	1
2	Introduction to renewable energy sources	1
3	Characterization of biomass	2
4	Types, construction, working principle, uses and safety/ environmental aspects of different renewable energy devices like	3
5	Gasifiers	5
6	Biogas plants	5
7	Solar passive heating devices	5
8	Photovoltaic cells and arrays	2
9	Brief introduction to	
10	Wind Energy	2
11	Hydroelectric energy	1
12	Ocean energy	1
13	Briquetting and bailing of biomass	1
14	Biomass combustion	1
15	Biodiesel preparation, and	1
16	Energy conservation in Agriculture	1

	Total	**32**
Practicals		
S.No.	Topic	No. of Practicals
1	Introduction of various laboratory facilities of SESA	1
2	Preparation of biomass sample	1
3	Determination of calorific value	1
4	Estimation of ash content of biomass	1
5	Estimation of moisture content of biomass	1
6	Estimation of fixed carbon and volatile matter of biomass	1
7	Demonstration of down draft throatless rice husk gasifier	1
8	Demonstration of down draft gasifier with throat	1
9	Demonstration of rice husk gasifier for thermal use	1
10	Demonstration of working of a fixed dome type biogas plants	1
11	Demonstration of working of a floating drum type biogas plants	1
12	Demonstration of biodiesel preparation	1
13	Measurement of basic solar parameters	1
14	Demonstration of solar water heater	1
15	Demonstration of PVC	1
16	Demonstration of solar cooker.	1
17	Determination of fuel properties.	1
	Total	**17**

Reference Books

- Renewable Energy Power for sustainable future. ,By: Godfrey Boyle.
- Energy Technology Non-conventional, Renewable and Conventional ,By: S.S. Rao and B.B. Parulekar,
- Handbook of Biomass Downdraft Gasifier Engine System, ,By: Thomas B Reed and Aqua Das.
- Small scale producer gas engine systems,,By: A Kaupp & J.R.Goss.
- Biogas Systems (Principles & Applications) ,By: K.M. Mittal
- Hand book of biogas technology, By: N.S. Grewal, S. Ahluwalia, S. Singh and G. Singh.
- Solar Energy Fundamentals and Applications, By: H.P. Garg and J. Prakash
- Solar energy, By: S.P. Sukhatme,
- Principles of Solar Energy. ,By: D. Yogi Goswami
- Renewable Energy, ,By: P.D. Dunn.

Sr. No.	Course Name	Course No.	Credit	L	P	T
3	Soil and Water Conservation Engineering	SWE - 202	3 (2 + 1)	2	1	0

Course content :

II 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction; soil erosion - causes, types and agents of soil erosion.	1
2	Water erosion - forms of water erosion.	1
3	Mechanics of erosion.	1
4	Gullies and their classification, stages of gully development.	1
5	Soil loss estimation - universal soil loss equation and modified soil loss equation, determination of their various parameters.	2
6	Erosion control measures, agronomical measures; contour cropping, strip cropping, mulching.	1
7	Mechanical measures - terraces - level and graded broad base terraces and their design.	2
8	Bench terraces & their design, layout procedure, terrace planning.	2
9	Bunds - contour bunds, graded bunds and their design.	3
10	Gully and ravine reclamation - principles of gully control, vegetative and temporary structures.	3
11	Wind erosion - factors affecting wind erosion, mechanics of wind erosion.	2
12	Soil loss estimation.	2
13	Wind erosion control measures - vegetative, mechanical measures, wind breaks & shelter belts, sand dunes stabilization.	2
14	Sedimentation - sedimentation in reservoirs and streams estimation and measurement sediment delivery ratio, trap efficiency.	2
15	Characteristics of contours and preparation of contour maps.	2
16	Land use capability classification.	2
17	Grassed water ways and their design.	2
18	Introduction to water harvesting techniques.	2
19	Introduction to stream water quality and pollution.	1
	Total	**34**

Practicals		
S.No.	Topic	No. of Practicals
1	Study of soil loss measurement techniques.	1
2	Study of details of Coshocton wheel	1
3	Study of details of multi-slot runoff samplers.	1
4	Determination of sediment concentration through oven dry method.	1
5	Problems on Universal Soil Loss Equation.	1
6	Preparation of contour map of an area and its analysis.	2
7	Design of vegetative waterways.	1
8	Design of contour bonding system.	2
9	Design of graded bonding system.	2
10	Design of various types of bench terracing systems.	2
11	Determination of rate of sedimentation and storage loss in reservoir.	1
12	Design of Shelter belts.	1
13	Design of wind breaks.	1
	Total	**17**

Reference Books

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

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	**Irrigation Engineering**	**SWE - 204**	**4 (3 + 1)**	**3**	**1**	**0**

Course content :

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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Irrigation, impact of irrigation on human environment, some major & medium irrigation schemes in India, purpose of Irrigation, source of irrigation water, present status of Development and utilization of different water resources of country	6
2	Measurement of irrigation water, weir, notches, flumes and orifices and other methods	6
3	Water conveyance, design of irrigation field channel, underground pipe	6

	conveyance system, irrigation structures, channel lining	
4	Land grading, different design methods and estimation of earth work and cost.	4
5	Soil water plant relationship, soil water movement, infiltration, evapotranspiration, soil moisture content, depth of irrigation, frequency of irrigation, efficiency of irrigation	8
6	Surface irrigation methods of water application, border, check basin, furrow and contour irrigation	6
7	Sprinkler and drip irrigation methods, merits , demerits, selection and design	8
8	Participatory irrigation management, economics of water resources utilization	4
	Total	**48**
Practicals		
S.No.	Topic	No. of Practicals
1	Measurement of soil moisture by different soil moisture measuring instruments.	2
2	Measurement of irrigation water	2
3	Measurement of infiltration rate	1
4	Computation of evaporation and transpiration	2
5	Land grading exercises	1
6	Design of under ground pipe line system	1
7	Infiltration-advance in border irrigation	2
8	Measurement of advance and recession in furrow irrigation and estimation of irrigation efficiency.	1
9	Measurement of uniformity coefficient of sprinkler irrigation method	1
10	Measurement of uniformity coefficient of drip irrigation method	1
11	Field problems and remedial measures for sprinkler and drip irrigation method.	2
	Total	**16**

Reference Books

- 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,

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	**Crop Process Engineering**	**APE - 202**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Scope and importance of food processing. Principles and methods of food processing.	4
2	Processing of farm crops; cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed.	6
3	Processing of animal products.	3
4	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.	4
5	Theory of mixing, types of mixtures for dry and paste. materials, rate of mixing and power requirement, mixing index.	4
6	Theory of separation, size and un sized separation, types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation.	6
7	Theory of filtration, study of different types of filters, rate of filtration, pressure drop during filtration.	4
8	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.	5
	Total	**36**

Practicals

S.No.	Topic	No. of Practicals
1	Preparation of flow and layout charts of a food processing plant.	2
2	Determination of fineness modulus and uniformity index.	1
3	Performance evaluation of hammer mill.	1
4	Performance evaluation of attrition mill.	1
5	Study of cleaning equipment.	1
6	Separation behaviour in pneumatic separation.	1

7	Study of grading equipment.	2
8	Evaluation of performance of indented cylinder and screen pre-cleaner.	2
9	Mixing index and study of mixers.	1
10	Study of conveying equipments.	2
11	Performance evaluation of bucket elevator.	1
	Total	**15**

Reference Books

- 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..

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	**Theory of Machines**	**FMP - 204**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to elements, links, pairs, kinematic chain and mechanism. Classification of pairs, mechanism and their inversion	3
2	Determination of velocity and acceleration using graphical method and instantaneous centers	4
3	Types of gears and law of gearing, involutes and cycloidal profile for gear teeth, spur gear nomenclature, introduction to helical, spiral, bevel and worm gear, simple, compound, reverted and epicyclic train	4
4	Determination of velocity ratio by tubular method, turning moment diagram, coefficient of fluctuation of speed and energy, fly wheel and its application	3

5	Types of belt drives, belt mechanism, belt materials, length of belts, power transmitted, velocity ratio, effect of centrifugal tension, creep and slip, chain drive	4
6	Types of friction, law of dry friction, friction of pivots and collars	2
7	Single disc, multiple disc and cone clutches, rolling friction and antifriction bearing	3
8	Types of governors, constructional details and analysis of watt, porter, proell governors	2
9	Effect of friction, controlling force curve, sensitiveness, stability, hunting, isochronisms, power and effect of governors	3
10	Static and dynamic balancing, balancing of rotating mass in one and different planes	2
11	Partial primary balancing of reciprocating masses	2
	Total	**32**
Practicals		
S.No.	Topic	No. of Practicals
1	Study and demonstration of different kinematic mechanism	2
2	Analysis of 4-bar mechanism and its inversions	1
3	Graphical solution of velocity diagram of Practical linkage mechanism.	2
4	Graphical solution of Acceleration diagram of Practical linkage mechanism.	2
5	Design and drawing of spur gear train	1
6	Design and drawing of epicyclic gear train	1
7	Study of cam and follower, its Practical utility	2
8	Study and demonstration of flywheel and governor	1
9	Study and demonstration of static and dynamic balancing.	2
	Total	**14**

Reference Books

- 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.

