POLYTECHNIC IN AGRICULTURAL ENGINEERING,
ANAND AGRICULTURAL UNIVERSITY,
MUVALIYA FARM, DAHOD-389160

COURSE CURRICULAM

APPENDIX-II

Semester I - Existing		
Course Code	**Course Title**	**Credits (T+P=T)**
HBS-1.1.1	English	1+1*=02
HBS-1.1.2	Applied Mathematics	4+0=04
HBS-1.1.3	Applied Physics	2+1=03
HBS-1.1.4	Engineering Chemistry	2+1=03
AGS-1.1.5	Agriculture For Engineers	3+1=04
FMP-1.1.6	Workshop Practice	0+1=01
REE-1.1.7	Environmental Science	3+0=03
	NSS/NCC/Phy. Edu. (Non-Credit)	
	Total Credits	15+5=**20**

Semester I – Revised Proposed		
Course Code	**Course Title**	**Credits (T+P=T)**
HBS-1.1.1	English	1+1*=02
HBS-1.1.2	Applied Mathematics	4+0=04
HBS-1.1.3	Applied Physics	2+1=03
HBS-1.1.4	Applied Chemistry	1+1=02
AGS-1.1.5	Soil Science & Agriculture For Engineers	2+1=03
FMP-1.1.6	Workshop Technology and Practice	1+2=03
FMP-1.1.7	Engineering Drawing	0+2=02
	NSS/NCC/Phy. Edu. (Non-Credit)	
	Total Credits	11+8=**19**

Semester II - Existing		
Course Code	**Course Title**	**Credits (T+P=T)**
HBS-1.2.1	Communication Skills	2+0=02
HBS-1.2.2	Engineering Mathematics - I	2+1*=03
FMP-1.2.3	Engineering Drawing	0+2=02
FMP-1.2.4	Engineering Mechanics	2+1=03
SWE-1.2.5	Surveying and Leveling	1+2=03
HBS-1.2.6	Engineering Physics	2+1=03
REE-1.2.7	Basics of Electrical Engineering	2+2=04
	NSS/NCC/Phy. Edu. (Non-Credit)	
	Total Credits	11+9=**20**

Semester II – Revised Proposed		
Course Code	**Course Title**	**Credits (T+P=T)**
HBS-1.2.1	Communication Skills	2+0=02
HBS-1.2.2	Engineering Mathematics - I	2+1*=03
HBS-1.2.3	Engineering Chemistry	2+1=03
HBS-1.2.4	Engineering Physics	2+1=03
SWE-1.2.5	Surveying and Leveling	1+2=03
FMP-1.2.6	Engineering Mechanics	2+1=03
REE-1.2.7	Basics of Electrical Engineering and Electric circuits	3+1=04
	NSS/NCC/Phy. Edu. (Non-Credit)	
	**Skill Development Training –I (Non-Credit)	
	Total Credits	14+7=**21**

**** Tutorial***

***** Summer training at the end of Second Semester is proposed for skill development in handling, minor repairs and maintenance of different equipments***

Semester III – Existing		
Course Code	**Course Title**	**Credits (T+P=T)**
HBS-2.1.1	Engineering Mathematics - II	2+1*=03
SWE-2.1.2	Water Resources Engineering	2+1=03
HBS-2.1.3	Computers Programming and Data Structures	1+2=03
FMP-2.1.4	Thermodynamics and Heat Engines	3+1=04
SWE-2.1.5	Soil and Water Conservation Engineering	2+1=03
REE-2.1.6	Electrical Circuits	2+1=03
FMP-2.1.7	Farm Power Engineering	2+1=03
	NSS/NCC/Phy. Edu. (Non-Credit)	
	Total Credits	14+8=**22**

Semester III – Revised Proposed		
Course Code	**Course Title**	**Credits (T+P=T)**
HBS-2.1.1	Engineering Mathematics - II	2+1*=03
HBS -2.1.2	Introduction to computer Web Designing and Internet Applications	1+1=02
SWE -2.1.3	Fluid Mechanics and Open Channel Hydraulics	2+1=03
SWE -2.1.4	Hydrology & Soil and Water Conservation Engg.	2+1=03
FMP -2.1.5	Thermodynamics, Refrigeration and Air Conditioning	2+1=03
FMP -2.1.6	Farm Power Engineering	2+1=03
FMP-2.1.7	Heat and Mass Transfer	2+0=02
	NSS/NCC/Phy. Edu. (Non-Credit)	
	Total Credits	13+6=**19**

