

SYLLABUS AND COURSE OUTLINE  
FOR  
DIPLOMA  
IN  
AGRICULTURAL ENGINEERING



POLYTECHNIC  
IN  
AGRICULTURAL ENGINEERING  
JUNAGADH AGRICULTURAL UNIVERSITY  
TARGHADIA

**Annexure-II****Detailed Syllabi of Polytechnic in Agricultural Engineering (w.e.f. 2025-26)****Semester-I**

<b>AE1.1</b>	<b><i>Deeksharambh</i> (Induction-cum-Foundation Course)</b>	<b>NG (0+2*)</b>
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The activities to be taken under *Deeksharambh*, in addition to giving a broad view and application areas of the subject of study, also will aim at creating a platform for

- Helping students from different backgrounds for cultural integration
- Knowing about the operational framework of academic process in university
- Instilling life and social skills, leadership qualities, team working spirit
- Developing social awareness, ethics and values, creativity
- Helping students to identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

The details of activities/ schedules will be decided by the parent universities. The structure shall include, but not restricted to:

- I. Discussions on operational framework of academic process in university, as well as interactions with academic and research managers of the University
- II. Creating awareness on the subject of study, and the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario
- III. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences;
- IV. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences;
- V. Field visits to related fields/ establishments; and
- VI. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills.

<b>AE1.2</b>	<b>Applied Chemistry</b>	<b>3(2+1)</b>
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**Theory**

**Unit 1:** Importance and scope of chemistry, laws of chemical combination, Dalton's atomic theory: concept of elements, atoms and molecules. Atomic and molecular masses mole concept and molar mass:

**Unit 2:** States of matter: Gases and liquids three states of matter. Intermolecular interactions, type of bonding. Role of gas laws in elucidating the concept of the molecule, Boyle's law, Charles law, Gay Lussac's law. Ideal behaviour, empirical derivation of gas equation. Ideal gas equation. Liquid State–Vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

**Unit 3:** Structure of atom: Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Rutherford's model and its limitations, Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship,

Pauli's exclusion principle  $n + l$  Law and Hund's rule, electronic configuration of atoms.

**Unit 4:** Periodic table: Significance of classification, modern periodic law and present form of periodic table. Enthalpy: Explanation and definition of term. Ionization enthalpy, electron gain enthalpy, electronegativity, valence.

**Unit 5:** Redox reactions: Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number.

**Unit 6:** Chemical equilibrium: Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium, Le Chatelier's principle. Ionic equilibrium: Ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polybasic acids, acid strength, concept of pH. Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect (with illustrative examples.) Handerson equation.

**Unit 7 :** Surface chemistry: Adsorption – physisorption and chemisorption; factors affecting adsorption of gases on solids; catalysis : homogenous and heterogeneous, activity and selectivity.

### Practical

1. Determination of melting point of an organic compound. (p-toluidine, naphthalene, oxalic acid,  $\beta$ - naphthol, resorcinol, benzoic acid.)
2. Determination of boiling point of an organic compound. (acetone, methyl acetate, acetic acid, xylene (o,m,p), water)
3. Determination of pH of some solutions obtained from fruit juices, varied concentrations of acids, bases and salts using pH paper or universal indicator.
4. Study the pH change in the titration of a strong base using universal indicator.
5. Study of pH change by common ion effect in case of weak acids and bases.
6. Determine the strength of a given solution of sodium hydroxide with the help of a standard solution of oxalic acid
7. Investigation of the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on them.
8. Study of the acidity of different samples of the tea leaves.
9. Determination of the rate of evaporation of different liquids.
10. Analysis of fruit and vegetable juices for their acidity.

### Suggested Readings

1. A Text Book of Physical Chemistry By O P Tandon and A S Singh G R Bathala Publications Pvt Limited, New Delhi
2. A Text Book of Organic Chemistry By O P Tandon G R Bathala Publications Pvt Limited, New Delhi
3. A Text Book of Inorganic Chemistry By O P Tandon G R Bathala Publications Pvt Limited, New Delhi
4. A Text Book of Numerical Chemistry By P Bahadur G R Bathala Publications Pvt Limited, New Delhi
5. A text book of Engineering Chemistry by S. S. Dara, S. Chand & Co. New Delhi.
6. Engineering Chemistry by M. M. Uppal & S.C. Bhatia, Khanna Publishers. New Delhi.
7. A Textbook of organic chemistry B.S. Bahl & ArunBahl S. Chand & Co., New Delhi.

8. A Textbook of organic chemistry P.L. Soni S. Chand & Co., New Delhi.
9. A Textbook of organic chemistry O.P. Agrawal Krishna Prakashan
10. A Textbook of organic chemistry Bahl & Tuli S. Chand & Co., New
11. Chemistry of Engineering Materials by C.P. Murthy, C. V. Agarwal and A. Naidu B. S. Publication Hyderabad
12. Engineering Chemistry by J. C. Kuriacose and J. Rajaram, Tata McGraw-Hill Co. New-Delhi.

<b>AE1.3</b>	<b>Applied Mathematics</b>	<b>3(3+0)</b>
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### Theory

#### Co-ordinate Geometry:

**Point & Triangle:** Coordinate systems, Study of point in coordinate system, Distance formula, Mid-point, Area and Centroid of a triangle and Locus of a point.

**Straight Line:** Equation of straight lines in various form (Slope point form, Two point form, Intercept form), Angle of intersection of lines and Parallel and Perpendicular lines.

**Circle:** General equation of circle and its characteristics, Centre and radius form, Tangent and Normal and related problems. .

**Permutations and Combinations:** Definition of Permutations and Combinations, Value of  ${}_n P_r$  and  ${}_n C_r$ , its properties and simple problems.

**Binomial theorem:** Binomial theorem (without proof) for positive integral index (expansion and general term); Binomial theorem for any index (expansion only) first and second binomial approximation with application to engineering problems.

**Logarithm:** General properties & Rules of logarithms, Calculations of engineering problems using log tables.

**Trigonometry:** Units of angles (degree and radian), Allied & Compound angles, Addition and Subtraction formulae, Graph of Sine and Cosine, Multiple and Sub-multiple angles, Transformation of Product into a sum or difference and vice versa, Periodic function, Sum and factor formulae, Inverse trigonometric function, Solution of triangles.

**Complex Numbers:** Definition, Real and Imaginary parts of a complex number, Polar and Cartesian representation of a complex number and conversion from one form to the other, Conjugate of a complex number, modulus and argument of a complex number, Addition, subtraction, multiplication and division of a complex number.

**Statistics and Probability:** Measurement of central tendency (Mean, Median and Mode), Measurement of dispersion (Standard deviation), Definition and laws on probability, Probability distribution (Binomial, Poisson and Normal).

### Suggested Readings

1. Applied Mathematics Vol. I by SS Sabharwal and Others by Eagle Prakashan, Jalandhar
2. Applied Mathematics Vol. II by SS Sabharwal and Others by Eagle Prakashan, Jalandhar
3. Engineering Mathematics Vol. I by Ishan Publishing House
4. Engineering Mathematics Vol. I by S Kohli and Others; IPH, Jalandhar
5. Engineering Mathematics by Dass Gupta
6. Advanced Engineering Mathematics by AB Mathur and VP Jagi; Khanna Publishers, Delhi
7. Higher Engineering Mathematics by BS Grewal; Khanna Publishers, Delhi
8. Engineering Mathematics by C Dass Chawla; Asian Publishers, New Delhi

9. NCERT 11<sup>th</sup> and 12<sup>th</sup> science Mathematics book.

AE1.4	Applied Physics	3(2+1)
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**Theory**

**Units and Dimensions:** Physical quantities, Fundamental and derived units, Systems of units (FPS, CGS, MKS and SI units), Dimensions and dimensional formulae of physical quantities (area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, surface, tension, coefficient of viscosity and strain), Dimensional equations and their applications, conversion from one unit to another unit for density, force, pressure, work, power, energy, velocity, acceleration, Limitations of dimensional analysis

**Force and Motion:** Scalar and vector quantities - examples, addition and multiplication (scalar product and vector product) of vectors, Force, resolution and composition of forces - resultant, parallelogram law of forces, Equilibrium of forces, Lami's theorem, Newton's Laws of motion - concept of momentum, Newton's laws of motion and their applications, determination of force equation from Newton's second law of motion; Newton's third law of motion conversion of momentum, impulse and impulsive forces, simple numerical problems based on third law. Projectile, horizontal and oblique projections and equation of trajectory, Derivation of time of flight, maximum height and horizontal range, Circular motion, Relation between linear and angular velocity and linear acceleration and angular acceleration, Centripetal force (derivation) and centrifugal force

**Work, Power and Energy:** Work: definitions and its SI units, Work done in moving an object on horizontal and inclined plane, (incorporating frictional forces), Power: definitions and its SI units, calculation of power in simple cases, Energy: Definitions and its SI units: Types: Kinetic energy and Potential energy, with examples and their derivation, Principle of conservation of mechanical energy (for freely falling bodies), transformation of energy from one form to another

**Magnetism and Matter:** Introduction, The Bar Magnet, Current Loop as a Magnet and its Magnetic Moment, Magnetism in Matter, Equivalence between a bar magnet and a solenoid, Gauss's Law for Magnetic Field, The magnetism of Earth and Magnetic Elements, Magnetization and Magnetic Intensity, Magnetic Flux, Absolute and Relative Permeability, Magnetic Susceptibility

**Waves and vibrations:** Generation of waves by vibrating particles, Wave motion with examples, Types of wave motion, transverse and longitudinal wave motion with examples, Velocity, frequency and wave length, Sound and Light waves

**Ray Optics:** Introduction, Reflection by spherical mirrors, Relation between focal length and radius of curvature, Spherical mirror formula, Lateral magnification, Refraction of light (Laws of refraction, refraction through compound slab, lateral shift, real depth and virtual depth), Total internal reflection, Spherical lenses (Lens-Maker's formula, magnification, power of lense), Refraction, dispersion and scattering of light, Rotational Motion, Definitions of torque, moment of inertia, radius of gyration, Conservation of angular momentum (qualitative), Theorems of parallel and perpendicular axes

**Gravitation and satellites:** Kepler's law of planetary motion, Newton's law of gravitation, Escape velocity (derivation), Satellites, Geostationary satellite,

**Practical**

1. To find the thickness of wire using a screw gauge
2. To find volume of solid cylinder and hollow cylinder using a Vernier caliper

- To determine the thickness of glass strip and radius of curvature of a concave surface using a spherometer
- By doing suitable experiment, draw the forward bias characteristic curve of a junction diode and determine its forward resistance.
- By performing an experiment, draw the characteristic curve of the given zener diode and determine its breakdown voltage.
- To draw the I-V characteristic curves of a p-n junction diode in forward bias and reverse bias.