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	Heat and Mass Transfer	APE - 204	2 (2 + 0)	2	0	0

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-Boltzman law, Kirchoff' s law, grey bodies and emissive power, solid angle, intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection and radiation by networks. Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Flick' s law, mass transfer coefficients. Reynold' s analogy.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introductory concepts, modes of heat transfer.	2
2	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.	4
3	Insulation materials, critical thickness of insulation.	2
3	Fins.	2
4	Free and forced convection. Newton' s law of cooling, heat transfer coefficient in convection.	3
5	Dimensional analysis of free and forced convection.	
6	Useful non dimensional numbers and empirical relationships for free and forced convection.	2
7	Equation of laminar boundary layer on flat plate and in a tube.	2
8	Laminar forced convection on a flat plate and in a tube.	1
9	Combined free and forced convection.	1
10	Introduction Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck' s law, Stefan-Boltzman law, Kirchoff' s law, grey bodies and emissive power, solid angle, intensity of radiation.	3
11	Radiation exchange between black surfaces, geometric configuration factor.	1
12	Heat transfer analysis involving conduction, convection and radiation by networks	2
13	Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units.	4
14	Heat exchanger analysis restricted to parallel and counter flow heat	2

	exchangers.	
15	Steady state molecular diffusion in fluids at rest and in laminar flow, Flick's law, mass transfer coefficients. Reynold's analogy.	3
	Total	**34**

Reference Books

- Heat transfer, By: Holman, J. P.
- Process Heat Transfer ,By: Kern.
- Heat Transfer ,By: Pitts and Sissom (1983).
- Heat and Mass Transfer ,By: Eckert E.R.G. and Drake, R.M. (1972)..
- Mass Transfer operations By: Treybal, R.E. (1981).
- Fundamentals of Engineering heat transfer By: Sachdeva (1986).
- Introduction to Heat Transfer. ,By: Incropera, F.P. (2001).
- Convective Heat Transfer. ,By: Bejan, A. (1994).
- Radiation Heat Transfer., By: Sparrow, E.M. and Cess, R.D. (1978).

Sr. No.	Course Name	Course No.	Credit	L	P	T
8	**Database Management and Internet**	**APE - 206**	**2 (0 + 2)**	**0**	**2**	**0**

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.

Practicals

S.No.	Topic	No. of Practicals
1	Basic Database Concepts	2
2	Introduction to RDBMS	2
3	SQL Commands DDL, DML	2
4	Select Command, Joins and functions	3
5	Group functions, Set functions	3
6	Working with Forms	2
7	Basic of HTML	2
8	Development of Web pages using mata tags.	3
9	Dynamic pages using Java Scripts	2
10	Connectivity of Web pages with databases	2
11	Project.	7
	Total	**30**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
9	**Field Operation and Maintenance of Tractors and Farm Machinery - I**	**FMP-206**	**1 (0 + 1)**	**0**	**1**	**0**

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.

Only practicals are in the course

Practicals

S.No.	Topic	No. of Practicals
1	Introduction to fuel system	1
2	Introduction to lubrication system	1
3	Introduction to Cooling system	1
4	Introduction to electrical system	1
5	Introduction to transmission system	1
6	Introduction to hydraulic system and final drive	2
7	Familiarization with tractor controls , starting stopping etc.	2
8	Driving of tractors (forward and reverse)	2
9	Hitching system, setting and field operation of farm machinery	3
10	Familiarization with different makes and models of tractors available	1
11	Hitching and operation of M.B. plough adjustment	1
12	Hitching and operation of trailing and mounted disc harrow	1
13	Field operation and adjustments of seed drills, planter, sprayers	3
	Total	**15**

Reference Books

- Elements of Agril. Engg. ,By: J. Sahay
- A course in Industrial safety , By: K.U. Mistry
- Farm machines and equipment , By: C.P. Nakra

Third Year

Semester - V

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	**Machine Drawing and CAD/CAM Commuter Graphics**	**FMP - 301**	**3 (1 + 2)**	**1**	**2**	**0**

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. B-spline 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.

Planning of lectures

S.No	Proposed No. of Lectures	Proposed No. of Lectures
1.	1st and 3rd angle methods of projection	1
2.	Preparation of working drawings from models and isometric views	1
3.	Drawing of missing views and different methods of dimensioning	1
4.	Concept of sections, revolved and oblique sections	1
5.	Sectional drawing of simple machine parts	1
6.	Types of rivet heads and riveted joints, process of producing leak proof joints	1
7.	Threads nomenclature, profiles, mull start, left and right hand and conventional representation of threads	1
8.	Nuts and bolts- square headed, hexagonal, types of lock nuts, studs, machine screws, cap screw and wood screw, foundation bolts	1
9.	Application of computers for design CAD, define, benefits, system components and computer hardware for CAD, display, input and output devices	1
10.	Graphic primitives, display file, frame buffer, display control, display processors, line generation, graphics software. Points and lines, polygons, filing of polygons, text primitive, windowing and clipping, view port	1

11.	Homogeneous coordinates, transformations, planners and space curves design	1
12.	Analytical and synthetic approaches, parametric and implicit equations	1
13.	B-spline and Biezer curves and Geometric modeling techniques, wire frames	1
14.	Introduction to solid modeling, introduction to numeric control, basic components of NC system, NC coordinate and motion control system	1
15.	Computer numerical control, direct numerical control, combined CNC /DNC	1
16.	NC machine tools and control units, tooling for NC machines, part programming, punched tape coding and format	1
17.	Manual and computer assisted programming	1
	Total	**17**
Total		

Practicals

S.No.	Topic	No. of Practicals
1	Preparation of manual drawing with dimensions from models	2
2	Preparation of manual drawing with dimensions from isometric drawings	2
3	Preparation of manual drawing with dimensions from machine components	2
4	Preparations of sectional drawings of single machine parts	2
5	Preparations of drawing of riveted joints	1
6	Preparations of drawings of thread fasteners	2
7	Demonstration on computer graphics	2
8	Demonstration on computer aided drafting using standard software	2
9	Practice on the use of basic and drawing commands on Auto cad	5
10	Generating simple 2-0 drawings with dimensions using Auto cad	3
11	Practice in use of modify and rebelling commands	3
12	Practice in graphics	2
13	Practice in mathematics	2
14	Practice in curve fitting and transformation	2
15	Demonstration on CNC machine	2
	Total	**34**

Reference Books

- Quality in Design and Manufacturing (CAD/CAM) ,By: Dalela Suresh
- Mechatronics – K. Adinarayana
- CAD/CAM Robotics & factories of the future ,By: S. Narayan, K. J. Reddy, P. Kuppan K.
- CAD/CAM ,By: Rao P.N.
- CAD/CAM : Computer-Aided Design And Manufacturing , By: Groover, M, Zimmers, E
- CAD/CAM Theory And Practice, By: Zeid, Ibrahim

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	**Machine Design**	**FMP - 303**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Meaning of design, machine design, phase of design, design considerations	2
2	Common engineering materials and their mechanical properties	2
3	Types of loads and stresses, theories of failure, factor of safety, selection of allowable stress	2
4	Stress concentration, elementary fatigue and creep aspect	2
5	Design of cotter joints, knuckle joints, pin joint and turn buckle	3
6	Design of welded joints subjected to static loads	2
7	Design of threaded fasters subjected to direct static loads, bolted joints loaded shear and eccentric loading	3
8	Design of shaft under torsion and combines bending and torsion	3
9	Design of keys, muff (sleeve), coupling and flange coupling	3
10	Design of helical and leaf spring, design of flat belt and V belt and pulley	3
11	Gear design, deign of bracket, levers, columns, thin cylinder and shell	3
12	Design of jack screw, selection of anti friction bearing	2
13	Design of curve beams, crane hooks, circular rings	2
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Study of stress analysis of different machine components Viz. rectangular strut, circular and hollow circular column	2
2	Problem based on load and stress analysis of strut, column, C- clamp brackets etc.	2
3	Study of theories of failure and related problems	2
4	Problems based on practical application of theories of failure	1
5	Study of factor of safety in normal loading and cyclic loading.	2
6	Design and drawing of knuckle joint and cotter joint.	2
7	Design and drawing of lever rocker arm of diesel engine.	1
8	Design and drawing of muff coupling and flange coupling.	2
9	Design and drawing of Helical spring	1

	Total	**15**

Reference Books

- Machine Design, By: R.S. Khurmi & Gupta
- Machine Design , By: R.C. Patel
- Machine Design , By: Agrawal P.S.
- Machine Design , By: Gohel D.B.
- Machine Design , By: Pandya & Shah

Sr. No.	Course Name	Course No.	Credit	L	P	T
3	**Dairy and Food Engineering**	**APE - 301**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Dairy development in India.	1
2	Engineering, thermal and chemical properties of milk and milk products.	4
3	Unit operation of various dairy and food processing systems, process flow charts for product manufacture.	4
4	Working principles of equipment for receiving, pasteurization sterilization, homogenization, filling & packaging, butter manufacture.	7
5	Dairy plant design and layout, composition and proximate analysis of food products.	4
6	Deterioration in products and their controls.	3
7	Physical, chemical and biological methods of food preservation.	4
8	Changes undergone by the food components during processing, evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing.	4
9	Plant utilities requirement.	3
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Study of a composite pilot milk processing plant & equipments	1
2	Study of pasteurizers	1
3	Study of sterilizers	1
4	Study of homogenisers	1
5	Study of separators	1
6	Study of butter churners	1
7	Study of evaporators	1

8	Study of milk dryers.	1
9	Study of freezers.	1
10	Design of food processing plants & preparation of layout.	1
11	Visit to multi-product dairy product.	1
12	Determination of physical properties of food products.	1
13	Estimation of steam requirements.	1
14	Estimation of refrigeration requirements in dairy & food plant	1
15	Visit to Food industry.	1
	Total	**15**

Reference Books /

- 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).