Semester IV - Existing		
Course Code	**Course Title**	**Credits (T+P=T)**
FMP-2.2.1	Farm Machinery and Implements	3+1=04
REE-2.2.2	Non Conventional Energy Sources	2+1=03
APE-2.2.3	Post Harvest Technology	3+1=04
REE-2.2.4	Applied Electronics and Instrumentation	2+1=03
FMP-2.2.5	Workshop Technology	
SWE-2.2.6	Irrigation Technology	2+1=03
FMP-2.2.7	Machine Drawing	3+1=04
	NSS/NCC/Phy. Edu. (Non-Credit)	0+2=02
	Total Credits	15+8=23

Semester IV – Revised Proposed		
Course Code`	**Course Title**	**Credits (T+P=T)**
HBS -2.2.1	Environmental Science & Disaster Management	2+1=03
SWE-2.2.2	Strength of Materials	1+1=02
SWE-2.2.3	Irrigation Technology	2+1=03
SWE-2.2.4	Ground Water and Drainage Engineering	2+1=03
FMP-2.2.5	Theory of Machines	2+0=02
FMP-2.2.6	Farm Machinery and Implements	2+1=03
PFE-2.27	Post Harvest Technology	2+1=03
REE-2.2.8	Non Conventional Energy Sources	2+1=03
	NSS/NCC/Phy. Edu. (Non-Credit)	
	**Skill Development Training –II (Non-Credit)	
	Total Credits	15+7=**22**

**** Tutorial***

***** Summer training at the end of Second Semester is proposed for skill development in handling, minor repairs and maintenance of different equipments***

Semester V - Existing		
Course Code	**Course Title**	**Credits (T+P=T)**
FMP-3.1.1	Farm Tractor Systems and Controls	2+2=4
APE-3.1.2	Agricultural Process Engineering	2+2=4
HBS-3.1.3	Entrepreneurship Development & Management	3+0=3
SWE-3.1.4	Watershed Management	2+1=3
APE-3.1.5	Agricultural Structures	2+1=3
	Elective - I	2+1=3
	Elective - II	2+1=3
	NSS/NCC/Phy. Edu. (Non-Credit)	
	Total Credits	**15+8=23**
**** Tutorial***		

Semester V – Revised Proposed		
Course Code	**Course Title**	**Credits (T+P=T)**
HBS-3.1.1	Entrepreneurship Development & Business Management	2+1=03
SWE -3.1.2	Watershed Management	2+1=03
FMP-3.1.3	Farm Tractor Systems and Controls	2+1=03
PFE -3.1.4	Agricultural Process Engineering	2+1=03
PFE -3.1.5	Agricultural Structures	2+1=03
	Elective - I	2+1=03
	Elective - II	2+1=03
	Study tour (Non-Credit)	
	Total Credits	**14+7=21**

Semester VI - Existing		
Course Code	**Course Title**	**Credits (T+P=T)**
ITP-3.2.1	Industrial Training cum Project Work	0+18=18
	NSS/NCC/Phy. Edu. (Non-Credit)	
	Total Credits	**18**
	Grand Total	**126**

Semester VI – Revised Proposed		
Course Code	**Course Title**	**Credits (T+P=T)**
ITP-3.2.1	Industrial Training cum Project Work	0+18=18
	Total Credits	**18**
	Grand Total	**120**

Appendix – III

FIRST SEMESTER

HBS-1.1.1 ENGLISH Credits - 2 (1 + 1)

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, Entrepreneurship.

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

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

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 FraidaDubin& 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.

HBS-1.1.2 APPLIED MATHEMATICS Credits - 4 (4 + 0)

Theory

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

2. Co-ordinate Geometry:

   2.1 Point& Triangle: Distance formula, Mid-point, Area and Centroid of a triangle, Locus of a point

   2.2 Straight Line : Forms of equation of straightlines : Slope point form, Two point form, Intercept form, Parallel and Perpendicular lines

   2.3 Circle: Equation of Circle, Centre and radius form, Tangent and Normal and related problems.

3. **Limit:** Concept of limit, Standard formulae & working rules of limitsand related example

4. **Permutations and Combinations:** Value of ${}_nP_r$ and ${}_nC_r$, its properties and simple problems

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

6. **Logarithm:**General properties& Rules of logarithms, Calculations of engineering problems using logtables

7. **Trigonometry:**Units of angles (degree and radian), Allied & Compound angles, Addition and Subtraction formulae, Multiple and Sub-multiple angles, Graph of Sine andCosine, Periodic function, Sum and Factor formulae, Inverse trigonometric function, Solution of triangles.