### Suggested Readings

- Basic Applied Physics by RK Gaur; Dhanpat Rai Publications
- Applied Physics Vol. I, TTTI Publication Tata McGraw Hill, Delhi
- Comprehensive Practical Physics - Volume I and II by IN Jaiswal; Laxmi Publishers
- Numerical Problems in Physics - Volume I and II by RS Bharaj; Tata McGraw Hill
- Simple Course in Electricity and Magnetism by CL Arora; S Chand and Co, New Delhi
- Fundamental Physics - Volume I and II by Gomber and Gogia; Pardeep Publications, Jalandhar
- A Text Book of Optics by Subramanian and Brij Lal
- Physics Laboratory Manual by PK Palanisamy, Scitech Publications
- Fundamentals of Physics by Resnick and Halliday, Asian Books Pvt. Ltd., New Delhi
- Concepts in Physics by HC Verma; Bharti Bhawan Ltd., New Delhi.

AE1.5	English	2(1+1)
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### Theory:

**Passages for Comprehension:-**The Language of Science, My Thousandth Goal, New Wonders in Cameras, Rip Van Winkle Comes to Town, Safety Practices, The Robotic Revolution, and Entrepreneurship.

**Grammar:-**Tenses, Voice-Change, Direct/Indirect narration, Prepositions, Determiners.

**Composition:** Letter (Formal and Informal), Paragraph Writing, Précis writing, Comprehension of unseen Passage.

### Tutorial

Practice on various topic of theory items.

### Suggested Readings

- 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
- “Communication skills for Technical students” Compiled by CDC, TTTI, Bhopal. Published by Somaiya Publications Pvt. Ltd. 4th Revised Edition, July, 1995.

<b>AE1.6</b>	<b>Farming Based Livelihood Systems</b>	<b>3(2+1)</b>
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**Theory**

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock production, Horticultural crops, Agro-forestry systems, Small-, medium- and large-enterprises including value chains and secondary enterprises as livelihood components for farmers, Commercial farming-based livelihood models by NABARD, ICAR; Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

**Practical**

Demonstration of farming systems and agricultural based livelihood enterprises; Study of production and profitability of crop based model, Study of production and profitability of livestock based model, Study of production and profitability of food processing based livelihood models, Study of production and profitability of farming based livelihood models; Field visit of innovative farming system model; Visit of Agri-based enterprises and study of their functional aspects; Study of agri-enterprises involved in industry and service sectors (Value Chain Models), Project concept formulation on farming-based livelihood systems along with cost and profit analysis, Case study of Start-Ups in agri-sectors.

**Suggested Readings**

1. Agarwal, A. and Narain, S. (1989). Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi, India
2. Ashley, C., Carney, D. (1999). Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7. [Google Scholar].
3. Carloni, A. (2001). Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy
4. Dixon, J. and A. Gulliver with D. Gibbon. (2001). Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO and World Bank, Rome, Italy and Washington, DC, USA.
5. Evenson, R.E. (2000). Agricultural Productivity and Production in Developing Countries. In FAO, The State of Food and Agriculture, FAO, Rome, Italy
6. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, Amitava Dey Ujjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan, S. K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna - 800 014, Bihar.

<b>AE1.7</b>	<b>Workshop Technology and Practice</b>	<b>2(0+2)</b>
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**Practical**

Introduction about different shops in the workshop; Safety and precautions to be taken in the workshop;

Study of different tools used for fitting and different fitting operations; Study of various measuring instruments used for fitting; Demonstration of fitting: sawing, filing and right angle fitting of MS flat; working with complex fitting jobs: operations of drilling, reaming, and threading and with tap dies; Preparation of a paper weight;

Study of various carpentry tools, types of wood and their characteristics and working with carpentry tools; Demonstration of preparing of simple joints in carpentry: cross half lap joint or T-half joint, Mortise and Tenon joint in carpentry; Preparation of dovetail joint in carpentry;

Study of welding, types of welding, oxyacetylene gas welding, types of flames, welding techniques and equipment used for gas welding, working with welding equipment; Working with electric arc welding; Equipment and tools, safety and precautions taken in arc welding; Preparation of Butt joint and lap joint with ARC welding;

Working on a lathe machine and study of different tools used in lathe machine; Demonstration of simple turning, step turning in lathe machine; Preparation of job on taper turning, drilling, knurling and threading in lathe machine;

Working with different machines in machine shop such as shaper, milling machine, etc. and with different tools used in machine shop; Demonstration on bending, shaping etc.; Exercise on Drawing, Punching, Riveting; Making different types of sheet metal joints using G.I. sheets.

**Suggested Readings**

1. Chapman W A J. 2018. Workshop Technology (Vol. I and II). Arnold Publishers (India) Pvt. Ltd., AB/9, Safdarjung Enclave, New Delhi.
2. Hajra Choudhury S K, Roy N, Hajra Choudhury A K. 2017. Elements of Workshop Technology (Vol. I and II). Media Promoters and Publishers Pvt. Ltd, Mumbai.
3. Khurmi R S and Gupta J K. 2018. A Text Book of Workshop Technology. S. Chand & Company Ltd, New Delhi.
4. Raghuwansi B S. 2016. A Course in Workshop Technology (Vol. I and II). Dhanpat Rai and Sons, 1682, Nai Sarak, New Delhi.

<b>AE1.8</b>	<b>NSS-I/NCC-I/Phy. Edu.</b>	<b>1(0+1)</b>
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**Practical/ Awareness activities**

- Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice- versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/Coy Drill.
- Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding.
- Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.

- Introduction to map, scales, and conventional signs. Topographical forms and technical terms.
- The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs.
- Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and
- Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS
- Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.
- NSS programme activities. Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth programmes/ schemes of GOI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.
- Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth- adult partnership. Social harmony and national integration
- Indian history and culture, role of youth in nation building, conflict resolution and peace-building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism
- Citizenship, constitution, and human rights. Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community-based organizations) and society movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

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**Semester-II**

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<b>AE2.1</b>	<b>Crop Production and Protection Technology</b>	<b>3(2+1)</b>
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**Theory**

Introduction and scope of agronomy; Classification of crops; Effect of different weather parameters on crop growth and development; Crop seasons; Time and method of sowing of major field crops, seed rate for important crops; Methods and time of application of manures and fertilizers, fertigation; Weeds and their management in crops; Crop rotation, cropping systems, cropping scheme, relay cropping, mixed cropping and intercropping. Soil forming processes; Classification and composition of soil, 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; Essential plants nutrients- their functions and deficiency symptoms in plants; Important inorganic fertilizers and their reactions in soils. Types of horticultural crops; Sowing and planting

times and methods; Seed rate and seed treatment for vegetable crops; Macro and micro propagation methods; Types of plant growing structures; Pruning and training; Water requirements and critical stages; Management of orchard; Major pests and diseases of horticultural and agriculture crops and their management

### Practical

Identification of crops and their varieties, seeds and weeds; Study of different fertilizer application methods and weed control methods; Judging the maturity time for harvesting of crop; Study of seed viability and germination test; Identification of rocks and minerals; Examination of soil profile in the field; Determination of bulk density; particle density and porosity of soil; Determination of organic carbon of soil; Identification of nutrient deficiency symptoms of crops in the field; Identification and description of important fruits, flowers and vegetables crops; Study of different garden tools; Preparation of nursery bed; Practices of pruning and training in some important fruit crops; Study of cultural operations for vegetable crops (sowing, fertilizer application, mulching, irrigation and weed control); Seed extraction techniques; Visit to commercial greenhouse/ polyhouse.

### Suggested Reading

1. Ahamad S, Anwar Ali and Sharma P K (Eds.). 2018. Plant disease management in Horticultural crops. Daya Publishing House, Delhi.
2. Biswas T D and Mukharjee S K. 1987. A text book of soil science. Tata McGraw-Hill publishing Co. Ltd.
3. Chadha K L. 2003. Hand Book of Horticulture. ICAR Publication, New Delhi.
4. Das D K. 2020. Introductory to Soil Science. Kalyani publication, Ludhiana.
5. Dey G C. 2013. Fundamentals of Agronomy. Jain Book Depot.
6. Ghildyal B P and Tripathy R P. 1987. Soil Physics. Wiley Eastern Ltd., New Delhi.
7. Indian Society of soil science. 2002. Fundamentals of soil science. ISSC, IARI, New Delhi.
8. Kumar N. 2017. Introduction to Horticulture. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
9. Muthukrishnan N, Ganapathy N, Nalini R and Rajendran R. 2005. Pest Management in Horticultural crops. New Madura Publishers, Madurai, Tamil Nadu.
10. Reddy S R. 2020. Principles of Agronomy. Kalyani Publisher.
11. Reddy Yellamanda T and Reddy Shankar G H. 1995. Principles of Agronomy. Kalyani Publishers Ludhiana.
12. Sehgal J L. 1996. Soil Pedology. Kalyani publication, Ludhiana.
13. Singh Jitendra. 2018. Fundamentals of Horticulture. Kalyani Publishers, Ludhiana.
14. Singh S S and Singh R. 2013. Principles and practices of Agronomy. Kalyani Publisher.
15. Sudheer K P and Indira V. 2016. Post-harvest technology of Horticultural crops, New Delhi.

<b>AE2.2</b>	<b>Engineering Chemistry</b>	<b>2(1+1)</b>
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### Theory

Definition of corrosion; Types of corrosion; Factors affecting the rate of corrosion; Methods of prevention of corrosion. Definition of fuels; classification of fuels; Calorific value and its unit; Combustion-chemical reaction. Lubricants: properties, mechanism, classification and tests.

Introduction and Definition of Polymer and Monomer; Classification of Polymer on basis of Molecular structure as Linear, Branch and Cross-linked polymers; Classification on basis of monomers (homopolymer and copolymer); Classification of Polymers on basis of Thermal behavior(Thermoplastics& Thermosetting).

### Practical

Determination of temporary and permanent hardness of water by EDTA method. Estimation of chloride in water: Estimation of dissolved oxygen in water. Determination of BOD in water sample: Determination of COD in water sample. Estimation of available chlorine in bleaching powder. Determination of viscosity of oil. Estimation of activity of water sample. Estimation of alkalinity of water sample. Determination of carbonate and non- carbonate hardness by soda reagent. Determination of coagulation of water and chloride ion content. Determination of specific rotation of an optically active compound.