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	**Tractor Systems and Controls**	**FMP - 305**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Study of transmission systems, clutch, gear box, differential and final drive mechanism	6
2	Familiarization of brake mechanism	3
3	Ackerman and hydraulic steering and hydraulic systems	4
4	Tractor power outlets- PTO, belt pulley, drawbar etc.	3
5	Tractor chassis mechanics and design for tractor stability	5
6	Ergonomics consideration and operational safety	4
7	Revision and problems	5
	Total	**30**

Practicals

S.No.	Topic	No. of Practicals
1	Introduction to transmission systems and components	1
2	Study of clutch functioning, parts and design problem on clutch system	1
3	Study of different types of gear box, calculations of speed ratios	1
4	Design problem on gear box	1
5	Study on differential and final drive and planetary gears	1
6	Study of brake systems and some design problems	1
7	Steering geometry and adjustments	1
8	Study of hydraulic systems in a tractor, hydraulic trailer and some	2

	design problems	
9	Traction performance of a tractor wheel	1
10	Finding C.G. of a tractor by weighing technique	1
11	Finding C.G. of a tractor using suspension / balancing techniques	1
12	Finding moment of inertia of a tractor	1
13	Appraisal of various controls in different makes tractors in relation to anthropometric measurements	1
	Total	**14**

Reference Books

- 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.

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	**Electrical Machines and Power Utilization**	**APE - 303**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of

		Lectures
1	Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits.	3
2	Hysteresis and eddy current losses.	2
3	Transformer: principle of working, construction of single phase transformer.	2
4	EMF equation, phase diagram on load, leakage reactance, transformer on load, equivalent circuit, voltage regulation.	3
5	Power and energy efficiency, open circuit and short circuit tests, principles.	2
6	Operation and performance of DC machine (generator and motor).	2
7	EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics.	3
8	DC motor characteristics, starting of shunt and series motor, starters, speed control methods-field and armature control.	3
9	Polyphase induction motor: construction, operation, equivalent circuit.	2
10	Phase diagram, effect of rotor resistance, torque equation, starting and speed control methods.	3
11	Single phase induction motor: double field revolving theory, equivalent circuit, characteristics.	3
12	Phase split, shaded pole motors.	2
13	Disadvantage of low power factor and power factor improvement.	2
14	Various methods of single and three phase power measurement.	2
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	To get familiar with AC, DC machines and measuring instruments.	1
2	To perform Open circuit and short circuit tests on a single phase transformer and hence find equivalent circuit , voltage regulation and efficiency.	2
3	To study the constructional details of D.C. machine and to draw sketches of different components.	1
4	To obtain load characteristics of d.c. shunt/series /compound generator.	2
5	To study characteristics of DC shunt/ series motors.	1
6	To study d.c. motor starters.	1
7	To Perform load-test on 3 ph. Induction motor & to plot torque V/S speed characteristics.	1
8	To Perform no-load & blocked –rotor tests on 3 ph. Induction motor to obtain equivalent ckt. Parameters & to draw circle diagram.	2
9	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.	1
10	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.	1
11	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.	1
12	To perform no-load & blocked –rotor test on 1 ph. Induction motor &	1

	to determine the parameters of equivalent ckt. Drawn on the basis of double revolving field theory.	
13	To Perform load –test on 1 ph. Induction motor	1
	Total	**16**

Reference Books

- Principles of D.C. machines , By: Langsdorff
- Electrical Machines , By: Nagrath & Kothari
- Electrical Machinery , By: P.S. Bhimbhra
- A textbook of electrical technology, Vol II, By: B L Threja
- A course in electrical technology , By: J B gupta

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	**Field Operation and Maintenance of Tractors and Farm Machinery - II**	**FMP-307**	**2 (1 + 1)**	**1**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to tractor maintenance procedure	1
2	Trouble and trouble shooting	2
3	Scheduled maintenance 10,50, 100, 250, 500 and 1000 hrs	3
4	Safety hints	2
5	Top end overhauling	2
6	Fuel saving tips	1
7	Preparing the tractor for storage	1
8	Care and maintenance procedure of agril. Machinery during operation and off season	2
9	Maintenance of workshop and minor repair	2
	Total	**16**

Practicals

S.No.	Topic	No. of Practicals
1	Introduction to fuel system	1
2	Introduction to lubrication system	1
3	Introduction to Cooling system	1
4	Introduction to electrical system	1
5	Introduction to transmission system	1
6	Introduction to hydraulic system and final drive	1
7	Familiarization with tractor controls , starting stopping etc.	1
8	Driving of tractors (forward and reverse)	1
9	Hitching system, setting and field operation of farm machinery	2
10	Familiarization with different makes and models of tractors available	1
11	Hitching and operation of M.B. plough adjustment	1

12	Hitching and operation of trailing and mounted disc harrow	1
13	Field operation and adjustments of seed drills, planter, sprayers	3
	Total	**16**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	**Strength of Material**	**RE - 301**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Slope and deflection of beams using integration techniques	3
2	Moment area theorems and conjugate beam method	3
3	Columns and Struts	3
4	Riveted and welded connections.	4
5	Stability of masonry dams	5
6	Analysis of statically indeterminate beams	5
7	Propped beams	3
8	Fixed and continuous beam analysis using superposition	3
9	Three moment equation and moment distribution methods.	4
	Total	**33**

Practicals

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

6	To study load deflection and other physical properties of closely coiled helical spring in tension and compression.	1
7	To perform the Rockwell, Vicker's and Brinell's Hardness tests on the given specimens.	1
8	To perform the Drop Hammer Test, Izod Test and Charpay's impact tests on the given specimens.	1
9	To determine compressive & tensile strength of cement after making cubes and briquettes.	3
10	To measure workability of concrete (slump test, compaction factor test)	2
11	To determine voids ratio & bulk density of cement, fine aggregates and coarse aggregates.	1
12	To determine fatigue strength of a given specimen.	1
13	To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials.	1
	Total	**16**

Reference Books

- 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,

Sr. No.	Course Name	Course No.	Credit	L	P	T
8	**Ground Water, Wells and Pumps**	**SWE - 301**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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 hydraulics-determination 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	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 state, design of open well, ground water exploration techniques, methods of drilling of wells, percussion, rotary, reverse rotary,	6

	design of assembly and gravel pack, installation of well screen completion, and development of well	
2	Ground water hydraulics, determination of aquifer parameters by different methods, such as Theis, Jacob, and Chow's etc. Theis recovery method, well interference, multiple well systems, surface and sub-surface exploitation, and estimation of ground water potential, quality of ground water, Artificial ground water recharge planning, modeling, ground water project formation	6
3	Pumping system, water lifting devices, different types of pumping types of pumping machinery, classification of pump, components parts of centrifugal pumps,	6
4	Pump selection, installation, and troubleshooting	3
5	Design of centrifugal pumps, performance curves, effect of speed on head capacity, power capacity and efficiency curve, effect of change of impeller, dimensions on performance characteristics	4
6	Hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics	4
7	Priming, self-priming devices, roto-dynamic pumps for special purposes such as deep well turbine pump, and submersible pump	3
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Verification of Darcy' s Law	1
2	Study of different drilling equipments	1
3	Sieve analysis for gravel and well screens design	1
4	Estimation of specific yield and specific retention	1
5	Testing of well screen	1
6	Drilling of a tubewell	1
7	Measurement of water level and drawdown in pumped wells	1
8	Estimation of aquifer parameters by Thies method, Coopers- Jacob method , Chow method, Theis Recovery method	1
9	Well design under confined and unconfined conditions, well losses and well efficiency	1
10	Estimating ground water balance	1
11	Study of artificial ground water recharge structures	1
12	Study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pumps, turbine, propeller and other pumps	1
13	Installation of centrifugal pump	1
14	Testing of centrifugal pump and study of cavitations	1
15	Study of performance characteristics of hydraulic ram	1
16	Study and testing of submersible pump	1
	Total	**16**

Reference Books

- 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

Semester - VI

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	**Agricultural Structures and Environment Control**	**APE - 302**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Planning and layout of farmstead.	1
2	Physiological reactions of livestock to solar radiation and other environmental factors.	2
3	Livestock production facilities, BIS. Standards for dairy, piggery, poultry and other farm structures.	3
4	Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc.	5
5	Design and construction of rural grain storage system.	3
6	Engineering for rural living and development, rural roads, their construction cost and repair and maintenance.	3
7	Sources of water supply. Norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community.	3
8	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.	3
9	Estimation of power requirement for domestic and irrigation, source of power supply, use of alternate source of energy, electrification of rural housing.	3
10	Scope, importance and need for environmental control.	2
11	Renewable and non-renewable resources and their equitable use.	1

12	Concept of eco-system, biodiversity of its conservation.	1
13	Environmental pollution and their control, solid waste management system, BOD and COD of food plant waste, primary and secondary treatment of food plant wastes.	4
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Instruments for measurements of environmental parameters.	1
2	Environmental indices for your city.	1
3	Harmonic analysis for sole-air temperature.	1
4	Reflective and non-reflective air space in buildings.	1
5	Cooling load of a farm building e.g. poultry house.	1
6	Moisture condensation in agricultural buildings.	1
7	Design and layout of a dairy farm.	1
8	Design and layout of a poultry house.	1
9	Design and layout of a sheep/goat house.	1
10	Design of a biogas plant. Design of a farm fencing system	1
11	Design of ventilation system for dairy and poultry house.	1
12	Design of a feed/fodder storage structures	1
13	Familiarization with local grain storage structures	1
14	Design of grain storage structures.	1
15	Cost estimation of a farm buildings	1
	Total	**15**

Reference Books

- 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. (
- Environmental control systems :Heating, cooling, lighting. , By Moore, F.F.
- Elements of bioenvironmental engineering. , By Gaudy, A.F, Gaudy, E. T.
- Microbiology for environmental engineers. , By Gaudy F.A., Gaudy, E.T.