8. **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.

RECOMMENDED BOOKS

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 EaglePrakashan, 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^{th} and 12^{th} science Mathematics book

HBS-1.1.3 APPLIEDPHYSICS `Credit – 3 (2+1)

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,

Semiconductor Physics: Introduction, Resistivity, Resistivity of Conductors, Insulators and Semiconductor (At Room , Temperature), Energy Level in Atom, Band Diagram, Valance Band, Conduction Band, Energy Band Gap, Conductors, Insulator and Semiconductors (A Band Picture), Covalent, Trivalent, Pentavalent Bond, Concept of Hole, Types of Semiconductors (Intrinsic Semiconductors, Extrinsic Semiconductors), N and P types Semiconductors (Extrinsic Semiconductors), P – N Junction Diode, Static Characteristics of PN Junction Diode, Forward Bias, Reverse Bias, Special types of PN junction Diode, Zener Diode, LED (Light Emitting Diode).

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

Suggested Readings

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

HBS 1.1.4 APPLIED CHEMISTRY Credit – 2 (1+1)

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 : Avogadro's law and Avogadro number, percentage composition, empirical and molecular formula, chemical reactions.

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. Deviation from ideal behaviour, liquefaction of gases. Critical temperature. Kinetic energy and molecular speeds (elementary idea) 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, Heisenberg's uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals – Aufbau principle, Pauli's exclusion principle $n+l$ Law and Hund's rule, electronic configuration of atoms, stability of half filled and completely filled orbitals.

Unit 4: Periodic table Significance of classification, brief history of the development of periodic table, modern periodic law and present form of periodic table, periodic trends in properties of elements atomic radii, ionic radii. Inert gas radii nomenclature of elements with atomic number greater than 100.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: enzyme catalysis; colloidal state : distinction between true solutions, colloids and suspensions; Lyophilic, Lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation; emulsion – types of emulsions. Elementary idea of nanomaterials.

Unit 8: Nature of chemical bond Valence electrons, ionic bond, Born Haber cycle : covalent bond parameters. Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence 158 bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization involving s, p and d orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules (qualitative idea only), hydrogen bond.

Practical

1. Determination of melting point of an organic compound. (p-toludine, naphthalene, oxalic acid, β-naphthol, resorcinol, benzoic acid.)
2. Determination of boiling point of an organic compound. (acetone, methyl acetate, acetic acid, xylene (o,m,p), water)
3. Crystallization of impure sample of any one of the following compounds. Alum, copper sulphate, benzoic acid.
4. Determination of pH of some solutions obtained from fruit juices, varied concentrations of acids, bases and salts using pH paper or universal indicator.
5. Study the pH change in the titration of a strong base using universal indicator.
6. Study of pH change by common ion effect in case of weak acids and bases.
7. Determine the strength of a given solution of sodium hydroxide with the help of a standard solution of oxalic acid
8. Checking the bacterial contamination in drinking water by testing sulphide ion.
9. Investigation of the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on them.
10. Study of the acidity of different samples of the tea leaves.
11. Determination of the rate of evaporation of different liquids.
12. 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

AGS-1.1.5 SOIL SCIENCE &AGRICULTURE FOR ENGINEERS Credits -3 (2 + 1)

Theory

Soils: Nature and origin of soil; soil forming rocks and minerals, their classification and composition, soil forming processes, classification of soils – soil taxonomy orders; important soil physical properties; and their importance; soil particle distribution; soil texture, soil structure, soil as a 3-phase system, bulk density, particle density, moisture content, porosity, degree of saturation, moisture holding capacity, soil water movement, saturated and unsaturated flow. Soil organic matter – its composition and decomposition, effect on soil fertility; soil reaction – acid, saline and sodicsoils; quality or irrigation water; essential plants nutrients – their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils.