### Suggested Readings

1. Bahl, B.S., Bahl, A. and Tuli, B.D. 2007. Essentials of Physical Chemistry. S. Chand and Co. Ltd, Delhi.
2. Finar, I.L. 2002. Organic Chemistry. Vol I and II.
3. Pearson.Glasstone, S. Elements of Physical Chemistry. The Macmillan Company of India Limited.

AE2.3	Engineering Drawing	2(0+2)
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### Practical

Uses of drawing aids: Drawing equipment instruments and materials, Construction of Polygons. Lines, lettering & dimensioning : Different types of lines, Vertical capital & lower case letters, Inclined capital & lower case letters, Dimensioning methods–aligned method & unilateral with chain, parallel, progressive & combined dimensioning projections of points, lines & planes : Reference planes, orthographic projections, 1<sup>st</sup> Angle and 3<sup>rd</sup> Angle Projections of points, Projections of Lines–determination of true lengths & inclinations, Projections of plane–determination of true shape, orthographic projections :Front view, Top view, Side view, Bottom view & rear view isometric projections : Difference between isometric projections & isometric drawing. Isometric views & isometric projections. Fasteners :Detachable & permanent fasteners–difference, Sketches of elements of screw threads, Sketches of thread forms–B.S, B.A, Square with worth, Acme with Knuckle, Buttress–Seller Unified., Internal & external threads, Left hand & right hand threads, Single & multi start threads, Lead & pitch, Sketches of studs, cap screws machine screws, set screws, Locking devices, bolts, hexagonal & square nuts & nut bolt & washer assembly. Sketches of various types of rivet heads (snap–pan–conical–countersunk) Sketches of keys (sunk, flat, saddle, gib head, woodruff), Sketches of hole & shaft Assembly.

### Suggested Reading

1. Bhat N D. 2010. Elementary Engineering Drawing. Charotar Publishing House Pvt. Ltd., Anand.
2. Bhatt N D and Panchal V M. 2013. Machine Drawing. Charotar Publishing House Pvt. Ltd., Anand.

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

<b>AE2.4</b>	<b>Engineering Mathematics</b>	<b>3(3+0)</b>
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### Theory

**Determinants:** Expansion of determinants (upto third order) using Sarrus rule, Expansion method and pivotal's condensation method. Properties of determinants, Solution of equations (upto 3 unknowns) by Cramer's rule.

**Matrices:** Definition of matrix, addition, subtraction and multiplication of matrices (up to third order). Inverse of a matrix by adjoint method, Solution of equations (up to 3 unknowns) by matrix method.

**Function:** Definition and concept of function, Examples.

**Limit:** Concept of limit, Standard formulae & working rules of limits and related example

**Differentiation:** Definition, Differentiation by first principle method, Rules of Sum, Product & Quotient of Functions, Chain Rule, Differentiation of Sum, Product & Quotient of different functions, Derivative of Implicit functions and Parametric functions, Substitution method, Logarithmic differentiation. Successive differentiation up to second order, Example related application of derivatives.

**Integration:** Concept, Integral of standard functions, Working rules of integration, Integration by parts, Integration by substitution method, Integration by partial fraction method, Definite Integral and its properties, Application of definite integral to find area, Double and triple integrals, Volume and surface revolution curves.

**Vectors:** Definition of vector and scalar quantities. Addition and subtraction of vectors. Dot product and Cross product of two vectors. Thumb rule. Angle between two vectors, Application of dot and cross product in engineering problems, Scalar triple product and vector triple product.

**Functions of a Complex Variable:** Limit, Continuity and derivative of complex functions, Analytic function, Cauchy-Reimann equations, Conjugate functions, Harmonic functions.

### Suggested Readings

1. Applied Mathematics Vol. I by SS Sabharwal and Others by Eagle Prakashan, Jalandhar
2. Applied Mathematics Vol. II by SS Sabharwal and Others by Eagle Prakashan, Jalandhar
3. Engineering Mathematics Vol. I by Ishan Publishing House
4. Engineering Mathematics Vol. I by S Kohli and Others; IPH, Jalandhar
5. Engineering Mathematics by Dass Gupta
6. Advanced Engineering Mathematics by AB Mathur and VP Jagi; Khanna Publishers, Delhi
7. Higher Engineering Mathematics by BS Grewal; Khanna Publishers, Delhi
8. Engineering Mathematics by C Dass Chawla; Asian Publishers, New Delhi
9. NCERT 11th and 12th science Mathematics book.

<b>AE2.5</b>	<b>Engineering Mechanics</b>	<b>2(1+1)</b>
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### Theory

Equilibrium of forces, free body diagrams, Centre of gravity (CG) of simple geometrical figures, CG by moments, plane figures, axis of references, CG of symmetric sections, unsymmetrical sections, solid bodies and cut sections; Moment of inertia: methods of finding out M.I.

Frictional forces, static friction, dynamic friction, limiting friction, normal reaction, angle of friction,

coefficient of friction, laws of friction, equilibrium of a body lying in horizontal and inclined planes; Simple stresses and strain, Hooke's law, Poisson's ratio, modulus of elasticity, Strain related problems Shear force and bending moment, fundamentals of shear force and bending moment, SFD and BMD of cantilever and simply supported and overhanging beams, point of contra-flexure; Torsion of circular shaft, torsional effect, hoop stress, power transmitted by a shaft; Mohr's circle.

### Practical

Problems on composition and resolution of forces; Study the moments of a force; Problems related to resultant of a concurrent-coplanar force system; Problems related to non-concurrent coplanar force system; Systems of couples in space; Problems related to centroids of composite areas; Problems on Moment of Inertia, radius of gyration of composite areas; Analysis of equilibrium of concurrent coplanar and non-concurrent coplanar force system; Problems involved with frictions; Analysis of simple trusses by methods of joints and methods of sections; Analysis of simple trusses by graphical method; Problems on simple stress and strains; Problems on shear and bending moment diagrams. Problems on stresses on beams Problems on torsion of the shafts; Analysis of plane and complex stresses.

### Suggested Reading

1. Bansal, R. K. 2005. A Text Book of Engineering Mechanics. Laxmi Publishers, New Delhi.
2. Khurmi, R. S. 2006. Strength of Materials. S. Chand Publishing.
3. Khurmi, R. S. 2018. A Text Book of Engineering Mechanics. S. Chand Publishing.
4. Prasad, I. B. 2004. Applied Mechanics and Strength of Materials. Khanna Publishers, New Delhi.
5. Prasad, I. B. 2004. Applied Mechanics. Khanna Publishers, New Delhi.
6. Sundarajan, V. 2002. Engineering Mechanics and Dynamics. Tata McGraw Hill Publishing Co. Ltd, New Delhi.

AE2.6	Engineering Physics	2(1+1)
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### Theory

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

**Practical**

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

**Suggested Readings**

1. Text Book of optics. Brijlal and Subrahmanyam by S. Chand and Co., New Delhi.
2. Optical State Physics and Fiber Optics by Sarkar Subir Kumar. S. Chand and Co., New Delhi.
3. Elements of Spectroscopy by Gupta S L, Kumar V Sharma R C. Pragati Prakasam, Meeruth.
4. Solid State Physics by Saxena B S and Gupta R C. Pragati Prakasam, Meeruth.
5. Essentials of Quantum Mechanics by Srivastava B N. Pragati Prakasam, Meeruth.
6. Fundamentals of Magnetism and Electricity by Vasudeva D N. S. Chand and Co., New Delhi.

<b>AE2.7</b>	<b>General Microbiology</b>	<b>3(2+1)</b>
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**Theory**

Scope and history of microbiology: (notable contributions of Leeuwenhoek, Pasteur, Koch, etc.); Groups of microorganisms; Applied area of microbiology, Classification and identification of micro-organism; Major Characteristics of Microorganisms- Microscopy: Introduction to microscope; Component of microscope; Structures external to cell wall, Cell wall; Structures internal to cell wall. Cultivation and preservation of micro-organisms: Nutritional requirements; Types of media. Physical condition required for the growth; Enumeration methods for micro-organisms. Bacterial Metabolism and Growth: Reproduction of bacteria; Growth of bacteria: growth curve, Control of microorganisms: Physical and Chemical agents.

**Practical**

To study Microscopy; Micrometry; Sterilization of glassware and acquainting with equipment used in microbiology; To prepare of nutrient agar media and techniques of inoculation; To study Staining methods (gram staining, negative staining); To study Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); To study Growth characteristics of fungi: To determine microbial numbers, direct plate count, generation time.

**Suggested Readings**

1. Pelczar Jr. M.J., Chan, E.C.S. and Krieg, N.R. 1998. Microbiology. 5th edn. Tata McGraw-Hill Education, New Delhi.

2. Tortora, G.J., Funke, B.R. and Case, C.L. 2014. Microbiology: An Introduction. 12th edn. Prentice-Hall, NY, USA.
3. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2013. Prescott's Microbiology. 9th edn. McGraw-Hill Higher Education, NY, USA.

<b>AE2.8</b>	<b>Surveying and Levelling</b>	<b>3(1+2)</b>
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### **Theory**

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

### **Practical**

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

### **Suggested Readings**

1. Surveying (Vol.I) by Punmia, B C 1987. Laxmi Publications, New Delhi.
2. Surveying (Vol.I) by Arora, K R 1990. Standard Book House, Delhi.
3. Surveying and Levelling by Kanetkar, T P 1993. Pune Vidyarthi Griha, Prakashan, Pune.

<b>AE2.9</b>	<b>NSS-II/NCC-II/Phy. Edu.</b>	<b>1(0+1)</b>
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### **Practical/ Awareness activities**

- Importance and role of youth leadership
- Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies
- Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programmes
- Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations
- Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

## **THIRD SEMESTER**

**HBS-2.1.1      ENGINEERING MATHEMATICS – II      Credit – 3 (2+1\*)**

### **Theory**

**Ordinary differential equations:** Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation, Differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel's and Legendre's differential equations.

**Functions of a Complex variable:** Limit, continuity and analytic function, Cauchy-Riemann equations, Harmonic functions.

**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. Fourier Sine and Cosine Series, Fourier series for function having period  $2L$ , Elimination of one and two arbitrary function.

**Partial differential equations:** Formation of partial differential equations Higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, and application of partial differential equations (one dimensional wave and heat flow equations, Laplace Equation).

### **Tutorial\***

Tutorials on solution of ordinary differential equations of first and higher orders. Series solutions of differential equations. Bessel's and Legendre's differential equations, Convergence of infinite series. Fourier series, harmonic analysis, analytical functions, Cauchy-Riemann equations, harmonic functions, Solution of partial differential equations, Application of partial differential equations.