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	**Drying and Storage Engineering**	**APE - 304**	**4 (3 + 1)**	**3**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Moisture content and methods for determination.	2
2	Importance of EMC and methods of its determination, EMC curve and EMC model.	3
3	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.	6
4	Air pressure within the grain bed, Shred's and Hukill's curve.	2
5	Different methods of drying including puff drying, foam mat drying, freeze drying, etc.	2
6	Study of different types of dryers- performance, energy utilization pattern and efficiency.	4
7	Study of drying and dehydration of agricultural products.	2
8	Types and causes of spoilage in storage.	2
9	Storage of perishable products, functional requirements of storage, control of temperature and relative humidity inside storage.	3
10	Calculation of refrigeration load.	2
11	Conditions for modified atmospheric storage and control of its environment.	2
12	Storage of grains: destructive agents, respiration of grains, moisture and temperature changes in stored grains air movement inside the storage, conditioning of environment inside storage through natural ventilation,	5

	mechanical ventilation, artificial drying.	
13	Grain storage structures such as Bukhari, Morai, Kothar, silo, CAP, warehouse - design and control of environment.	4
14	Storage of cereal grains and their products, storage of seeds, hermetically sealed and air-cooled storages-refrigerated, controlled atmosphere, modified atmospheric and frozen storages.	4
15	Storage condition for various fruits and vegetables under cold and CA storage system.	3
16	Economic, aspects of storage.	2
	Total	**48**

Practicals

S.No.	Topic	No. of Practicals
1	Study of mechanics of bulk solids affecting cleaning, drying and storage of grains.	1
2	Measurement of moisture content during drying and aeration.	1
3	Measurement of relative humidity during drying and aeration using different techniques.	1
4	Measurement of air velocity during drying and aeration.	1
5	Drying characteristic and determination of drying constant.	2
6	Determination of EMC and ERH.	1
7	Study of various types of dryers.	1
8	To study the effect of relative humidity and temperature on grains stored in gunny bags.	1
9	Design and layout of commercial bag storage facilities.	2
10	Design and layout of commercial bulk storage facilities.	2
11	Study of different domestic storage structures.	1
12	Visits to commercial handling and storage facilities for grains.	2
	Total	**15**

Reference Books

- Drying and storage of grains and oilseeds, By: Brooker D. B. F. W. Bakkee-Arkema 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
3	Design of Structures	RE - 302	3 (2 + 1)	2	1	0

Course content :
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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Loads and use of I. S. Codes.	3
2	Design of connections.	3
3	Design of structural steel members in tension,	3
4	compression and bending.	4
5	Design of steel roof truss.	3
6	Analysis and Design of singly and doubly reinforced sections, Shear, Bond and Torsion.	5
7	Design of Flanged Beams, Slabs,	4
8	Design of Flanged, Columns, Foundations,	3
9	Design of Flanged Retaining walls and Silos	4
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Design and drawing of steel roof truss	5
2	Design and drawing of RCC building	5
3	Design and drawing of Retaining wall	4
	Total	**14**

Reference Books

- Design of steel structures Vol. I , By: Ram Chandra,
- Steel structures , By: Vazirani and Ratwani,
- Design of steel structures, By: Ramamrutham,
- Concrete structures , By: Vazirani & Ratwani,
- Plain and Reinforced concrete Vol. I , By: Jaikrishna and O. P. Jain
- Design of Plane and reinforced concrete structures , By: S. Ramamrutham
- IS: 800-1984 Code of Practice for General Construction in steel
- Indian Standard Code of Practice for use of structural steel in General Building Construction
- ISI Handbook for Structural Engineers. Structural Steel Section
- IS 456:2000 Indian Standard Code of Practice for Plain and Reinforced Concrete.

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	**Drainage Engineering**	**SWE - 302**	**2 (1 + 1)**	**1**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Drainage, objectives of drainage, familiarization with the drainage problems of the State	1
2	Surface drainage, drainage coefficient, types of surface drainage, design of open channel.	2
3	Sub-surface drainage purpose and benefits, investigations of design parameters, hydraulic conductivity, drainable porosity, water table etc.	2
4	Types and use of subsurface drainage system,	1
5	Design of surface drains, interceptor and relief drains	2
6	Derivation of ellipse (Hooghoudt's) and Ernst's drain spacing equations	1
7	Design of subsurface drainage system.	1
8	Drainage materials, drainage pipes, drain envelope	1
9	Layout, construction and installation of drains	1
10	Drainage structures, Vertical drainage, Bio-drainage, Tile Drains	1
11	Drainage of irrigated and humid areas	1
12	Salt balance, reclamation of saline and alkaline soils. Leaching requirements,	1
13	Conjunctive use of fresh and saline waters.	1
14	Economic aspects of drainage	1
	Total	**17**

Practicals

S.No.	Topic	No. of Practicals
1	In-situ measurement of hydraulic conductivity	1
2	Determination of drainage coefficients	1
3	Installation of piezometer and observation well	1
4	Preparation of iso-bath and isobar maps	1
5	Measurement of hydraulic conductivity and drainable porosity	1
6	Design of surface drainage systems	3

7	Design of subsurface drainage systems	3
8	Determination of chemical properties of soil and water	1
9	Fabrication of drainage tiles	1
10	Testing of drainage tiles	1
11	Determination of gypsum requirement for land reclamation	1
12	Installation of sub-surface drainage system	1
13	Cost analysis of surface and sub-surface drainage system	1
	Total	17

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	**Soil and Water Conservation Structures**	**SWE - 304**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction and classification of structures	1
2	Functional requirements of soil erosion control structures;	1
3	Flow in open channels-types of flow, state of flow, regimes of flow, energy and momentum	2
4	Principles, specific energy and specific force; hydraulic jump and Its application,	1
5	Type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of energy;	1
6	Runoff measuring structures-parshall flume..- H - flume and weirs;	2
7	Straight drop spillway - general description, functional use, advantages and disadvantages, Structural parts and functions; components of spillway, Hydrologic and hydraulic design of drop structure	4

8	Structural design of a drop spillway-loads on headwall, variables affecting equivalent fluid pressure,	2
9	Determination of saturation line for different flow conditions, seepage under the structure	1
10	Free board and wave free board, aeration of weirs, concept of free and submerged flow,	1
11	Equivalent fluid pressure of triangular load diagram for various flow conditions,	1
12	Creep line theory, uplift pressure estimation,	2
13	Safety against sliding, over turning, crushing and tension;	1
14	Chute spillway, general description and its components, hydraulic design, energy dissipaters, design criteria of a SAF stilling basin and its limitations,	4
15	Drop inlet spillway- general description, functional use, design criteria;	3
16	Design of diversions;	1
17	Small earth embankments-their types and design	2
18	Principles, farm ponds and reservoirs	2
19	Cost estimation of structures	2
	Total	**34**
	Practicals	
S.No.	Topic	No. of Practicals
1	Design of H-flume	1
2	Design of Parshall flume	1
3	Construction of specific energy and specific force diagram	1
4	Measurement of hydraulic jump parameters and amount of energy dissipation	1
5	Hydrologic and hydraulic design of a straight drop spillway	1
6	Determination of uplift force and construction of uplift pressure diagram	1
7	Determination of loads on headwall and construction triangular load diagram	1
8	Stability analysis of a straight drop spillway	1
9	Design of drop inlet spillway	1
10	Hydraulic design of a chute spillway;	1
11	Design of small earth embankments	1
12	Design of a SAF energy dissipater	1
13	Design of water harvesting structures;	3
14	Cost estimation of structures.	1
15	Visit to watershed	1
	Total	**17**

Reference Books

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

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	**Refrigeration and Air Conditioning**	**FMP- 302**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Principles of refrigeration, types of refrigeration system, mechanical vapour compression, vapour absorption system, components of mechanical refrigeration.	5
2	Second law of thermodynamics applied to refrigeration, carnet cycle, reversed carnot cycle, coefficient of performance, and unit of refrigeration.	5
3	Refrigerant, desirable properties of ideal refrigerant.	2
4	Centrifugal and steam jet refrigeration systems, thermoelectric refrigeration systems, vortex tube and other refrigeration systems.	4
5	Ultra low temperature refrigeration, cold storages, insulation material, design of cold storages, defrosting.	3
6	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.	5
7	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, types of air conditioners - applications.	5
8	Humidifiers and dehumidifiers.	2
9	Cooling load calculations.	2
10	Moisture content and methods for determination.	1
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Study of vapour compression and vapour absorption systems.	1
2	Study of Electrolux refrigerator.	1
3	Solving problems on refrigeration on vapour absorption system.	1