Agronomy : Definition and scope of agronomy. Classification of crops, Effect of different weather parameters on crop growth and development. Principles of tillage, tilth and its characteristics. Soil water plant relationship and water requirement of crops, weeds and their control, crop rotation, cropping systems, Relay cropping and mixed cropping.

Horticulture: Scope of horticultural and vegetable crops. Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties, Criteria for site selection, layout and planting methods, nursery raising, macro and micro propagation methods, plant growing structures, pruning and training, fertilizer application, fertigation, irrigation methods,harvesting, grading and packaging, post-harvest practices, Garden tools, management of orchard, Extraction and storage of vegetables seeds.

Practical

Identification of rocks and minerals; Examination of soil profile in the field; Collection of Soil Sample; Determination of moisture content, bulk density; particle density and porosity of soil; siol texture and particle size distribution. Determination of organic carbon of soil; Determination of Nitrogen, Determination of Phosphorus and Determination of Potassium; Determination of EC, pH, ESP, SAR, RSC. Identification of nutrient deficiency symptoms of crops in the field.

Identification of crops and their varieties seeds and weeds; Fertilizer application methods; Different weed control methods; Judging maturity time for harvesting of crop; Study of seed viability and germination test.

Identification and description of important fruit; flowers and vegetables crops; Study of different garden tools; Preparation of nursery bed; Practices of pruning and training in some important fruit crops.

Suggested Readings

- Nature and properties of soils by Brady Nyle C and Ray R Well. 2002. Pearson Education Inc., New Delhi.
- Fundamentals of Soil Science. Indian Society of Soil Science. 1998. IARI, New Delhi.
- A. Textbook of Pedology Concepts and Applications by Sehgal J. Kalyani Publishers, New Delhi.
- Introduction to Soil Physics by Hillel D. 1982. Academic Press, London.
- Chemistry of Soil by E.E. Bear
- Principles of Agronomy by T. Y. Reddy and G. H. Shankara Reddy, Kalyani Publishers, Ludhiana
- Fundamentals of Agronomy by Rajat D.
- Principles and Practices of Agronomy by S. S. Singh
- Introductuion of Agronomy by V. W. Vaidya and K. R. Shahastrabudhe
- Principles of Horticulture by Prasad and Kumar
- Principles of Horticulture by Denison
- Horticultural Science by J Janick
- Plant Propagation : Principles and Practices by Hartmen and Kester

FMP-1.1.6 WORKSHOP TECHNOLOGY AND PRACTICE Credit- 3 (1+2)

Theory

Introduction to various carpentry tools, materials, types of wood and their characteristics and Processes or operations in wood working; Introduction to Smithy tools and operations; Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Casting processes; Classification, constructional details of center lathe, Main accessories and attachments. Main operations and tools used on center lathes. Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations. Types of drilling machines. Constructional details of pillar types and radial drilling machines. Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine.

Practical

Preparation of simple joints: Cross half Lap joint and T-Halving joint; Preparation of Dovetail joint, Mortise and tenor joint; Jobs on Bending, shaping etc.; Jobs on Drawing, Punching, Rivetting. Introduction to tools and measuring instruments for fitting; Jobs on sawing, filing and right angle fitting of MS Flat; Practical in more complex fitting job; Operations of drilling,, reaming, and threading with tap and dies; Introduction to tools and operations in sheet metal work; Making different types of sheet metal joints using G.I. sheets. Introduction to welding equipment, processes tools, their use and precautions; Jobs on ARC welding – Lap joint, butt joint; T-Joint and corner joint in Arc welding; Gas welding Practice – Lab, butt and T-Joints; Introduction to metal casting equipment, tools and their use; Mould making using one-piece pattern and two pieces pattern; Demonstration of mould making using sweep pattern, and match plate patterns; Introduction to machine shop machines and tools; Demonstration on Processes in machining and use of measuring instruments; Practical jobs on simple turning, step turning; Practical job on taper turning, drilling and threading; Operations on shaper and planer, changing a round MS rod into square section on a shaper; Demonstration of important operations on a milling machine, making a plot, gear tooth forming and indexing; Any additional job.

Suggested Readings

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

FMP- 1.1.7 ENGINEERING DRAWING Credit – 2 (0+2)

Practical

Introduction of drawing scales; First and third angle methods of projection. Principles of orthographic projections; References planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines; Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids.