### **Suggested Readings**

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

## **HBS-2.1.2 INTRODUCTION TO COMPUTER, WEB DESIGNING AND INTERNET APPLICATIONS** **Credit – 2 (1+1)**

### **Theory**

Theory: computer fundamentals; hardware and software; input, output and storage devices; Operating System (Microsoft Windows), Introduction to MS Office - Word, Excel, Power Point. Brief History of Internet, Internet applications; Basics in Web Design, Basic principles in developing a web designing, Planning process, Five Golden rules of web designing, creation of a web site using HTML/ DREAM WEAVER

### **Practical**

MS Word. MS Excel. MS Power Point. Internet applications: Web Browsing, Creation and operation of Email account. Basic of HTML; Development of Web pages using HTML tags/ Working with DREAM WEAVER

### **Suggested Readings**

- Computer Fundamentals by P.K. Sinha
- Office 2013 Quick Start Guides by Microsoft
- Developing web design latest edition by Jennifer Niederst Robbins..
- Web Design with HTML5 by Frainand Ben. Responsive
- Internet Applications in Product Design and Manufacturing by George Q. Huang, K.L. Mak.  
ISBN:3540434658

## **SWE-2.1.3 FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS** **Credit – 3 (2+1)**

### **Theory**

Properties of fluids: Ideal and real fluid. Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, centre of pressure, buoyancy, meta centre and meta centric height, condition of floatation and stability of submerged and floating bodies; Kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flow net. Types of fluid flow, translation, rotation, circulation and vorticity, Vortex motion; Dynamics of fluid flow, Bernoulli's theorem, venturimeter, orifice meter and nozzle, siphon; Laminar flow: Stress strain relationships, flow between infinite parallel plates both plates fixed, one plate moving, discharge, average velocity; Laminar and turbulent flow in pipes, general equation for head loss Darcy, Equation, Moody's diagram, Minor and major hydraulic losses through pipes and fittings, flow through network of

pipes, hydraulic gradient and energy gradient; Flow through orifices (Measurement of Discharge, Measurement of Time), Flow through Mouthpieces, Flow over Notches, Flow over weirs, Chezy's formula for loss of head in pipes, Flow through simple and compound pipes, Open channel design and hydraulics: Chezy's formula, Bazin's formula, Kutter's Manning's formula, Velocity and Pressure profiles in open channels. Introduction to fluid machinery.

### **Practical**

Study of manometers and pressure gauges. Verification of Bernoulli's theorem. Determination of coefficient of discharge of venturi-meter and orifice meter. Determination of coefficient of friction in pipeline. Determination of coefficient of discharge for rectangular and triangular notch. Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice. Determination of coefficient of discharge for mouth piece. Study of current meter.

### **Suggested Readings**

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

## **SWE-2.1.4 HYDROLOGY & SOIL AND WATER Credit – 3 (2+1) CONSERVATION ENGINEERING**

### **Theory**

**Introduction:-** Water resources and their importance. Hydrological cycle. Hydrologic equation and its components. Geohydrological and hydrological balance. Rainfall and its measurement. Factors affecting rainfall. Run off, factors affecting runoff. Estimation of runoff.

**Erosion:-** Definition, Classification of erosion viz. Geological & accelerated. agents causing erosion. Mechanics of Water Erosion: Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion and principle of gully erosion and Classification of gullies. Stream channel erosion. Effects of water erosion, Factors affecting erosion by water. Mechanics Of Wind Erosion: Processes of saltation, suspension, surface creep. Factors affecting erosion by wind.

**Erosion Control :-** Principles of erosion control. Agronomic and field practices to control erosion

by wind & water i.e. Contour farming, strip cropping, tillage etc. Terracing to control erosion by water. Types of terraces. Terrace design parameters and planning a terrace system. Bench terraces, types and design parameters. Use of bunds to control erosion and design parameters of bunds. Contour bunding. Vegetated water ways for the control of erosion

### **Practical**

To study different instruments at meteorological observatory station, To study the rainfall measurement system. Analysis of rainfall data i.e. intensity, duration, frequency analysis, mean-areal depth of rainfall, measurement and estimation of runoff. To study the various types of soil erosion and their control. To study the terracing and bunds for soil erosion control. To study the vegetative water ways for the control of erosion and safe disposal of water.

### **Suggested Readings**

- Soil & Water Conservation Engineering by Glenn O. Schwab, Richard K.
- Frevert, Talcott W. Edminster, Kenneth K. Barnes; John Wiley & Sons New York
- Manual of Soil & Water Conservation Practice by Gurmail Singh; Oxford & IBH Publication co.
- Soil & Water Conservation Engineering by Suresh R.; Standard Publication
- Principle of Agricultural Engineering Volume-II by A.M. Michael & T.P. Ojha; Jain brothers.
- Hydrology: Principles analysis and design (Revised II Edition) Raghunath, H.M. 2006. New Age International, Pvt. Ltd., Publishers, New Delhi.
- Engineering Hydrology (III Edition) by K Subramaniya. 2008. Tata McGraw Hill Publishing Co, New Delhi
- Watershed Hydrology by Suresh R.; Standard Publication
- Land and water management engineering (IV edition) by VVN Murthy. Kalyani Publishers, New Delhi

## **FMP-2.1.5      THERMODYNAMICS, REFRIGERATION      Credit – 3 (2+1) AND AIR CONDITIONING**

### **Theory**

Thermodynamics properties, closed and open system, flow and non-flow processes, gas laws, laws of thermodynamics, internal energy. Application of first law in heating and expansion of gases in non-flow processes. First law applied to steady flow processes. Kelvin-Planck and Clausius statements. Reversible processes. Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, change of entropy of gases in thermodynamics process. Otto, diesel and dual cycles, Simple problems of these cycles. Principles of refrigeration, - units, terminology, production of low temperatures, air refrigerators working on reverse Carnot cycle and Bell Coleman cycle. Vapour

refrigeration-mechanism, P-V,P-S,P-H diagrams, vapor compression cycles, dry and wet compression, super cooling and sub cooling. Vapour absorption refrigeration system. Common refrigerants and their properties. Design calculations for refrigeration system. Cold storage plants. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process. Air conditioning – principles –Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods, fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling load calculations, types of air conditioners – applications.

### **Practical**

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

### **Suggested Readings**

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

## **FMP-2.1.6**

## **FARM POWER ENGINEERING**

**Credit – 3 (2+1)**

### **Theory**

**Principles of IC Engines:-**Introduction and classification of IC engines. Working principle of four stroke and two stroke cycle. Petrol and Diesel engines, their comparison location and function of

various parts of IC engines and material used for them. Concept of IC engine terms, bore, stroke, dead centre, crank throw, compression ratio, clearance volume, swept volume/piston displacement, total volume, engine displacement and piston speed. Calculation of IHP, BHP, FHP and engine efficiencies. Working principle of rotary (wankle) engine.

**Air Intake System:-**Components of air intake system viz. pre-air cleaner, inlet manifold, exhaust manifold, types of air cleaners: wet, dry

**Fuel System in Diesel Engine:-** Components of fuel system, description and working of fuel feed pump, types working of fuel injection pump, injector, fuel filters, complete detail and working of micro fuel injection system for a multi cylinder engine

**Cooling and Lubrication:-** Necessity of engine cooling, cooling system, their main features, thermostat, defects in cooling system and their rectification, functions of lubrication, types and properties of engine lubricants, additives for improving the properties , lubrication system of IC engine, oil pumps, oil filters, pressure relief valve, positive crank case ventilation.

**IC Engine Testing:-** Engine power, indicated and brake power, efficiency - mechanical, thermal, relative and volumetric efficiencies, methods of finding indicated and brake horse power, Morse test and heat balance sheet performance and endurance tests of IC engine specification (according To ISI). Exhaust smoke analysis and pollution control.

### **Maintenance, repair and overhaul of engines**

#### **Practical**

Identification of various types of diesel engines ;Identification of various tools used for dismantling and assembling IC engines ;Performing pre-starting checks on engine; Engine dismantling and inspection of various parts, measurements of clearances; Engine assembly and trouble shooting, Study of engine governing system, Study of valve system, Study of fuel injection equipments of multi cylinder engine, dismantling and reassembling, Study of cooling system, water pump, thermostat valve; Study of lubrication system, oil pump, oil filter. Determination of indicated power/brake power and specific fuel consumption.

#### **Suggested Readings**

- Farm Tractors by S.C. Jain and Rai; Tata Oxford Company.
- IC Engine by S.S. Thethi.
- Elements of Agricultural Engineering by Dr. JagdishwarSahay; Standard Publisher Distributors, NaiSarak, Delhi-II0006.

## **FMP-2.1.7 HEAT AND MASS TRANSFER**

**Credit – 2 (2+0)**

### **Theory**

Principles of measurement of temperature and different scales of temperature. Difference between heat and temperature on the basis of K.E. of molecules. Bimetallic and Platinum resistance thermometer: their merits and demerits. Pyrometers- Disappearing filament optical pyrometer. Modes of transfer of heat (conduction, convection and radiation with examples). Coefficient of thermal conductivity, determination of thermal conductivity of good conductor (Searle's method) and bad conductor (Lee's disc method). Properties of heat radiation. Prevost's theory of heat exchange. General differential equation of conduction. One dimensional steady state conduction through plane and composite walls, tubes and spheres with and without heat generation. Electrical analogy. Insulation materials. Fins, Free and forced convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Useful non dimensional numbers. Equation of laminar boundary layer on flat plate and in a tube. Laminar forced convection on a flat plate and in a tube. Combined free and forced convection. Introduction. Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, grey bodies and emissive power, solid angle, intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection and radiation by networks. Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Flick's law, mass transfer coefficients. Reynold's analogy.

### **Suggested Readings**

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

## **FOURTH SEMESTER**

### **REE-2.2.1 ENVIRONMENTAL SCIENCE AND CREDITS - 3 (2 + 1) DISASTER MANAGEMENT**

#### **Theory**

**Environmental Studies:-** Scope and importance. Natural Resources: Renewable and non-renewable resources. Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Ecosystems: Concept, Structure, function, Producers, consumers, decomposers, Energy flow, ecological succession, food chains, food webs, ecological pyramids. Introduction, types, characteristic features, structure and function of the forest, grassland, desert and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: definition, cause, effects and control measures of a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Social Issues and the Environment from Unsustainable to Sustainable development, Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

dies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

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

### **Practical**

Case Studies and Field work. Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural. Study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc. Expected impact of climate change on agricultural production and water resources, Mitigation Strategies, Economics of climate change. Disaster Management introduction, Natural and Manmade Disaster Studies, Informatics for Disaster Management, Quantitative Techniques for Disaster Management Environmental Impact Assessment (EIA) and Disaster Management Disaster Management Policy Environmental Modelling.