4	Experiments with the refrigeration tutor to study various components of refrigeration.	1
5	Determination of the coefficient of performance of the refrigeration tutor.	1
6	Experiment on humidifier for the determination of humidifying efficiency.	1
7	Experiment on dehumidifier for the determination of dehumidifying efficiency.	1
8	Experiment on the cooling efficiency of a domestic refrigerator.	1
9	Experiments on working details of a cold storage plant and air conditioning unit.	1
10	Experiments with air conditioning tutor to study various components.	1
11	Determination of the coefficient of performance of air conditioning tutor.	1
12	Estimation of refrigeration load.	1
13	Estimation of cooling load for air conditioner.	1
14	Estimation of humidification and dehumidification load.	1
15	Design of complete cold storage system.	1
	Total	**15**

Reference Books

- 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. & Jain.
- Food preservation by Refrigeration , By: Lorentze

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	**Entrepreneurship Development and Communication Skills**	**AEE - 302**	**3 (2 + 1)**	**2**	**0**	**1**

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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Assessing overall business environment in the Indian economy	2
2	Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs	2
3	Globalization and the emerging business / entrepreneurial environment	2
4	Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up	4
5	Managing competition; entrepreneurship development programs; SWOT analysis; Generation, incubation and commercialization of ideas and innovations	2
6	Government schemes and incentives for promotion of entrepreneurship	2
7	Government policy on Small and Medium Enterprises (SMEs) / SSIs; Export and Import Policies relevant to horticulture sector	2
8	Venture capital; Contract farming and joint ventures, public-private partnerships; Characteristics of Indian farm machinery industry; Social Responsibility of Business.	2
9	Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills.	4
10	Field diary and lab record; indexing, footnote and bibliographic procedures	3
11	Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting;	3
12	Individual and group presentations, impromptu presentation, public speaking Group discussion; Organizing seminars and conferences	3
	Total	**32**

Tutorials

S.No.	Topic	No. of **Tutorials**
1	Listening and note taking	2
2	Writing skills	1
3	Oral presentation skills	2
4	Field diary and lab record	2
5	Indexing, footnote and bibliographic procedures.	2
6	Reading and comprehension of general and technical articles.	2
7	Précis writing, summarizing, abstracting	1
8	Individual and group presentations.	4
	Total	**16**

Reference Books

- 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

Semester - VII

S.No.	Course Name	Course No.	Credit
1	**Project**	**AE - 401**	**6**
2	**Seminar**	**AE - 403**	**1**

S No.	Course Name	Course No.	Credit	L	P	T
3	**Renewable Energy Technology**	**RE - 401**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:
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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Design and operational parameters	2
2	performance evaluation and maintenance aspects of gasifiers,	6
3	performance evaluation and maintenance aspects of biogas plants,	4
4	Performance evaluation and maintenance aspects of solar passive heating devices,	5
5	Performance evaluation and maintenance aspects of photovoltaic cells and arrays,	5
6	Performance evaluation and maintenance aspects of briquetting machines and balers	5
7	Bio diesel utilization in CI engines.	5
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Performance evaluation of solar water heater	2
2	Performance evaluation of solar cooker	2
3	Characteristics of solar photovoltaic panel	1
4	Evaluation of solar air heater/dryer	1
5	Performance evaluation of a rice husk throatless gasifier engine system	2
6	Performance evaluation of down draft gasifier with throat for thermal application	1
7	Performance evaluation of a fixed dome type biogas plant	1
8	Performance evaluation of floating drum type biogas plant	1
9	Estimation of calorific value of producer gas	1

10	Testing of diesel engine operation using biodiesel	1
11	Evaluation of briquetting machine using biomass material; evaluation of rice straw briquette.	2
	Total	**15**

Reference Books

- Renewable Energy: Power for sustainable future , By: Godfrey Boyle.
- Energy Technology: Non-conventional, Renewable and Conventional , By: S.S. Rao and B.B. Parulekar
- Handbook of Biomass Downdraft Gasifier Engine System, By: Thomas B Reed and Aqua Das.
- Small scale producer gas engine systems, By: A Kaupp & J. R. Goss.
- Biogas Systems (Principles & Applications) , By: K.M. Mittal,
- Hand book of biogas technology, By: N.S. Grewal, S. Ahluwalia, S. Singh and G. Singh.
- Solar Energy Fundamentals and Applications, By: H.P. Garg and J. Prakash,
- Solar energy, By: S.P. Sukhatme,
- Principles of Solar Energy. , By: D. Yogi Goswami *et al.*
- Renewable Energy , By: P.D. Dunn. Peter Peregrinus Ltd., London.

Student will have to take minimum of 15 credits courses from the following Cafeteria Courses :

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	**Food Packaging Technology**	**APE - 401**	**3 (2 + 1)**	**2**	**1**	**0**

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, labeling 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Factors affecting shelf life of food material during storage; spoilage mechanism during storage.	4
2	Definition, requirement, importance and scope of packaging of foods; types and classification of packaging system; advantage of modern packaging system.	4
3	Different types of packaging materials used.	4
4	Different forms of packaging, metal container, glass container, plastic container, flexible films, shrink packaging, vacuum & gas packaging.	5
5	Packaging requirement & their selection for the raw & processed foods.	3

6	Advantages & disadvantages of these packaging materials; effect of these materials on packed commodities.	3
7	Package testing.	2
8	Printing, labeling and lamination.	2
9	Economics of packaging.	2
10	Performance evaluation of different methods of packaging food products; their merits and demerits; scope for improvements.	3
11	Disposal and recycle of packaging waste.	2
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Identification of different types of packaging materials.	1
2	Determination of tensile strength of given material	1
3	Determination of compressive strength of given package	1
4	To perform different destructive tests for glass containers	1
5	To perform non-destructive tests for glass containers	1
6	Vacuum packaging of agricultural produces	1
7	Determination of tearing strength of paper board	1
8	Measurement of thickness of packaging materials	1
9	To perform grease-resistance test in plastic pouches	1
10	Determination of bursting strength of packaging material	1
11	Determination of water-vapour transmission rate	1
12	Shrink wrapping of various horticultural produce	1
13	Testing of chemical resistance of packaging materials.	1
14	Determination of drop test of food package	1
15	Visit to relevant industries	1
	Total	**15**

Reference Books

- 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.

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	Design and Maintenance of Greenhouse	RE - 403	3 (2 + 1)	2	1	0

Course content :

History and types of greenhouse; importance, function and features of green house; scope and development of green house 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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	History and types of greenhouse	1
2	Function and features of greenhouse ,	1
3	Scope and development of greenhouse technology	1
4	Location, planning and various components of greenhouse,	1
5	Design criteria and calculations	3
6	Construction materials and methods of construction	2
7	Covering material and characteristics	1
8	Solar heat transfer	2
9	Solar fraction for greenhouse	2
10	Steady state analysis of greenhouse	2
11	Greenhouse heating, cooling, shedding and ventilation system	2
12	Carbon dioxide generation and monitoring and lighting systems	1
13	Instrumentation and & computerized environmental control systems	2
14	Watering, fertilization, root substrate and pasteurization	1
15	Containers and benches	1
16	Plant nutrition, Alternative cropping systems	1
17	Plant tissue culture	2
18	Chemical growth regulation	1
19	Disease control, integrated pest management,	1
20	Post production quality and handling	2
21	Cost analysis of greenhouse production,	1
22	Application of greenhouse & its repair & maintenance	1
	Total	**32**

Practicals		
S.No.	Topic	No. of Practicals
1	Study / visit to a functional green house; planning and layout of green house & associated utilities	2
2	Material selection for the construction of green house Economic analysis of green house; Visit to a commercial green house	2
3	Measurement of temp. using thermometer, thermistor & thermocouples inside the green house	1
4	Measurement of humidity & air velocity using various methods	1
5	Measurement of solar radiations inside the green house	1
6	Application of psychometric charts; estimation of cooling requirements in a green house; estimation of ventilation requirements	2
7	Thermal performance of green house	1
8	Application of data loggers for simultaneous estimation & control of different parameters like temp., RH, solar radiations etc	2
9	Calculations of environment indices inside a green house	1
10	Structural analysis of green house	2
	Total	**15**

Reference Books

- Solar Engineering Thermal Process. , By: Duffie J.A. and Beckman W.A.
- Greenhouse Advanced Technology , By: Hanan
- Greenhouse Operation & Management. , By: Nelson P.V.
- Handbook of Greenhouse technology, By: Radhamanohar
- Greenhouse Technology , By: Tiwari G.N. and Goyal R.K.

Sr. No.	Course Name	Course No.	Credit	L	P	T
3	**Waste and Byproduct Utilization**	**APE - 403**	**2 (1 + 1)**	**1**	**1**	**0**

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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Types and formation of byproducts and waste; magnitude of waste generation in different food processing industries.	1
2	Concept scope and maintenance of waste management and effluent treatment.	2
3	Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters.	2
4	Microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues.	1
5	Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette.	2
6	Generation of electricity using surplus biomass, producer gas generation and utilization.	1
7	Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermi-composting.	2
8	Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments.	1
9	Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments.	2
10	Advanced waste water treatment process-sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal.	2
11	Assessment, treatment and disposal of solid waste; and biogas generation.	1
	Total	**17**

Practicals		
S.No.	Topic	No. of Practicals
1	Waste characterization: (a) temperature (b) pH (c) solids content (d) turbidity (e) BOD (f) COD.	1
2	Determination of ash content of agricultural wastes.	1
3	Determination of un-burnt carbon in ash of paddy straw.	1
4	To study about briquetting of agricultural residues.	1
5	Estimation of excess air for better combustion of briquettes.	1
6	To study about extraction of oil from rice bran.	1
7	To study about waste treatment plant in food industry.	1
8	To study about utilization of whey.	1
9	To study about recovery of peel oil.	1
10	To study about recovery of germ and germ oil from by-product of cereals.	1
11	Practical on bioconversion of agro-wastes.	1
12	Practical on recycling of agro-wastes and by-products.	1
13	Visits to various industries using waste and food byproducts.	1
	Total	**13**

Reference Books

- 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.