Preparation of working drawing from models and isometric views. Drawing of missing views. Different methods of dimensioning. Concept of sectioning. Revolved and oblique sections. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints. Nomenclature, thread profiles, multi start threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts. Forms of screw threads, representation of threads, Bolts- headed centre, stud screws, set screws, butt, hexagonal and square; keys- types, taper, rank taper, hollow saddle etc.

Suggested Readings

- Elementary Engineering Drawing by Bhat N D. 2010. Charotar Publishing House Pvt. Ltd., Anand.
- Machine Drawing by Bhatt N D and Panchal V M. 2013. Charotar Publishing House Pvt. Ltd., Anand.
- Machine Drawing by Narayana K L and Kannaiah P. 2010. Scitech Publications (India) Pvt. Ltd., Chennai.
- A text book of Engineering Drawing by K Venkata Reddy, BS Publications Hyderabad.

SECOND SEMESTER

HBS-1.2.1 COMMUNICATION SKILLS Credits - 2 (2 + 0)

Theory

Communication Techniques:-Importance of communication. Process of communication. Types of communication -verbal and non-verbal. Flow of Communication- horizontal, vertical, upward, downward. Essentials of good communication. Level of communication. Presentation Techniques using audio visual aids. Listening skill

Composition:-Unseen passage Comprehension. Newspaper Report Comprehension. Advertisement Comprehension. Précis/ summary Writing. Report Writing. Business Letter Writing. Writing an Application for Job.

Grammar:-Number(Conversion into plural in sentences). Transformation of sentences. Answering the Verbal Questions in Affirmative and Negative. Changing into negative without changing the meaning. Idioms and phrases.

Suggested Readings

- Technical Communication for GTU by Meenakshi Raman, Sangeeta Sharma, Oxford University Press-New Delhi
- Essentials of Business Communication by Pal and Rorualling; Sultan Chand and Sons
- The Essence of Effective Communication, Ludlow and Panthon; Prentice Hall of India
- New Design English Grammar, Reading and Writing Skills by AL Kohli (Course A and course B), Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,
- New Design English Reading and Advanced Writing Skills for Class XI and XII by MK Kohli and AL Kohli; Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,
- A Practical English Grammar by Thomson and Marlinet
- Spoken English by V Sasikumar and PV Dhamija; Tata McGraw Hill
- English Conversation Practice by Grount Taylor; Tata McGraw Hill
- Developing Communication Skills by Krishna Mohan and MeeraBanerji; MacMillan India Ltd., Delhi
- Business Correspondence and Report Writing by RC Sharma and Krishna Mohan; Tata McGraw Hill Publishing Company Ltd. New Delhi
- Communication Skills by Ms. R Datta Roy and KK Dhir, Vishal Publication, Jalandhar

HBS-1.2.2 ENGINEERING MATHEMATICS -I Credits - 3 (2 + 1*)

Theory

1. **Determinants and Matrices**: Expansion of determinants (upto third order) usingSarrus rule, Expansion method and pivotal's condensation method. Properties of determinants, Solution of equations (upto 3 unknowns) by Cramer's rule. Definition of matrix, addition, subtraction and multiplication of matrices (upto third order). Inverse of a matrix by adjoint method, Solution of equations (up to 3 unknowns) by Matrix method

2. **Differentiation:**Definition, Rules of Sum, Product& Quotient of Functions, Chain Rule, Derivative of Implicit functions and Parametric functions, Logarithmic differentiation. Successive differentiation up to second order, Examplerelated application of derivatives.

3. **Integration and Integral calculus**: Concept, Integral ofstandard 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 revoluation curves.

4. **Vectorsand vector calculus:**Definition of vector and scalar quantities. Addition and substraction 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, Differentiation of vectors, scalar and vector point functions,Gradient of a scalar point function, Divergence and Curl of a vector point function, Integration of vector function (Line, Surface and Volume integrals)

RECOMMENDED BOOKS

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

HBS-1.2.3 ENGINEERING CHEMISTRY Credits - 3 (2 + 1)

Theory

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

Practical

Determination of temporary and permanent hardness of water by EDTA method. Estimation of chloride in water: Estimation of dissolved oxygen in water. Determination of BOD in water sample: Determination of COD in water sample. Estimation of available chlorine in bleaching powder. Determination of viscosity of oil. Estimation of activity of water sample. Estimation of alkalinity of water sample. Determination of carbonate and non- carbonate hardness by soda reagent. Determination of coagulation of water and chloride ion content. Determination of specific rotation of an optically active compound. Determination of Xnax and verification of Beer Lambert Law. Determination of calorific value of fuel. Identification of functional groups (alcohol, aldelyde, ketones, carboxylic acid and amide) by IR. Chromatographic analysis. Determination of molar refraction of organic compounds.