### **Suggested Readings**

- Text Book of Environmental Studies for Undergraduate Courses by Bharucha Erach. 2005. University Grants Commission, University Press, Hyderabad.
- Introduction to Environment Science by Sharma J P. 2003. Lakshmi Publications.
- Principles of Environmental Studies by Chary Manohar and Jaya Ram Reddy. 2004. BS Publishers, Hyderabad.

- Water and Waste Water Analysis by Kaul S N, AshuthoshGautam. 2002. Days Publishing House, Delhi.
- Methods in Environmental Analysis – Water. Soil and Air by Gupta P K. 2004. Agro bios, Jodhpur.
- Adaptation and mitigation of climate change-Scientific Technical Analysis Climate change.1995: Cambridge University Press, Cambridge.
- Natural Disaster. Sharma by R.K. & Sharma, G. 2005. APH Publishing Corporation, New Delhi.
- Environment and Ecology: Biodiversity, Climate Change and Disaster Management by Husain Majid. 2013. online book.

## **SWE-2.2.2            STRENGTH OF MATERIALS            Credit – 2 (1+1)**

### **Theory**

Elasticity, definition of stress and strain. Different types of modulus of elasticity. Explanation of stress - strain diagram.Slope and deflection of beams using integration techniques, moment area theorems and conjugate beam method. Vibration of cantilever and beam, determination of time period of a cantilever. Free, forced and resonant vibrations with examples. Columns and Struts. Riveted and welded connections. Stability of masonry dams. Analysis of statically intermediate beams. Propped beams. Fixed and continuous beam analysis using superposition, three moment equation and moment distribution methods.

### **Practical**

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. To perform the compression test on; Concrete cylinders & cubes, C.I., M.S. & Wood specimens and to determine various physical and mechanical properties. 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. 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. To study the behaviour of materials (G.I. pipes, M.S., C.I.) under torsion and to evaluate various elastic constants. To study load deflection and other physical properties of closely coiled helical spring in tension and compression. To perform the Rockwell, Vicker's and Brinell's Hardness tests on the given specimens. To perform the Drop Hammer Test, Izod Test and Charpy's impact tests on the given specimens. To determine compressive & tensile strength of cement after making cubes and briquettes. To measure workability of concrete (slump test, compaction factor

test). To determine voids ratio & bulk density of cement, fine aggregates and coarse aggregates. To determine fatigue strength of a given specimen. To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials.

### **Suggested Readings**

- Strength of Materials by Khurmi R.S. 2001. S. Chand & Co., Ltd., New Delhi.
  - Mechanics of Structures (Vo-I ) by Junarkar S.B. 2001. Choratar Publishing House, Anand.
  - Strengths of Materials by Ramamrutham S. 2003. DhanpatRai and Sons, NaiSarak, New Delhi.
- Strengths of Materials by R.K. Bansal, Laxmi Publications. New Delhi

## **SWE- 2.2.3      IRRIGATION TECHNOLOGY**

**Credit- 3(2+1)**

### **Theory**

**Introduction:** Irrigation, necessity of irrigation and advantages and disadvantages of irrigation. Types of irrigation viz. artificial(flow, lift etc.) and natural. Sources of irrigation water. Quality of irrigation water.

**Water Requirement of Crops:** Evaporation, measurement of evaporation by pan evaporimeter. Transpiration and transpiration ratio. Evapotranspiration or consumptive use, seasonal consumptive use, peak period consumptive use. Measurement of evapotranspiration by direct methods viz. Lysimeter experiment, Field experimental plots. Estimation of evapotranspiration from evaporation data and climatological data(introduction only). Water infiltration and determination of infiltration rate. Water requirement, net and gross irrigation requirement of crops. Irrigation frequency and irrigation period. Estimation of irrigation depth and irrigation scheduling, irrigation intensity Duty and Delta; factors affecting duty and methods of improving duty. Irrigation efficiencies- water conveyance, application, storage, distribution, water use, project, operational and economic efficiency. Uniformity coefficient.

**Water Application Methods :**Surface methods of irrigation viz. border, check basin and furrow irrigation, their basic details, characteristics, types and their adaptability. Concept of sub-surface irrigation method, its importance and adaptability. Sprinkler and Drip irrigation: their adaptability and limitations.

**Water Lifting Devices :**Introduction to various water lifting devices viz. manual, animal and power operated. Classification of pumps-positive displacement (reciprocating and rotary), variable displacement. Terms related to pumps. Principle of operation of centrifugal pumps (volute and diffuser type, single stage and multistage type). Types of impellers of centrifugal pump; Installation,

operation and maintenance of centrifugal pumps, submersible pump and vertical turbine pumps; their common troubles and remedies. Principles of operation of propeller and jet pumps, their adaptability and limitations. Criteria and procedures for selection of irrigation pumps, power requirements, efficiency and economics of irrigation pumping plants.

**Conveyance of irrigation water :**Canals and their classification (brief description only), seepage from canals and field channels. Canal lining-various types. Their advantages and disadvantages. Introduction to various water conveyance structures and their functions e.g. flumes, tunnels, inverted siphons, flexible tubing and gated pipes. Open channels, their types, layout and design parameters. Subsurface systems of water conveyance, their components, hydraulics and layout.

### **Practical**

Installation and operation of centrifugal pump; Dismantling of centrifugal pump, study of constructional feature of its component and its assembly; Installation, operation & maintenance of submersible pump. Identifying/locating the faults/troubles and remedies; Determination of infiltration rate of soil. Problems on water requirement of crops, duty, delta, base period, irrigation scheduling, irrigation efficiency, etc.

To survey market and field for the availability, adaptability and selection of various types of pumps and irrigation systems in the region; Measurement of irrigation water in the field channels with the use of Parshall flumes, H, HS, HL and weir. Design problems on lined and unlined channels. Study tours to irrigation and drainage projects.

### **Suggested Readings**

- Irrigation Engineering by M. Lal & et al.; New India Publishing House.
- Water use Efficiency in Agriculture by Giriappa; Oxford & IBH Publication Co.
- Irrigation Practice & Water Management by FAO; Oxford & IBH Publication Co.
- Irrigation Engineering by Sharma & Bari; Satya Parkashan Publishers.
- Irrigation Engineering (Vol. 1, 2, 3) by Sharma & Sharma; Oxford & IBH Publication Co.
- Irrigation Water Power & Water Resource Engineering by K. R. Arora; Standard Publication.
- Irrigation & Water Power Engineering by Dr. B.C. Punamia & et al; Laxmi Publication, New Delhi.
- Sprinkler Irrigation by Sivanappan; Oxford & IBH Publication Co.
- Water well & Pump Engineering by A.M. Michael & S.D. Khepar; Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Irrigation Theory and Practice by A.M. Michael; Vikas Publishing House, New Delhi.
- Principles of Agricultural Engineering (Vol-II) by A.M. Michael & T.P. Ojha; Jain Brothers, New Delhi.

**SWE- 2.2.4      GROUND WATER AND DRAINAGE      Credit- 3(2+1)**  
**ENGINEERING**

**Theory**

**Well Hydraulics:-** Ground water sources, types of water bearing formations( confined, unconfined aquifer etc.) aquifer characteristics influencing yield of wells. Determination of aquifer constant, specific capacity of wells. Different terms related to well hydraulic such as water tables, isobath, isobar lines , draw down. Recharge of ground water.

**Open Wells and Tube Wells:-** Types of wells, open wells, their design parameters and construction of an open well, tube wells, methods of drilling tube wells-rotary drilling, core drilling and percussion drilling. Well installation and well development-objectives and methods. Testing of tube well.

**Salt affected soils and their reclamation :-** Saline, alkaline and acid soils, Reasons and factors of their formation. Effect of salinity, alkalinity and acidity on plant growth. Reclamation of these soils and their management.

**Waterlogged soils and their drainage:-** Water logging, causes of water logging and its effects. Drainage. Types of drainage systems viz. surface and subsurface drainage. Introduction to drainage investigation. Benefits of drainage. Drainage properties of soil. Drainage coefficient. Surface drainage-functional components, types (random drain, parallel field drain, parallel open ditch and bedding system used in flat areas and cross slope ditch system used in sloping areas). Introduction to design criteria and design parameters of open ditches. Benefits of subsurface drainage. Introduction to investigations for subsurface drainage, different method of subsurface drainage viz. tile drains, mole drains, deep open drains and combination of tile and opened drains.

**Practical**

To study the rainfall measurement system . To study the types of water bearing formations. Study of different types of wells. Different methods of ground water investigation. Study of different types of screen and strainers. Determination of hydraulic conductivity under laboratory and field conditions. Determination of drainable porosity. Determination of drainage requirement. To determine leaching requirement and gypsum requirement for reclamation of saline and sodic soils. Study of different types of filters and strainers used in subsurface drainage system.

**Suggested Readings**

- Water well & Pump Engineering by A.M. Michael & S.D. Khepar; Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Irrigation Theory and Practice by A.M. Michael; Vikas Publishing House, New Delhi.

- Principles of Agricultural Engineering (Vol-II) by A.M. Michael & T.P. Ojha; Jain Brothers, New Delhi.
- Land and Water Management Engineering by V.V.N. Murthy

## **FMP-2.2.5                      THEORY OF MACHINES**

**Credit – 2 (2+0)**

### **Theory**

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, coefficient 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, iso-chronism, power and effort of a governor. Static and dynamic balancing. Balancing of rotating masses in one and different planes.

### **Suggested Readings**

- Theory of Machines by Bevan Thomas. 1984. CBS Publishers and Distributors, Delhi.
- Theory of Machines by Ballaney P L. 1985. Khanna Publishers, 2-B Nath Market, NaiSarak, New Delhi.
- Mechanisms and Machine Theory by Rao J S and Dukkipatti R V. 1990. Wiley and Sons Ltd., New Delhi.
- Theory of Mechanisms and Machines by LalJagdish. 1991. Metropolitan Book Co. Pvt.Ltd., 1 NetajiSubash Marg, New Delhi..
- Theory of Machines by Rattan S B. 1993. Tata McGraw Hill Publishing Co. Ltd., 12/4 Asaf Ali Road, New Delhi.
- Theory of Machines by Khurmi R S and Gupta J K. 1994. Eurasia Publishing House Pvt. Ltd., Ram Nagar, New Delhi.

**Theory**

**Introduction:-**Importance of farm mechanization, Classification of machinery &implements used in the farm for raising crops

**Primary Tillage Equipment :-**Introduction to various primary tillage implements used on the farm. Functions, constructional details, adjustments and study of different plough viz. mould board plough, disc plough, rotary plough (rotator) and chisel plough.