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	**Development of Processed Products and Equipments**	**APE - 405**	**3 (2 + 1)**	**2**	**1**	**0**

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 separation-filtration, sieving, centrifugation, sedimentation; mechanical handling-conveying and elevation; size reduction and classification-mixing; kneading, blending.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Applications of unit operations to the food industry.	2
2	Analytical processing concepts with regards to mass and energy balances.	2
3	Equipment involved in the commercially important food processing methods and unit operations.	3
4	Value addition to cereals like rice, wheat etc.	2
5	Parboiling of rice, quality of processed products of rice & wheat.	2
6	Processing of pulses, spices and condiments.	2
7	Extruded food product, fermented food product, frozen and dried product.	2
8	Technology of meat, fish and poultry products.	2
9	Technology of milk and milk products.	2
10	Fruits and vegetables product: candy, nutraceuticals, snack foods.	2
11	Food product development trends.	1
12	Food additives and labeling.	1
13	Process equipment for thermal processing-evaporation, dehydration, drying, blenching, Pasteurization, distillation.	4
14	Process equipment for mechanical separation-filtration, sieving, centrifugation, sedimentation;	3
15	Process equipment for mechanical handling-conveying and elevation; size reduction and classification-mixing; kneading, blending.	4
	Total	**34**

Practicals		
S.No.	Topic	No. of Practicals
1	Working principle and operation of Engleberg huller	1
2	Study of different cleaners and graders used in agro processing industries	2
3	Working principle, operation and maintenance of paddy destoner-cum-cleaner, rubber roll sheller, paddy separator and vertical cone whitener	3
4	Familiarization with operation and performance of machinery and equipments of Satake rice milling unit of 500 kg/hr.	1
5	Planning and layout of roller wheat flour milling & rice milling	1
6	Visit to milk plant	1
7	Visit to roller flour mill	1
8	Visit to mark fed canneriesill	1
9	Visit to fruit/vegetable processing plants	2
10	Flow process diagram and study of various models of the machines used in a sugar m	2
	Total	**15**

Reference Books

- Unit operations of Agricultural Processing, By: Sahay, K. M. & K.K. Singh.
- Post harvest technology of cereals, pulses and oilseeds , By: Chakraverty, A.

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	**Food Processing Plant Design and Layout**	**APE - 407**	**2 (1 + 1)**	**1**	**1**	**0**

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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Meaning and definition of plant layout.	1
2	Objectives and principles of layout. Types of layout.	1
3	Salient features of processing plants for cereals, pulses oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products.	3
4	Location selection criteria.	1
5	Selection of processes, plant capacity, project design, flow diagrams	2
6	Selection of equipments, process and controls, handling equipments.	2
7	Plant layout, plant elevation.	1

8	Requirement of plant building and its components, sanitation.	1
9	Labour requirement.	1
10	Plant installation.	1
11	Power and power transmission.	1
	Cost analysis, preparation of feasibility report.	2
	Total	**17**

Practicals

S.No.	Topic	No. of Practicals
1	Planning, visit and layout of flour milling plant.	1
2	Planning, visit and layout of rice milling plant.	1
3	Planning, visit and layout of milk plant.	1
4	Planning, visit and layout of bakery plant	1
5	Planning, visit and layout of honey/turmeric/chillies processing	3
6	Planning, visit and layout of fruits and vegetable dehydration plant.	2
7	Planning, visit and layout of beverages industry.	1
8	Planning, visit and layout of edible of extraction plant.	2
9	Planning, visit and layout of ice-cream plant	1
10	Planning, visit and layout of sugar mill plant.	2
		15

Reference Books

- 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.

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	**Micro Irrigation System Design**	**SWE - 401**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Past, present and future need of micro-irrigation systems.	2
2	Role of Govt. for the promotion of micro-irrigation in India.	1
3	Merits and demerits of micro-irrigation system.	1

4	Types and components of micro-irrigation system.	2
5	Micro-irrigation system- design, design synthesis, installation, and maintenance.	4
6	Sprinkler irrigation - types, planning factors, uniformity and efficiency.	4
7	Laying pipeline, hydraulic lateral, sub-mains and main line design, pump and power unit selection.	4
8	Drip irrigation – potential, automation, crops suitability.	4
9	Fertigation – Fertilizer application criteria, suitability of fertilizer compounds, fertilizer mixing, injection duration, rate and frequency, capacity of fertilizer tank.	3
10	Quality control in micro-irrigation components.	3
11	Design and maintenance of polyhouse; prospects, waste land development – hills, semi-arid, coastal areas, water scarce areas, Benefit and Cost analysis.	6
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Study of different types of micro-irrigation systems and components; Field visit of micro-irrigation system;	2
2	Study of water filtration unit; Discharge measurement study of different micro-irrigation systems;	2
3	Study of water distribution and uniformity coefficient;	2
4	Study of wetted front and moisture distribution under various sources of micro-irrigation system;	2
5	Design of micro-irrigation system for an orchard;	1
6	Design of micro-irrigation system for row crops design of spray type micro-irrigation system;	1
7	Design of micro-irrigation system for hilly terraced land; Study of automation in micro-irrigation system;	2
8	Study of micro climate inside a Polyhouse	1
9	Study of maintenance and cleaning of different components of various systems;	2
10	Design of sprinkler irrigation system; Design of landscape irrigation system	2
	Total	**17**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	**Watershed Planning and Management**	**SWE - 403**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Watershed management - problems and prospects.	2
2	Watershed based land use planning.	2
3	watershed characteristics – physical and geomorphologic, factors affecting watershed management.	3
4	Hydrologic data for watershed planning.	2
5	Watershed delineation, delineation of priority watershed.	2
6	Water yield assessment and measurement from a watershed.	2
7	Hydrologic and hydraulic design of earthen embankments and diversion structures.	3
8	Sediment yield estimation and measurement from a watershed and sediment yield models.	2
9	Rainwater conservation technologies - in-situ and storage, design of water harvesting tanks and ponds.	3
10	Water budgeting in a watershed.	2
11	Effect of cropping system, land management and cultural practices on watershed hydrology.	2
12	Evaluation and monitoring of watershed programmes.	2
13	People's participation in watershed management programmes.	2
14	Planning and formulation of project proposal; cost benefits analysis of watershed programmes.	3
15	Optimal land use models; case studies.	2
	Total	**34**

Practicals		
S.No.	Topic	No. of Practicals
1	Study of watershed characteristic; analysis of hydrologic data for watershed management;	2
2	Delineation of watershed and measurement of area under different vegetative and topographic conditions;	2
3	Measurement of water and sediment yield from watershed;	2
4	Study of different watershed management structures;	3
5	Study of various water budget parameters; .	2
6	Study of watershed management technologies;	3
7	Preparation of a techno-economically effective project proposal	3
	Total	**17**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
8	**Minor Irrigation and Command area Development**	**SWE - 405**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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 with in 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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Major, medium and minor irrigation projects – their comparative performance.	4
2	Development and utilization of water resources through different minor irrigation schemes.	4
3	Basic concepts of command area definition.	2
4	Need, scope, and development approaches.	3

5	Historical perspective, command area development authorities.	2
6	Interaction/collaboration of irrigation water use efficiency and agricultural production.	4
7	Planning and execution of on farm development activities within the scope of command area development.	4
8	Use of remote sensing techniques for command area development.	4
9	Case studies of some selected commands.	4
10	Farmer's participation in command area development.	3
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Topographic survey and preparation of contour map.	2
2	Preparation of command area development layout plan;	1
3	Land leveling design for a field;	1
4	Earthwork and cost estimation.	1
5	Irrigation water requirement of crops;	1
6	Preparation of irrigation schedules; .	1
7	Planning and layout of water conveyance system;	1
8	Design of Irrigation systems	2
9	Conjunctive water use planning;	1
10	Application of remote sensing for command area development;	2
11	Technical Feasibility and economic viability of a command area project.	2
12	Study tour to minor irrigation and command area development projects	2
	Total	**17**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
9	**Gully and Ravine Control Structures**	**SWE - 407**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction; floods - causes of occurrence.	2
2	Flood classification - probable maximum flood, standard project flood, design flood.	4
3	Flood estimation - methods of estimation; estimation of flood peak - Rational method, empirical methods.	3
4	Unit hydrograph method.	2
5	Statistics in hydrology, flood frequency methods - Log normal, Gumbel' s extreme value, Log-Pearson type-III distribution.	4
6	Depth-area-duration analysis.	2
7	Flood forecasting, flood routing - channel routing, Muskingum method.	3
8	Reservoir routing, modified Pul's method.	2
9	Flood control, history of flood control, structural and non-structural methods of flood control measures.	3
10	Storage and detention reservoirs, levees, channel improvement.	2
11	Gulley erosion and its control, soil erosion and sediment control measures;	3
12	River training works, planning of flood control projects and their economics.	4
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Determination of flood stage-discharge relationship in a watershed.	1
2	Determination of flood peak-area relationships.	1
3	Determination of frequency distribution functions for extreme flood values using Gumbel' s method.	2
4	Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution.	2
5	Determination of confidence limits of the flood peak estimates for Gumbel' s extreme value distribution.	2
6	Determination of probable maximum flood.	1
7	Standard project flood and spillway design flood;	1

