

**SYLLABUS FOR ENGINEERING TECHNOLOGY BRANCHES ONLY**  
**(JELET-2015)**  
**ENGINEERING MATHEMATICS**  
**(FOR ALL BRANCHES)**

**MATRIX & VECTOR**

Matrix - Definition - Order of a matrix - Leading element - Principal diagonal. Types of matrices - Null matrix - Square matrix - Identity matrix - Upper and lower triangular matrix - Symmetric matrix.

Determinant of a square matrix - Minors and cofactors - Procedures for evaluation - Properties of determinants (no deduction) - Evaluation of determinant by Ohio's method (4 th order) - Problems.

Concept of vector-Addition and subtraction of vectors- Multiplication of a vector by a scalar - Position vector of a point - Ratio formula - Rectangular resolution of a vector - Dot and cross product - Geometrical interpretation -Distributive law -Applications.

**NUMERICAL METHODS**

Meaning of interpolation - Difference table - Newton's forward interpolation formula (no deduction) - Problems.

Introduction to numerical integration - Formulae for composite trapezoidal and Simpson's 1/3 rule (no deduction) - Related problems.

Numerical solution of non-linear equations - Formula for Newton-Raphson method (no deduction) - Problems.

Numerical solution of system of linear equation - Gauss-Elimination Method (no deduction) - Problems.

**DIFFERENTIAL EQUATIONS**

Definition - Order and degree of a differential equation - Differential equations of 1st order and 1st degree - Separation of variables - Problems.

Homogeneous differential equations - Equations reducible to the homogeneous form - Problems.

Exact differential equations - equations reducible to the exact form - problems. Linear equations - Bernoulli's equations.

Differential equations of 2nd order with constant co-efficients - Complementary function and particular integral - Problems

**PARTIAL DIFFERENTIATION**

Function of two or more variables - Definition and meaning of partial derivatives (1st \ order). Homogeneous functions - Euler's theorem on homogeneous functions (no deduction) - Problems.

**PROBABILITY AND STATISTICS**

Introduction - Random experiment - Sample space - Events. Classical and axiomatic definition of probability. Addition and multiplication theorem - Related problems.

Statistics - Frequency distribution.

Measure of central tendency - Mean - Median - Mode - Standard deviation - Simple problems

**ELECTRICAL TECHNOLOGY**  
**(FOR ALL BRANCHES)**

**KIRCHOFF'S LAW**

Kirchoff's voltage and current laws, Star-delta transformations - Simple problems on all topics.

**A. C. FUNDAMENTALS**

Concept & significance of R.M.S. value, peak value, average value, crest factor and form factor of sinusoidal voltage/current - Equation of instantaneous value of sinusoidal voltage / current - Simple problems on all.

**A. C. SERIES CIRCUIT**

R-L & R-C A.C. series circuit (no deduction, only the expressions of voltage, current & power for sinusoidal sources), power factor, power triangle simple problems.

**STORAGE CELL, TRANSFORMER, MOTORS ETC.**

Basic Principle of: Storage cell, DC. motors, Transformer, A.C. generators & motors (No deduction & problems).

**MAGNETIC CIRCUIT**

Concept on magnetic circuit, Definitions and units of magnetic flux, m.m.t. and reluctance, analogy with electrical circuit, simple problems.

#### **MOTOR STARTER**

Need of motor starter mentioning some names useful for D.C. motors & A.C. motors.

#### **MOTORS FOR INDUSTRIAL USES**

Simple Electrical Circuit for motor installation, using block diagram of different components.

#### **POWER GENERATION, TRANSMISSION & DISTRIBUTION**

Brief idea about the power generation, transmission and distribution using block diagram of different stages.

#### **VOLTAGE STABILISER & UPS SYSTEM**

Brief idea about the operational principle of voltage stabilizer and UPS system (no description of internal circuit)

#### **HOUSE WIRING**

Simple idea house wiring starting from commencement of supply, using necessary diagram, role of fuses / MCB, fault finding & earthing concept.

#### **LIGHTING SCHEMES**

Types of lighting scheme and factors considered for designing lighting schemes i.e. illumination level, uniformity of illumination, colour of light, glare, mounting height, spacing between luminaries, colour of surrounding walls etc.

#### **WATTMETER & MEGGAR**

Uses & connection diagram of Wattmeter - Use of Meggar with circuit diagram.

#### **ELECTRICAL ENERGY MEASUREMENT**

Electrical energy measurement (no mathematical deduction & description of apparatus) - circuit diagram for single phase energy-meter connection.