**Secondary Tillage Implements :-**Introduction to the various secondary tillage implements. Study of cultivators &harrows, their types, functions &constructional details.

**Seeding and Planting Equipment :-**Introduction to various seeding and planting machinery used for various crops. Study of components &functions of seed drills &planters; Concept of minimum tillage technology (Zerotill, striptill drill, bed planters). Calibration of seed drills and planters.

**Interculture Tools, Weeding Tools :-**Introduction to various tools used for interculture, study of their functions and constructional details. Types of sprayers and dusters, their uses and constructional details.

**Fertilizer Manure Application Equipment :-**Familiarization with the manure spreaders &granular fertilizer spreading equipment, study of their functions and importance. Study of various types of the nozzles used in the sprayers.

**Harvesting and Threshing Machinery :-** Familiarization with the harvesting machines for various crops e. g. hay harvesters, forage harvesters, vertical conveyer reapers, cotton pickers, com harvester, potato diggers, ground nut diggers.

**Constructional details &principles of working:-**Study of power thresher including axial flow thresher - main components, function and constructional details. Safety requirements in threshing operations. Introduction to combine harvesters and straw combines and study of their operation. Losses during harvesting and threshing operations and their management.

**Land Development Machinery:-**Familiarization with various land development implements e.g. leveler, planer, scraper, ridger. Study of their functions and adaptability.

**Practical**

To study the constructional features and different components of the following agricultural implements/ farm machines. Primary tillage implements: Mould board plough /Disc plough. Secondary tillage implements: Harrow/Cultivators, Rotavators. Sowing Machines: Seed Drill/Planter/Transplanter, no-till, strip-till drill, bed planter, sugarcane planters, potato-planter. Interculture equipment/tools: Wheel hand hoe/Cultivators. Harvesting Machines: Vertical Conveyer

Reaper/Mower/Potato digger/ Groundnut Digger. Threshing Machines: Wheat/paddy thresher, axial flow thresher, High capacity multicrop thresher. Seed treater, different types of sprayers and dusters.

Note: Emphasis should be laid on operation, maintenance, repair, safety and trouble shooting of farm machines and calibration of seeding machinery.

### **Suggested Readings**

- Element of Farm Machinery by AC. Srivastava and RajuPrimlari; Oxford &IBH Publishing Co. Pvt Ltd, New Delhi
- Principle of Farm Machinery by R.A. Kepner, Roy Bainer, and E.H. Barger; CBS Publishers and Distributors, Delhi
- Elements Of Agricultural Engineering Part 1 & 2 by Dr. O.P. Singhal and Naresh Chandra Aggarwal; Mumfordganj, Allahabad
- Principle of Agricultural Engineering Volume-I by A.M. Michael & T.P. Ojha; Jain brothers.
- Farm Power Machinery Volume-I by ISAE; Jain brothers
- Farm Power Machinery & Surveying by Irshad Ali ; KitabMahal, NaiSarak, Delhi
- Farm Machinery by Smith

**PFE- 2.2.7**

**POST HARVEST TECHNOLOGY**

**Credit – 3 (2+1)**

### **Theory**

**Introduction:** Introduction to post harvest technology of agricultural produce, its need, scope and Importance, Brief description and introduction to various post harvest operation such as cleaning, grading, sorting, drying, storage, milling, size reduction, expelling, extraction, blending, heat treatment, separation, material handling (transportation, conveying, elevating),washing, their functions and use in the post harvest processing

### **Drying of Cereals and Pulses:**

- i. Thermal properties - Specific heat - Thermal Conductivity - Thermal diffusivity
- ii. Theory of grain drying - Thin layer drying - Moisture content - Moisture measurement - Direct and indirect methods, Equilibrium moisture content (EMC) - Determination of EMC - EMC models - Hysteresis - Bound, unbound and free moisture, Drying curves - Constant rate period and falling rate period - Deep bed drying, Methods of grain drying - Conduction, Convection, Radiation, Dielectric, Chemical and Sack drying,

- iii. Principles of operation of different types of dryers viz. Deep bed dryers, flat bed dryers, continuous flow dryers, L.S.U. dryers, fluidized bed dryers, rotary dryer, spouted beds, tray and tunnel dryers.
- iv. Paddy and its handling - Cleaning - Drying - Cracking of paddy during drying and its prevention - Methods of paddy drying - Sun drying and mechanical drying
- v. Storage of Cereals and Pulses

**Storage of Cereals and Pulses:** Introduction, need and importance, general principles of storage, temperature and moisture changes during storage i.e. influence of moisture content, relative humidity, temperature, fungi etc. on stored product. Fungi, insect and other organism associated with stored grains. Familiarization with the various types of storage structures. Deep and shallow bins. Traditional and modern storage structures. Management of storage structures. Losses during storage and their control, space requirement of bag storage structure.

### **Post Harvest Technology of Fruit and Vegetable Processing**

- i. Production and processing scenario of Fruits and vegetables in India and world-scope of fruit and vegetable processing industry in India- present status, constraints and prospective. Factors affecting rate of dehydration Reconstitution -coefficient of rehydration.
- ii. Freezing-process, types of freezing-changes during cold storage-thawing; Canning of fruits and vegetables-process-unit operations. Hurdle concept- Intermediate moisture foods
- iii. Processing Technology of Jam – What is Jam?-Ingredients and their role in quality of Jam- Processing of Jam (flowcharts)-Tests for end point determination-Problems in Jam making.
- iv. Jelly and Marmalades – Jelly- Difference between Jam and Jelly Processing of Jelly-End point determination-Failure of Jellies to set Cloudy or foggy Jellies-Formation of crystals-Syneresis. & Marmalades-what is a marmalade-types-Jam marmalade-Jelly marmalade Problem in marmalade making.
- v. Sauces and Ketchups- what are sauces –difference between sauce and a ketchup-classification of sauces-thick and thin sauces-processing of Tomato sauce/ketchup-Preparation of soya sauce(thin sauce)-problems in making of sauces
- vi. Types of Beverages-Processing, technology of Beverages-Flow charts of Juice-examples-RTS –Nectar, cordial and Squash.
- vii. Processing technology of vegetable wafers- potato wafers- preparation types of peeling-discolorations- slicing-Drying-Frying-Salting-packing.

**Food chemistry & Food Microbiology:** Definition, Introduction, Importance and History of Food Chemistry, Water activity and sorption isotherm, Microbial spoilage of foods, Cause of spoilage

classification of foods by ease of spoilage. Factors affecting kinds and numbers of microorganisms

in food, Extrinsic factors, Intrinsic factors, Contamination of Foods. Sources of contamination, Principles of Food Preservation. Methods of Food preservation, application in food preservation

### **Practical**

1. Determination of physical properties of agricultural materials e.g. size, shape, density and angle of repose.
2. Study of operation and adjustments of air screen cleaner-cum-grader.
3. Study of operation and adjustment of specific gravity separator.
4. Study of operation and adjustment of indented cylinder separator.
5. Determination of moisture content of grains
6. Study of different types of dryers.
7. Study of domestic grain storage structures.
8. Visit to warehouses (bag storage and bulk storage structures).
9. Visit to cold-storage.
10. Study of different packaging materials.

### **Suggested Readings**

1. Post Harvest Technology of Cereal, Pulses, Oil seeds by A.Chakraverty; Oxford & IBH Publication Co.
2. Unit operation of Agro Processing Engineering by Dr.K.M. Sahay& K.K Singh; Vikas Publications.
3. Physical properties of plant and animal materials by N.N.Mohsenin, Gordon and Breach, 1970
4. Post Harvest Technology of fruits & Vegetables by Thompson; CBS Publishers and Distributors, 485 Jain Bhavan, Shandara Delhi-II 0032.
5. Post Harvest (Introduction Physiology Handling fruits & Vegetables by Wills R.B.H. etal; Oxford & IBH Publication Co.

## **REE- 2.2.8 NON-CONVENTIONAL ENERGY SOURCES      Credit – 3 (2+1)**

### **Theory**

**Introduction :**Conventional and Non conventional sources of energy. Need, importance and scope of non conventional and alternate energy resources.

**Biogas and Bio-mass :**Bio-gas, Benefits of bio-gas. Technology of biogas. Principles, feedstock, types and design of biogas plants, comparison of designs. Main parts of biogas plants, digester, gas holder, pressure gauge, gas controlling cocks and meter. Selection of biogas model and size. Site

selection of biogas plants. Appliances of biogas plant - burner, heating plate, lamps. Operation, trouble shooting and maintenance of biogas plant. Safety measures in biogas plant. Introduction to biomass and farm residue, management and briquetting.

**Wind Energy Technology :**Introduction, scope and significance. Type and constructional details of windmill - vertical and horizontal axis. Data required for windmill installation such as meteorological data, geohydrological, agricultural and socio- economic data. Site selection of windmill. Maintenance and performance of windmill.

**Solar Energy Technology :**Introduction, significance of solar energy, solar spectral and green house effect. Principles of thermal collection and storage. Comparison of flat type collector and concentration or focusing type collectors. Introduction to Spv module, its principle and applications.

**Solar Thermal Systems :** Operation, constructional details and maintenance of solar cooker, solar water heater, solar still, solar water pump, SPV system, solar crop dryer etc.

**Energy Conservation:** Principles of energy conservation. Familiarization with the different energy conservation appliances and practices, improved cooking stoves, benefits of improved cooking stoves over the traditional cooking stoves.

### **Visits**

Visits should be made to following places: Solar energy appliances manufacturing units. Energy parks/ Schools of energy at Agricultural Universities. Community/ Institutional biogas plants.

### **Practical**

Demonstration/study of solar cooker. Demonstration/study of solar water distillation. Demonstration/study of solar water heater. Demonstration/study of solar photovoltaic lighting system Demonstration/study of water pumping system. Visit to biogas plants, domestic community/institution for study and demonstration of biogas plants. Demonstration/study of the working of a windmill. Study of energy saving appliances and their applications

### **Suggested Readings**

- Advance in Biogas Technology by O.P.Chawla; Publications & Information Div. ICAR, New Delhi.
- Solar Energy by S.P. Sukhatme; Tata McGraw-hill Publishing Co. Ltd., New Delhi.
- Solar Energy Utilization by G.D. Rai; Khanna Publishers, New Delhi.
- Bio Gas Technology by K.C. Khandelwal&S.S. Mahdi; Tata McGraw-hill Publishing Co. Ltd., New Delhi.
- Biomass Energy by OECD; Oxford &IBH Publication Co.
- Wind Energy For water Pumping by Srivastava; Oxford &IBH Publication Co.
- Cook Stoves For Masses by N.S. Grewal; PAU, Ludhiana.