8	Design of levees for flood control.	1
9	Design of jetties.	1
10	Study of vegetative and structural measures for Gulley stabilization.	2
11	Designing and planning of a flood control project.	1
12	Cost and benefit analysis of a flood control project.	2
	Total	**17**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
10	**Remote Sensing & GIS Applications**	**SWE - 409**	**3 (2 + 1)**	**2**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Remote Sensing: Definition, stage in remote sensing, modern remote sensing technology versus conventional aerial photography; visual image interpretation.	2
2	Image interpretation, basic principles of image interpretation, factors governing the quality of an image.	2
3	Factors governing interpretability, visibility of objects, elements of image interpretation, techniques of image interpretation.	2
4	Digital image processing, digital image; remote sensing in agriculture progress and prospects.	4
5	Microwave radiometry for monitoring agriculture crops and hydrologic forecasting.	2
6	Arial photo interpretation for water resources development and soil conservation survey.	4
7	GIS: History of development of GIS definition.	2
8	Basic components, and standard GIS packages.	2
9	Data-entry, storage and maintenance.	2

10	Data types-spatial-non-spatial (attribute data).	4
11	Data structure, data format- point line vector-raster–polygon-object structural model.	4
12	Files, files organization-data base management systems (DBMS), entering data in computer digitizer- scanner-data compression.	4
	Total	**34**

Practicals

S.No.	Topic	No. of Practicals
1	Familiarization with remote sensing and GIS hardware;	1
2	Use of instruments for aerial photo interpretation;	2
3	Interpretation of aerial photographs and satellite imagery;	2
4	Basic GIS operations such as image display;	2
5	Study the various features of GIS software package;	3
6	Scanning and digitization of maps;	2
7	Data base query and map algebra;	2
8	GIS supported case studies in water resources management	3
	Total	**17**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
11	**System Engineering**	**SWE - 413**	**3 (3 + 0)**	**3**	**0**	**0**

Course content :

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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	System concepts.	3
2	Requirements for a Linear programming problems.	3
3	Mathematical formulation of Linear Programming problems and its Graphical solution.	4
4	Response of systems. Computer as a tool in system analysis.	3
5	Simplex method. Degeneracy and Duality in linear programming.	4
6	Artificial variable techniques, Big M method and two phase methods.	4
7	Mathematical models of physical systems.	4
8	Modeling of Agricultural Systems and operations.	4
9	Cost analysis.	3
10	Transportation problems.	3
11	Assignment problems.	3
12	Waiting line problems.	3
13	Project management by PERT/CPM.	5
14	Resource scheduling.	5
	Total	**51**

Reference Books /

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
12	**Reservoir and Farm Pond Design**	**SWE - 411**	**3 (2 + 1)**	**2**	**1**	**0**

Course content:

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.

Planning of lectures		
S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Earthen embankments - functions, advantages and disadvantages	2
2	Classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type	3
3	Foundation requirements, grouting	2
4	Seepage through dams - estimation of seepage discharge, location of seepage/phreatic line by graphical and analytical methods	3
5	Flow-net and its properties, seepage pressure, seepage line in composite earth embankments	4
6	Drainage filters, piping and its causes	2
7	Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc.	7
8	Stability of slopes - analysis of failure by slice method	3
9	Types of reservoirs and farm ponds	2
10	Design and estimation of earth work; cost analysis	4
	Total	**32**

Practicals		
S.No.	Topic	No. of Practicals
1	Study of different types and materials of earthen dams	1
2	Determination of the position of phreatic line in earth dams for various conditions	2
3	Stability analysis of earthen dams against head water pressure	1
4	Stability analysis of earthen dams against foundation shear	1
5	Stability analysis of earth dams against sudden draw down condition	1
6	Stability of slopes of earth dams by friction circle method / different methods; Construction of flow net for isotropic and anisotropic medium	3
7	Computation of seepage by different methods	1
8	Determination of settlement of earth dam	1
9	Input-output-storage relationships by reservoir routing	1
10	Design of farm ponds	1
11	Cost estimation of farm ponds and other structures.	2
	Total	**15**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
13	**Tractor Design and Testing**	**FMP - 401**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Procedure for design and development of agril. Tractor	3
2	Study of parameters for balanced design of tractor for stability and weight distribution	4
3	Hydraulic lift and hitch system design	3
4	Design of mechanical power transmission in agril. Tractor	4
5	Design of Ackerman steering and tractor hydraulic systems	3
6	Study of special design features of tractor engines and their selection	2
7	Design of seat and control of an agril. Tractors	5
8	Tractor testing	4
9	General revision	4
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Design problems of tractor clutch (single / multiple disc clutch)	2
2	Design problem on spur gears and bevel gears	1
3	Design problem of helical gears	1
4	Design of gear box (synchromesh / constant mesh), design of variable speed constant mesh drive	2
5	Selection of tractor tyres	1
6	Problem on design of governor and problem related to selection of hydraulic pump	2
7	Engine testing as per BIS code- various tests	1
8	Drawbar performance in the lab.	1
9	PTO test and measure the tractor power in the lab. / field	1
10	Determining the turning space, turning radius and brake test	1
11	Hydraulic pump performance test and air cleaners and noise measurement test	2
12	Visits to tractor testing centre / industry	1
	Total	**16**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
14	**Hydraulic Drive & Controls**	**FMP – 403**	**3 (2 + 1)**	**2**	**1**	**0**

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)

Planning of lectures

Sr. No.	Topics to be covered in Lecture	No. of Lectures
1	Hydraulic basics	2
2	Pascal's law, Flow, Energy, Work and Power	3
3	Hydraulic Systems	2
4	Color coding, reservoirs, Strainers and filters	3
5	Filtering materials and elements	2
6	Accumulators, Pressure gauges and Volume meters	3
7	Hydraulic circuits, Fittings and Connectors	2
8	Pumps, Pump classifications, Performances, Displacement	3
9	Designs, gear Pumps, vane pumps, Piston pumps, Pump operation	3
10	Hydraulic Actuators, Cylinders, Construction and Applicators, Maintenance	2
11	Hydraulic motors, Valves, Pressure control valves, Directional control valves, Flow control valves, Valve installation, Valve failures and remedies, Valve assembly, Trouble shooting	2
12	Hydraulic circuit diagrams and troubleshooting, United states of American standard Institute, USASI Graphical symbols	2
13	Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units	2
14	Fail safe and safety systems, Robotics, Use of Hydraulic and Pneumatics drives in agricultural systems, PLCs (Programmable Logic Controls)	2
	Total	**33**

Practicals

Sr. No.	Topic	No. of practicals
1	Introduction to Hydraulic systems	1
2	Study of hydraulic pumps	2
3	Study of hydraulic actuators	2

4	Study of hydraulic motors	1
5	Study of hydraulic valves, hydraulic codes and circuits	3
6	Building simple hydraulic circuits, hydraulics in tractors	3
7	Introduction to pneumatics, pneumatics devices	1
8	Pneumatics in Agriculture	1
9	Use of hydraulic and pneumatics for Robotics	1
	Total	**15**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
15	**Farm Power and Machinery Management**	**FMP - 405**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Role of mechanization and its relationships to productivity, employment, social and technical changes	6
2	Performance and power analysis	3
3	Cost analysis of machinery- fixed cost and variable costs, effects of inflation on cost	5
4	Selection of optimum machinery and replacement criteria	5
5	Break even point and its analysis, reliability and cash flow problems	5
6	Mechanization planning	4
7	Case studies and agricultural mechanization in India	4
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Mechanization and role in different capacities	2
2	Solving problems related to cost analysis and inflation	2
3	Solving problems related to selection of equipment / machinery	1

4	Solving problems related to replacement of machinery / equipment	1
5	Break even point and its analysis	1
6	Role of time value of money	1
7	Seminar on the topic on farm machinery management	2
8	Design of farm mechanization plan for different farm size and cropping pattern	2
	Total	**12**

Reference Books

- 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.

Sr. No.	Course Name	Course No.	Credit	L	P	T
16	**Human Engineering and Safety**	**FMP - 407**	**2 (1 + 1)**	**1**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Human factors in system development – concepts of system	1
2	Basic process in system development, performance reliability, human performance	2
3	Information input process, visual display, major types and use of displays, auditory and factual display	2
4	Speech communications	1
5	Biomechanics of motion, types of movements, range of movements	1
6	Strength and endurance, speed and accuracy, human control of systems	1
7	Human motor activities, controls, tools and related devices	1
8	Anthropometry	1
9	Arrangement and utilization of work space, atmospheric condition , heat exchange process and performance, air pollution	2
10	Dangerous machine (Regulation) act	1
11	Rehabilitation and compensation to accident victims	1

12	Safety gadgets for spraying, threshing, chaff cutting	1
13	Safety gadgets for tractor and trailer operation etc.	1
	Total	**16**