Suggested Readings

- Engineering Chemistry by Jain P L and Jain M. 1994. DanpatRai publishing company Pvt. Ltd., Delhi.
- Essentials of Physical Chemistry by Bahl B S, ArunBahl and Tuli B.D. 2007. S. Chand and Co. Ltd., Delhi.

HBS-1.2.4 ENGINEERING PHYSICS Credit – 3 (2+1)

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 T_c superconductors. Spontaneous and stimulated emission, Einstein A and B coefficients. Population inversion, He-Ne and Ruby lasers. Ammonia and Ruby masers, Holography-Note. Optical fiber. Physical structure. basic theory. Mode type, input output characteristics of optical fiber and applications. Illumination: laws of illumination, luminous flux, luminous intensity, candle power, brightness.

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'sbridge.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

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

SWE-1.2.5 SURVEYING AND LEVELLING Credit – 3 (1+2)

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, Leveling difficulties and error in leveling, 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

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

FMP-1.2.6 ENGINEERING MECHANICS Credit – 3 (2+1)

Theory

Basic concepts of Engineering Mechanics. Force systems, Centroid, Moment of inertia, Free body diagram and equilibrium of forces. Frictional forces, Analysis of simple framed structures using methods of joints, methods of sections and graphical method. Simple stresses. Shear force and bending moment diagrams. Stresses in beams. Torsion. Analysis of plane and complex stresses.

Practical

Problems on composition and resolution of forces, moments of a force, couples, transmission of a couple, resolution of a force into a force & a couple; Problems relating to resultant of; Co-planer force system, collinear force system, concurrent force system, co-planer concurrent force system, co-planer non-concurrent force system, Non-coplaner concurrent force system, Non-coplaner non-concurrent force system, system of couples in space; Problems relating to centroids of composite areas; Problems on moment of inertia, polar moment of inertia, radius of gyration, polar radius of gyration of composite areas; Equilibrium of concurrent – co-planer and non concurrent – co-planer force systems; Problems involving frictional forces; Analysis of simple trusses by method of joints

and method of sections; Analysis of simple trusses by graphical method; Problems relating to simple stresses and strains; Problems on shear force and bending moment diagrams; Problems relating to stresses in beams; Problems on torsion of shafts; Analysis of plane and complex stresses.

Suggested Readings

- Engineering Mechanics and Dynamics by Sundarajan V 2002. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Engineering Mechanics by Timoshenko S and Young D H 2003. McGraw Hill Book Co., New Delhi.
- Applied Mechanics by Prasad I B 2004. Khanna Publishers, New Delhi.
- Applied Mechanics and Strength of Materials by Prasad I B 2004. Khanna Publishers, New Delhi.
- A Text Book of Engineering Mechanics by Bansal R K 2005. Laxmi Publishers, New Delhi

REE- 1.2.7 BASICS OF ELECTRICAL ENGINEERING Credit–4 (3+1) &ELECTRICAL CIRCUITS

Theory

Application and Advantage of Electricity: Difference between AC and DC, various applications of electricity, advantages of electrical energy over other types of energy

Basic Quantities of Electricity : Definition of voltages, current, power and energy with their units, name of instruments used for measuring above quantities, connection of these instruments in an electric circuit, Sinusoidal steady state response of circuits, Instantaneous and average power, power factor, reactive and apparent power, Concept and analysis of balanced polyphase circuits

Domestic Installation : Distinction between light and fan circuits and single phase power circuit, subcircuits, various accessories and parts of electrical installation. Identification of wiring systems. Common safety measures and earthing

Electric Motor: Definition and various applications of single-phase and three-phase motors. Connection and starting of three-phase induction motors by star-delta starter. Changing direction of rotation of a given 3 phase induction motor

Electrical Safety: Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application, concept of earthing and various types of earthing, applications of MCBs and ELCBs