- Energy in Agricultural Engineering by ISAE; Jain Brothers, Delhi.
- Non Conventional Energy Sources by G.D. Rai; Khanna Publishers, New Delhi.
- Renewable & Conventional Energy by S. Rao.

## **FIFTH SEMESTER**

### **HBS – 3.1.1 ENTREPRENEURSHIP DEVELOPMENT AND      Credit -3(2+1) BUSINESS MANAGEMENT**

#### **Theory**

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

#### **Practical**

Preparation of business – Strengths Weaknesses Opportunities and Threats (SWOT) analysis, Analysis of financial statements (Balance Sheet, Profit loss statement). Compounding and

discounting, Break-even analysis Visit to agro-based industries – I, Visit to agro-based industries – II Study of Agro-industries Development Corporation , Ratio analysis – I, Ratio analysis – II, Application of project appraisal technique – I(Undiscounted measures), Application of project appraisal technique – II(Discounted Measures), Formulation of project feasibility reports – Farm Machinery Project proposals as entrepreneur – individual and group - Presentation of project proposals in the class.

### **Suggested Readings**

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

## **SWE- 3.1.2                    WATERSHED MANAGEMENT**

**Credit -3(2+1)**

### **Theory**

Watershed management - problems and prospects. Watershed based land use planning. Watershed characteristics – physical and geomorphologic, factors affecting watershed management. Hydrologic data for watershed planning. Watershed delineation, delineation of priority watershed. Water yield assessment and measurement from a watershed. Temporary structures for the control of gully erosion, their types and adaptability. Permanent soil conservation structures viz. Drop spillway, Chute spillway, Hydrologic and hydraulic design of earthen embankments and diversion structures. Drop inlet spillway for the control of erosion; their principles, adaptability, constructional features and material of construction. Introduction to the farm ponds, earthen embankments and water harvesting in relation to soil and water conservation, soil conservation through tree and grass cultivation. Concept of ground water recharge, watershed management. Sediment yield estimation

and measurement from a watershed and sediment yield models. Rainwater conservation technologies - in-situ and ex-situ, 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. Introduction and application of remote sensing and GIS in watershed management

### **Practical**

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

### **Suggested Readings**

- Hydrology and Soil Conservation Engineering, by Ghanshyam Das, PHI Learning Pvt. Ltd.
- 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 by B.D. Dhawan
- Watershed planning and management by Rajvir Singh
- Soil and water conservation engineering by Ghanshyam Das

## **FMP- 3.1.3 FARM TRACTOR SYSTEMS AND CONTROLS Credit –3 (2+1)**

### **Theory**

**Introduction:** Sources of farm power and scope of mechanization. Tractor - classification and different type of tractors and systems. Main assemblies of the tractors (Names only)

**Power Transmission System of Tractors:** Functions and various components of power train.

Clutch; functions of clutch, type of clutch(single plate, dual plate and multi plate clutch) . Gear box;

function and working of gear box, types of gear boxes (sliding, constant mesh and synchromesh gears). Differential and differential lock; function and constructional details. Final drive; reduction gear and rear axle. Power take off shaft and drive to the PTO shaft.

**Braking System:** Importance and function of brakes, various types of brakes viz. mechanical and hydraulic and their working.

**Wheels and Tyres:** Types of wheels rim and tyres used in tractors. Function of tyres. Causes of tyre wear. Need for changing the rear wheel, spacing of wheels and arrangement for the change. Wheel ballasting and methods of ballasting.

**Hydraulic System;** Principles and working of hydraulic system.

**Steering System;** Functions and components of steering systems.

**Electrical System :** components of electrical systems viz. battery, starter switch, self starter, motor, dynamo: their construction, functions, operation; maintenance and care of the battery.

**Economics:** Selection and Safety of Tractors. Various factors affecting the right selection of a tractor. Safety measures in the operation of tractor, cost analysis of use of tractors.

**Periodical Maintenance, Repair and Overhauling of Tractor.** Daily, weekly and monthly maintenance, repair and overhauling of tractor.

**Tractor Testing :** Traction, Terms related to traction- Traction efficiency, coefficient of traction, rolling resistance, slip, rim pull. Tractor testing stations, test conditions, general requirements for testing a tractor. Type of tests.

### **Practical**

Familiarization with tractors available in India; Familiarization with various tools used for dismantling and assembling of tractors and implements; Study of clutch and its components and assembly; Study of gear box, differential and final drive; Study of Brake and steering Wheel equipment-care and maintenance, fitting of wheels and adjustment of track width; Operation of hydraulics system, draft position and mix control systems; Periodical maintenance and service of tractors; Repair and overhaul of tractors; To prepare the cost estimate for repair work.

### **Suggested Readings**

- Elements of Agricultural Engineering by Dr. JagdishwarSahay; Standard Publisher Distributors, NaiSarak, Delhi-II0006.
- Farm Power Machinery & Surveying by Irshad Ali; KitabMahal, Allahabad, Surjit Book Depot P.B. No. 1425,4074-75, NaiSarak, Delhi.
- Principle of Agricultural Engineering Volume-I by A.M. Michael &T.P.Ojha;
- Jain brothers.

- Farm Machines & Equipments by C.P. Nakra; Dhanpat Rai & Sons, Nai Sarak New Delhi.
- Farm Tractors Maintenance & repairs by S.C. Jain & C.R. Rai; Tata McGraw-hill Publishing Co. Ltd., New Delhi.
- Elements of Agricultural Engineering Part 1 & 2 by Dr. O.P. Singhal and Naresh Chandra Aggarwal; Mumfordganj, Allahabad.
- Basic Farm Machinery by Shippen & Ellen; Jain brothers.
- Tractors and Their Power Units by John B. Liljedahl & *et al.* Wiley India Pvt. Ltd, New Delhi

### **PFE- 3.1.4 AGRICULTURAL PROCESS ENGINEERING Credit – 3(2+1)**

#### **Theory**

Introduction and importance of physical properties shape and size of grains, shape and size of fruits, bulk density of the grains, true density of the grains, porosity, angle of repose, test weight, Co-efficient of external friction, co-efficient of internal friction, colour of food materials, aero and hydrodynamic properties, drag coefficient and terminal velocity. Some basic concepts of rheology, rheological equations, ASTM standard.

Physical states of a material, classical ideal materials, ideal elastic behavior (Hookean body), ideal plastic behavior (St. Venant body), ideal viscous behavior (Newtonian liquid), Evaporation, boiling point elevation, types of evaporators, batch type pan evaporator, natural circulation evaporators rising film evaporator, falling film evaporator, rising and falling film evaporator, forced-circulation evaporator plate evaporator. Design of a single effect evaporator, material and energy balances, evaporator efficiency, boiling point elevation, methods of improving evaporator efficiency. Sizing of multiple effect evaporators

Introduction to heat processing - blanching, pasteurization, sterilization, Kinetics of microbial death, decimal reduction time and thermal resistance constant, process lethality

Introduction to material handling and transportation - selection of material handling machines and conveyors, belt conveyor; belt conveyor idlers, idler spacing, belt tension, Bucket elevator: head section, boot section, elevator legs, elevator belts, buckets, drive mechanism, hp requirement, Screw conveyor: screw conveyor details, various shapes of screw conveyor trough, capacity and horse power Pneumatic conveyor, limitations of pneumatic conveying, chain conveyor,

Pretreatment unit operations: cleaning, sorting: fixed aperture sorting: variable aperture screens, image processing, color sorting, weight sorting and grading, Peeling, dehulling, dehusking, Size reduction: introduction, grinding and cutting, energy used in grinding, Kick's law, Rittinger's law, Bond's law Equipment for size reduction: cutters & grinders, crushers, gyratory crusher, hammer mill, ball mill,

Separation by centrifugation and filtration, separation by expression, extraction using solvents Membrane concentration

Modern rice milling process - cleaning, dehussing, husk separation, paddy separation, polishing and grading operations and their related equipments, parboiling of paddy and its principle, methods of parboiling of paddy, malting of cereals - uses of malt

Breakfast cereal foods - flaked breakfast cereals, puffed breakfast cereals, shredded and granular breakfast cereals and cereals puffed by extrusion

Extrusion technology, principle of working, classification of extruders according to process and construction, extruded products and their processing.

### **Practical**

1. Determination of engineering properties of food materials.
2. Determination of internal and external angle of repose of food grains.
3. Determination of static angle of repose of food grains.
4. Study of Plate type of heat exchangers used in Dairy and Food Industry
5. Study of Shell and Tube type of heat exchangers used in Dairy and Food industry
6. Study of different materials handling equipments.
7. Visit to rice milling industry for the study of parboiling and rice milling equipment.
8. Visit to a Dal mill and study the operations.
9. Visit to flour mill and study of machinery and processes used in flour milling.
10. Visit to oil-mill and solvent extraction plant.

### **Suggested Readings**

1. Rice Processing Technology by Bandhyopadhyaya; Oxford & IBH Publication Co.
2. Post harvest Technology of cereal, Pulses, oil seeds by Chakraverty; Oxford & IBH Publication Co.
3. Food Processing, by Potty & Mulky; Oxford & IBH Publication Co.
4. Seed Industry in India, by Gurdev Singh; Oxford & IBH Publication Co.
5. Unit operation of Agro Processing Engineering by Dr. K.M. Sahay; Vikas Publications.
6. Principle of Agro Process Engineering, by Dr.K.M. Sahay; Vikas Publications.
7. Seed Technology by R.L. Aggarwal; Oxford & IBH Publication Co.
8. Rice Processing Technology by S. Bandyopadhyaya & N.C. Roy; Oxford
9. Food Processing Industry in India by Desai; Oxford & IBH Publication Co. Fruits
10. Vegetable Processing by Bhatti Suman; Oxford & IBH Publication Co. Drying &
11. Storage of Grains & oil Seeds by Brooker D.B.; Oxford & IBH Publication Co.

## **PFE- 3.1.5                    AGRICULTURAL STRUCTURES Credit – 3(2+1)**

### **Theory**

1. Planning and layout of farmstead.
2. Livestock production facilities, BIS. Standards for dairy, piggery, poultry and other farm structures.
3. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc.
4. Design and construction of rural grain storage system.
5. 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.
6. Estimation of power requirement for domestic and irrigation, source of power supply, use of alternate source of energy, electrification of rural housing.