Practicals

S.No.	Topic	No. of Practicals
1	Use of bicycle ergo meter for calibration of subject in laboratory	1
2	Calibration of subject in the lab. using tread mill	1
3	Study of respiration gas meter and its use in farm operations	2
4	Calibration of subject using heart rate monitor	2
5	Study of general fatigue of the subject using Blink ratio method	1
6	Study on the use of electromyography equipment	1
7	Anthropometric measurements of farm workers and statistical analysis	2
8	Strength parameter measurements of farm workers and statistical analysis	1
9	Study of optimum work place layout and locations of controls	2
10	Familiarization of noise and vibration equipment	2
	Total	**15**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
17	**Production Technology for Agril. Machinery**	**FMP - 409**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Critical appraisal in production of agricultural machinery, modeling and stress analysis of machinery part by using standard software	2
2	Advance in material used for tractor and agril. Machinery cutting tools	3

	including CNC tools and finishing tools	
3	Advance manufacturing techniques like EDM, Pm	2
4	Heat treatment of steel including pack carburizing shot pining, chemical vapour deposition	4
5	Limits, fits, tolerance, jig & fixture, micro structure analysis, industrial lay out planning, quality management	4
6	Economics of process selection	2
7	Techno economic feasibility of project report, selection of standard / critical components	4
8	Servo motors, drive and controllers	2
9	CNC controllers for machine tools	3
10	CNC programming	3
11	Assembly and plant automation storage and transformation	3
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Study of use of standard software in production of agriculture machine and machine components	1
2	Study of CNC machine and working principle of CNC machine	1
3	CNC programmes for manufacturing of agriculture machine components	2
4	Study of EDM machine	1
5	To increase the hardness of agriculture machine components by hardening and carburizing process	2
6	Study of shot ring operation and shot machinery	1
7	Design and drawing of cultivator / seed drill parts	2
8	Design and drawing of sprayer parts	2
9	Design and drawing of harvester and thresher parts	1
10	Study of plant lay out and problem on lay out planning of small scale industry	2
11	Case study for manufacturing of tractor through industry visit	1
	Total	**16**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
18	**Mechanics of Tillage and Traction**	**FMP - 411**	**3 (2 + 1)**	**2**	**1**	**0**

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to mechanics of tillage tools	2
2	Engineering properties of soil, principles and concepts, stress strain relationship	4
3	Design of tillage tools , principles of soil cutting	3
4	Design equation, force analysis	3
5	Application of dimensional analysis in soil dynamics performance of tillage tools	4
6	Introduction to traction and mechanics, off road traction and mobility	4
7	Traction model, traction improvement, traction prediction, tyre size, tyre lug geometry and their effects, tyre testing	4
8	Soil compaction and plant growth, variability and geo statistic , application of GIS in soil dynamics	4
9	General revision and doubts	4
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Measurements of static soil parameters related to tillage	1
2	Measurement of dynamic soil related to tillage	1
3	Measurement of soil parameters related to puddling and floatation	2
4	Measurement of draft for passive rotary and oscillating tools	2
5	Measurement of slip and sinkage under dry and wet soil conditions	2
6	Measurement of load and fuel consumption for different farm operations	3
7	Economics of weight transfer and tractor loading including placement and traction aids	2
8	Studies on tyres, tracks and treads under different conditions	2
9	Studies on compaction and number of operations	1
	Total	**16**

Reference Books

- 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

Sr. No.	Course Name	Course No.	Credit	L	P	T
19	Environmental Engineering	RE - 405	3 (2 + 1)	2	1	0

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Importance of safe water supply system,	2
2	Domestic water requirements for urban and rural areas. Sources of Water supply Intakes and transportation of water	4
3	Drinking water quality. Indian Standards of drinking water.	3
4	Introduction to water treatment Domestic waste water: quantity, characteristics, disposal in urban and rural areas.	4
5	Sewer: types, design discharge and hydraulic design.	4
6	Introduction to domestic wastewater treatment. Design of septic tank.	4
7	Solid waste: quantity, characteristics and disposal for urban and rural areas.	4
8	Introduction to air pollution. Types of pollutants properties and their effects on living beings.	4
9	ISI standards for pollutants in air and their abetments.	3
	Total	**32**

Practicals

S.No.	Topic	No. of Practicals
1	Determination of turbidity; pH of solution;	2
2	Suspended solids; Dissolved solids; Total solids;	2
3	Temporary hardness; Permanent hardness;	2
4	Fluorides; Chlorides,	1
5	Dissolved oxygen; BOD	2
6	Collection of air samples and their analysis;	2
7	Numerical problems related to theory	3

8	Visit to treatment plant.	2
	Total	**16**

Reference Books

- Wastewater treatment for Pollution control, By: Soli J. Arceivala
- Wastewater Engineering Treatment Disposal, By: Metcalf & Eddy
- Environmental Engineering (Vol.I) , By: S.K.Garg
- Environmental Engineering (Vol.II) , By: S.K.Garg
- Elements of Environmental Engineering, By: K.N.Duggal, S.
- Manual on Water Supply and treatment, Central Public Health & Environmental Engineering Organisation, New Delhi
- Standard Methods for the Examination of Water & Wastewater, American Public Health Association
- Manual on sewerage and sewage treatment, Ministry of Urban Development, New Delhi
- Fundamentals of Air Pollution, By: B. S. N Raju,

Sr. No.	Course Name	Course No.	Credit	L	P	T
20	**Biomass Management for Fodder and Energy**	**RE - 407**	**2 (1 + 1)**	**1**	**1**	**0**

Course content :

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.

Planning of lectures

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Introduction to biomass management, biomass resource assessment management techniques/supply chains,	2
2	Processing of paddy straw, densification- Extrusion process, pellets, mills and cubers,	2
3	Bailing-classification, uses; residue management for surface mulch and soil incorporation,	2
4	Paddy Straw choppers and spreaders as an attachment to combine Harvester,	2
5	Mulch seeder, Paddy Straw Chopper-cum-Loader, Balar for collection of straw	2
6	Processing of straw/ fodder for animal use; Agricultural and horticultural use, Cushioning material for fruits and vegetables	3
7	Mulching and Composting, Paper and cardboard manufacturing, Straw as a fuel.	3
	Total	**16**

Practicals

S.No.	Topic	No. of

		Practicals
1	Familiarization with different straw management techniques	2
2	On-farm and off-farm uses of straw	1
3	Collection, loading and transport equipments for unbruised loose straw	2
4	Briquetting machine and preparation of briquettes	2
5	Straw baler and making of bales in the field	2
6	Straw/ fodder chopping machines	2
7	Straw/ mulching & incorporating machinery	2
8	Machinery requirement for baling forage crops for silage	2
	Total	**15**

Reference Books

- Principles of Farm Machinery, 3rd Edition, By: R.A. Kepner, Roy Bainer & E.L. Barger,
- Biomass Management Systems , By: Braden Allenby,
- Biomass Resource Assessment California Biomass Collaborative Biological & Agricultural Engineering University of California, 1 Shields Avenue, Davis, CA 95616-5924

Semester -VIII

S.No.	Course Name	Course No.	Credit
1	**In-Plant Training :** Student will undertake in-plant training of 25 credits hours which will include practical training at the Institution, training in one (4 months) / two (2 months each) Industrial Units and Educational tour.	AE (SWE) - 402	10
		AE (FMP /APE / RE) - 404	15
		Total	**25**

Educational tour : Study tour of 21 days and submission of report of is compulsory for all students. The study tour for the final year students will be organized by the college as per prevailing rules of the University.

In-Plant Training (25 credit hours): The in-plant training is intended to expose the students to an environment in which they are expected to be associated in their future career. The students will be required to have hands-on-experience at progressive farms, research institutions manufacturing or agro-processing industries and in rural areas. The training includes farm planning and development of irrigation/drainage project, watershed development, manufacturing technology of agricultural or processing machinery, testing and evaluation, quality control, marketing and servicing.

Objectives: Hands-on-training in:

- Manufacturing testing and evaluation, sales and marketing and service
- Farm development, irrigation and drainage project planning, watershed development
- Agro-processing, food product development and manufacture

Operational Aspects

- The training shall be compulsory and form a part of the curriculum for the award of the degree
- This programme be conducted in the final year of the degree programme
- Six months duration shall be covered during the final year for the training to be carried out at various centers, plants and institutes
- The detailed programme of work shall be developed and carried out by the students. The evaluation procedures to be followed shall be prepared by the concerned faculty/department of the institute in the form of a manual for reference of students, evaluators and the functionaries concerned. The manual shall contain all details about training programme.

- The credit for training programme shall be 25.
- The programme shall be of residential nature and it shall be compulsory for the student to stay at the place of posting.
- A minimum of 80 percent attendance is necessary during the training programme
- Supervision: In order to take policy decision and to solve the operational and administrative bottleneck if any, there should be a college level committee consisting of the following:

Dean, College of Agricultural Engineering	- Chairman
Chairman Academic Committee of college	- Member
Head of concerned department	- Member

Experiential Learning: The experiential learning is intended to build practical skills and entrepreneurship among the graduates with an aim to deal with work situations and for better employability and self-employment. It will involve setting-up of model plans for food processing and value addition for product diversification, setting up of workshops for manufacturing, operation and maintenance of farm machinery and equipment, maintenance and custom hiring of farm machinery and equipment. Thus, besides in-plant training, two hands-on training programme, each of six weeks duration during summer breaks of second
year and third year would be required to be completed by every student. Performance of the students in the training programme be evaluated based on: (a) work quality, (b) acquired knowledge and expertise, (c) attendance, (d) maintenance of records (e) report, (f) demonstration and presentation in seminar, and (g) work outcome.

The suggested areas for experiential learning are as follows:

1. Fabrication of marketable tools and implements Facility required - Production workshop
2. Processing of agri-produce Facility required - Agro-processing centre - Pilot plant for processing and packaging of selected grain/horticultural crop
3. Custom hiring of package of farm equipment Facility required - Tractor and set of farm implements.