Practical

1. Connection of a three-phase motor and starter with fuses and reversing of direction of rotation
2. Connection of a single-phase induction motor with supply and reversing of its direction of rotation
3. Charging of a lead - acid battery
4. Troubleshooting in domestic wiring system
5. Connection and reading of an electric energy meter
6. Study of a distribution board for domestic installation
7. Use of ammeter, voltmeter, wattmeter, energy meter and multi-meter
8. Ohm's Law verification
8. Study of different types of fuses
9. Study of earthing practices

Suggested Readings

1. Basic Electrical Engineering by PS Dhonga1; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; SatyaPrakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi
7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi

THIRD SEMESTER

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

Theory

Course content :

Differential calculus: Taylor's and Maclaurin's expansions; indeterminate form; function of two or more independent variables, Partial differentiation, Homogeneous functions and Euler's theorem, Composite functions, Total derivatives, Change of variables, Jacobians, error evaluation, Maxima and Minima.

Ordinary Differential equations: Formation of 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,Differentialequations of higher order.

Partial Differential Equations: Formation of partial differential equations, Lagrange's linear equation, Solution of non-linear partial differential equations, Charpit's method

Matrices: Elementary transformation, Rank of a matrix, Reduction to normal form, Gauss-Jordon method to find inverse of a matrix, Consistency and solution of linear equations, Eigen values and eigen vectors, Linear transformation,Cayley-Hamilton theorem.

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

Fourier Series: Infinite series and its convergence, Periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, Functions having arbitrary period, Even and odd functions, Half range series, Harmonic analysis.

Reference Books

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

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 CONSERVATION ENGINEERING Credit – 3 (2+1)

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-arial 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 GlenniO.Schwav, 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.
- Hydraology: 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 AND AIR CONDITIONING Credit – 3 (2+1)

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 Claussius 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. DhanpetRai and Sons, 1682 NaiSarak, 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. DhanpatRai and Sons 1682 NaiSarak, 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 Raod, 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-ll0006.

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 DISASTER MANAGEMENT Credits - 3 (2 + 1)

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-sports 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 BharuchaErach. 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 Charpay'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; SatyaParkashan Publishers.
- Irrigation Engineering (Vol. 1, 2, 3) by Sharma &Sharma; Oxford &ffiH 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 ENGINEERING Credit- 3(2+1)

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.

FMP- 2.2.6 FARM MACHINERY AND IMPLEMENTS Credit – 3 (2+1)

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 modem 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 te**c**hnology 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 meterological 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 Spy 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 photovoltic 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 BUSINESS MANAGEMENT Credit -3(2+1)

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. byOmri Rawlins, N. 1980. Prentice Hall Inc., New Jersey
- Economic Analysis of Agricultural Projects. byGittenger 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 Saddal Rover, 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 CONTOLS 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-ll0006.
- 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; DhanpatRai&Sons ,NaiSarak 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 Shiphen& 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, dehusking, 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. Princple 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&ffiH 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&ffiH 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

Sr.no	Courses	Course .no	credit
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 – 3.1.6MICRO 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 SMagar
- 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 Operationby D. Karmeli, G. Peri and M. Todes

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

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 Managementby B.D. Dhawan
- Irrigation System : Design and Operationby D. Karmeli, G. Peri and M. Todes

FMP – 3.1.8TRACTOR 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 agriculturaltractor. 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 – 3.1.9FARM POWER AND MACHINERY MANAGEMENT Credit – 3(2+1)

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 suntropical areas by Hall, C. W.

- Preservation and storage of grains, seeds and their by-products by Multon J.L.
- Food packaging materials by Mahadeviah, M. and R. V .Gowramma.
- Post harvest physiology, handling and utilization of tropical and sub tropical fruits and vegetables by Pantastico, E.C.B.
- Agricultural process engineering byHanderson, S. and Perry, S.M.
- Post harvest handling-A systems approach byShewfelt, 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, blenching, 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 bySahay, 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. byDuffie J.A. and Beckman W.A.
- Greenhouse Advanced Technology by Hanan
- Greenhouse Operation & Management. by Nelson P.V.
- Handbook of Greenhouse technology by Radhamanohar
- Greenhouse Technology by Tiwari G.N. and Goyal

*Study tour of 1 week within the state is proposed during the 5th 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
11	79 <> 65	Very good
111	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.