### **. LIST OF PRACTICALS**

1. Design and layout of a dairy farm.
2. Design and layout of a poultry house.
3. Design and layout of a sheep/goat house.
4. Design of a biogas plant.
5. Design of ventilation system for dairy and poultry house.
6. Design of a feed/fodder storage structures
7. Familiarization with local grain storage structures
8. Moisture condensation in agricultural buildings.
9. Design of grain storage structures.
10. Cost estimation of a farm buildings

### **LIST OF BOOKS**

1. Ventilation of Agricultural Structures, By: Hellickson, M.L. and Walker, J.N.
2. Farm Structures in tropical climates. FAO., By Bengtsson, L.P.
3. Agricultural buildings and structures. National Food & Energy , By Whitaker, J.H
4. Farm buildings: From planning to completion, By Phillips, R.E.
5. Practical farm buildings: A textbook & Handbook, By Boyd, J.S.

**ELECTIVE – I                      Credit – 3(2+1)**

**ELECTIVE – II                     Credit –3(2+1)**

Electives can be selected from the courses below

<b>Sr.no</b>	<b>Courses</b>	<b>Course .no</b>	<b>credit</b>
1.	Micro Irrigation System Design	SWE – 3.1.6	3 (2 + 1)
2.	Minor Irrigation and Command area Development	SWE – 3.1.7	3 (2 + 1)
3.	Tractor Design and Testing	FMP – 3.1.8	3 (2 + 1)
4.	Farm Power and Machinery Management	FMP – 3.1.9	3 (2 + 1)
5.	Food Packaging Technology	PFE – 3.1.10	3 (2 + 1)
6.	Development of Processed Products and Equipments	PFE – 3.1.11	3 (2 + 1)
7.	Renewable Energy Technology	REE – 3.1.12	3 (2 + 1)
8.	Design and Maintenance of Greenhouse	REE – 3.1.13	3 (2 + 1)

### **SWE – 3.1.6 MICRO IRRIGATION SYSTEM DESIGN    Credit – 3(2+1)**

#### **Theory**

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. Use of AutoCAD and GPS survey in design and layout of MIS.

#### **Practical**

Study of different types of micro-irrigation systems and components. Field visit of micro-irrigation system. Study of water filtration unit; Discharge measurement study of different micro-irrigation systems. Study of water distribution and uniformity coefficient. Study of wetted front and moisture distribution under various sources of micro-irrigation system. Design of micro-irrigation system for an orchard. Design of micro-irrigation system for row crops design of spray type micro-irrigation system. Design of micro-irrigation system for hilly terraced land. Study of automation in micro-irrigation system. Study of micro climate inside a Polyhouse. Study of maintenance and cleaning of different components of various systems. Design of sprinkler irrigation system. Design of landscape irrigation system

### **Suggested Readings**

- 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

## **SWE – 3.1.7 MINOR IRRIGATION AND COMMAND AREA DEVELOPMENT      Credit –3(2+1)**

### **AREA DEVELOPMENT**

#### **Theory**

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

#### **Practical**

Topographic survey and preparation of contour map. Preparation of command area development layout plan. Land leveling design for a field. Earthwork and cost estimation. Irrigation water requirement of crops. Preparation of irrigation schedules. Planning and layout of water conveyance system. Design of Irrigation systems. Application of remote sensing for command area development. Study tour to minor irrigation and command area development projects

#### **Suggested Readings**

- Principles of farm irrigation System design by 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

### **FMP – 3.1.8 TRACTOR DESIGN AND TESTING**

**Credit – 3(2+1)**

#### **Theory**

Design and development of agricultural tractor. Study of parameters for balanced design of tractor for stability and weight distribution. Hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractor. Design of Ackerman steering and tractor hydraulic systems. Study of special design features of tractor engines and their selection. Tractor testing

#### **Practical**

Design problems of tractor clutch (single / multiple disc clutch). Design problem on spur gears and bevel gears. Design problem of helical gears. Selection of tractor tyres. Problem on design of governor and problem related to selection of hydraulic pump. Engine testing as per BIS code-various tests. Drawbar performance in the laboratory. Determining the turning space, turning radius and brake test. Hydraulic pump performance test and air cleaners and noise measurement test. Visits to tractor testing centre

#### **Suggested Readings**

- 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 by R.S. Khurmi

### **FMP – 3.1.9 FARM POWER AND MACHINERY**

**Credit – 3(2+1)**

#### **MANAGEMENT**

#### **Theory**

Role of mechanization and its relationships to productivity, employment, social and technical changes. Performance and power analysis. Cost analysis of machinery- fixed cost and variable costs, effects of inflation on cost. Selection of optimum machinery and replacement criteria. Break even point and its analysis, reliability and cash flow problems. Mechanization planning

#### **Practical**

Solving problems related to cost analysis and inflation. Solving problems related to selection of equipment / machinery. Solving problems related to replacement of machinery / equipment. Role of

time value of money. Seminar on the topic on farm machinery management. Design of farm mechanization plan for different farm size and cropping pattern

### **Suggested Readings**

- 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 byCuplin C. and Claude S.

## **APE – 3.1.10 FOOD PACKAGING TECHNOLOGY**

**Credit – 3(2+1)**

### **Theory**

Objectives of packaging and its utility. 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. Packaging aspect of Modified Atmospheric packaging(MAP) and Controlled atmospheric packaging(CAP). Different types of packaging materials used. Different forms of packaging, metal container, glass container, plastic container, flexible films, shrink and steam 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 and labeling. Economics of packaging. Performance evaluation of different methods of packaging food products; their merits and demerits; scope for improvements. Disposal and recycling of packaging waste.

### **Practical**

Identification of different types of packaging materials. Determination of tensile strength of given material. Determination of compressive strength of given package. Vacuum packaging of agricultural produces. Determination of tearing strength of paper board. Measurement of thickness of packaging materials. To perform grease-resistance test of packaging materials. Determination of bursting strength of packaging material. Determination of water-vapour transmission rate & Oxygen transmission rate. Shrink wrapping of various horticultural produce. Testing of chemical resistance of packaging materials. Determination of drop test of food package. Visit to relevant industries.

### **Suggested Readings**

- Handling and storage of food grains in tropical and subtropical 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.

### **APE–3.1.11 DEVELOPMENT OF PROCESSED PRODUCTS & EQUIPMENTS**

**Credit –3(2+1)**

#### **Theory**

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. Fruits and vegetables product: candy, nutraceuticals, snack foods. Food product development trends. Food additives and labeling. Process equipment for thermal processing-evaporation, dehydration, drying, blanching, Pasteurization, distillation. Process equipment for mechanical separation-filtration, sieving, centrifugation, sedimentation. Process equipment for mechanical handling-conveying and elevation; size reduction and classification-mixing; kneading, blending.

#### **Practical**

Working principle and operation of Engleberg huller. Study of different cleaners and graders used in agro processing industries. Working principle, operation and maintenance of paddy destoner-cum-cleaner, rubber roll sheller, paddy separator and vertical cone whitener. Planning and layout of roller wheat flour milling & rice milling. Visit to milk plant. Visit to roller flour mill. Visit to fruit/vegetable processing plants. Flow process diagram and study of various models of the machines used in a sugar mill

#### **Suggested Readings**

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

## **REE – 3.1.12 RENEWABLE ENERGY TECHNOLOGY Credit – 3 (2+1)**

### **Theory**

Design and operational parameters of non-conventional devices, performance evaluation and maintenance aspects of gasifiers, performance evaluation and maintenance aspects of biogas plants, Performance evaluation and maintenance aspects of solar passive heating devices, Performance evaluation and maintenance aspects of photovoltaic cells and arrays, Performance evaluation and maintenance aspects of briquetting machines and balers, Utilization of bio-fuels in CI engines.

### **Practical**

Performance evaluation of solar water heater, Performance evaluation of solar cooker, Characteristics of solar photovoltaic panel, Evaluation of solar air heater, Performance evaluation of a fixed dome type biogas plant, Performance evaluation of floating drum type biogas plant, Estimation of calorific value of producer gas, Testing of diesel engine operation using biodiesel, Performance evaluation of different biomass briquette.

### **Suggested Readings**

- 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.

## **REE -3.1.13 DESIGN AND MAINTENANCE OF GREENHOUSE Credit - 3 (2+1)**

### **Theory**

History and types of greenhouse, Function and features of greenhouse , Scope and development of greenhouse technology, Location, planning and various components of greenhouse, Design criteria and calculations, Construction materials and methods of construction, Covering material and characteristics, Solar heat transfer, Solar fraction for greenhouse, Steady state analysis of

greenhouse, Greenhouse heating, cooling, shedding and ventilation system, Carbon dioxide generation and monitoring and lighting systems , Instrumentation and & computerized environmental control systems, Watering, fertilization, root substrate and pasteurization, Containers and benches, Plant nutrition, Alternative cropping systems, Plant tissue culture.

Chemical growth regulation, Disease control, integrated pest management, Post production quality and handling, Cost analysis of greenhouse production, Application of greenhouse & its repair & maintenance.

### **Practical**

Study / visit to a functional green house, Material selection for the construction of green house, Economic analysis of green house; Visit to a commercial green house, Measurement of humidity & air velocity using various methods, Measurement of solar radiations inside the green house, Application of psychometric charts; estimation of cooling requirements in a green house; estimation of ventilation requirements, Thermal performance of green house, Calculations of environment indices inside a green house, Structural analysis of green house

### **Suggested Readings**

- 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 Radhamaoahar
- Greenhouse Technology by Tiwari G.N. and Goyal

\*Study tour of 1 week within the state is proposed during the 5<sup>th</sup> semester as Non-Credit course

## SIXTH SEMESTER

### **ITP- 3.2.1 INDUSTRIAL TRAINING CUM Credit – (0+18) PROJECT WORK**

Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Sr. No.	Perfonnance criteria	Max. marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of proiect assignment	10	10	8	6	4	2
2.	Planning and execution of considerations	10	10	8	6	4	2
3.	Quality of perfonnance	20	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20	20	16	12	8	4
5.	Sense of responsibility	10	10	8	6	4	2
6.	Self expression! communication skills	5	5	4	3	2	1
7.	Interpersonal skills/human relations	5	5	4	3	2	1
8.	Report writing skills	10	10	8	6	4	2
9.	Viva voce	10	10	8	6	4	2
Total marks		100	100	80	60	40	20

Each teacher is expected to guide the project work of 5-6 students.

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

	Range of maximum marks	Overall Grade
I	More than 80	Excellent
II	79 > 65	Very good
III	64 > 50	Good
IV	49 > 40	Fair
V	Less than 40	Poor

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented professional training in the same industry and re-evaluated before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

#### Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.
2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.
3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.
4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.