### **COMPUTER APPLICATIONS & PROGRAMMING (FOR ALL DISCIPLINES) DETAIL COURSE CONTENT**

#### **Group - A — FUNDAMENTALS OF COMPUTER**

##### **Module 1 — INTRODUCTION TO COMPUTER**

- 1.1 Brief history of evolution of computers
- 1.2 Various components of computer (brief knowledge)
- 1.3 Hardware-CPU, inputs output system, primary memory, secondary memory.
- 1.4 Peripherals devices - Printers, plotter, scanners, digital cameras, web cam. sound card & speaker systems, dicta phone
- 1.5 Software Operating system, system software like compilers and device drivers, and various application software (definitions only).

##### **Module 2—INFORMATION REPRESENTATION**

- 2.1 NUMBER SYSTEM : Binary, Octal & Hexadecimal
- 2.2 Conversion of number systems, signed and unsigned representation
- 2.3 Binary arithmetic & compliments,
- 2.4 Character codes : ASCII. BCD & Gray codes

##### **Group - B — SOFTWARE CONCEPTS Module 3 — BASIC OF SOFTWARE**

- 3.1 Classification of Software systems-system software and application software.
- 3.2 Basic concepts of compilers, interpreters, assemblers and device drives
- 3.3 Operating system - Single user, multi user, graphical user interfaces and characters user interfaces.
- 3.4 Case studies :  
MS - DOS, Windows

##### **Group - C — INTRODUCTION TO PROGRAMMING Module 4 — INTRODUCTION TO PROGRAMMING**

- 4.1 Algorithm and flowchart
- 4.2 Different types of programming languages - machine level, assembly level and high level languages (basic concepts only)
- 4.3 Brief introduction to different high level languages including C

- 4.4 Basics of C-Language ; i
- 4.5 Branching and looping statements
- 4.6 Arrays and user defined functions

**Group - D — COMPUTER NETWORKING AND INTERNET Module 5 — COMPUTER NETWORKING AND INTERNET**

- 5.1 Basics of Computer Networking - LAN, MAN, WAN (definitions only)
- 5.2 Client - Server architecture (elementary level)
- 5.3 Internetworking concepts of world wide web, domain name system emails
- 5.4 Web browsing, use of search engines, web site hosting (elementary level).

**ENVIRONMENTAL ENGINEERING  
(FOR ALL BRANCHES)**

**AIR & ENVIRONMENT INTRODUCTION**

Man & Environment. Overview (socio-economic structure & occupational exposures) - Scope of Environmental Engineering - pollution problem due to urbanisation & industrialisation

**AIR POLLUTION**

Causes of air pollution - types & sources of air pollutants - Climatic & Meteorological effect on air pollution concentration - formation of smog & fumigation

**ANALYSIS OF AIR POLLUTANTS**

Collection of Gaseous Air Pollutants - Collection of Particulate Pollutants - Analysis of Air Pollutants like: Sulphur dioxide - Nitrogen oxide - Carbon monoxide - Oxidants & Ozone - Hydrocarbons - Particulate Matter

**AIR POLLUTION CONTROL MEASURES & EQUIPMENT**

Control of Particulate Emission - Control of Gaseous Emission - Flue Gas Treatment Methods: Stacks Gravitational and Inertial Separation. Settling Chambers, Dynamic Separators. Cyclones. Filtration, Liquid Scrubbing. Spray Chambers. Packed Towers. Orifice and Venturi Scrubbers, Electrostatic Precipitators. Gas/ solid Absorption, Thermal Decomposition.

**METHODS & APPROACH OF AIR POLLUTION CONTROL**

Controlling smoke nuisance — Develop air quality criteria and practical emission standards — creating zones suitable for industry based on micrometeorology of air area — Introducing artificial methods of removal of particulate and matters of waste before discharging to open atmosphere

**WATER & ENVIRONMENT WATER SOURCES**

Origin of waste water — Type of water pollutants and their effects

**DIFFERENT SOURCES OF WATER POLLUTION**

Biological Pollution (point & non-point sources) - Chemical Pollutants: Toxic Organic & Inorganic Chemicals - Oxygen demanding substances - Physical Pollutants: Thermal Waste - Radioactive waste - Physiological Pollutants: Taste affecting substances - other forming substances

**WATER POLLUTION & ITS CONTROL**

Adverse effects on : Human Health & Environment, Aquatic life, Animal life, Plant life — Water Pollution Measurement Techniques - Water Pollution Control Equipment & Instruments - Indian Standards for Water Pollution Control

**SOIL & ENVIRONMENT**

**SOIL POLLUTING AGENCIES & EFFECT OF SOLUTION**

Liquid & Solid Wastes - Domestic & industrial Wastes - Pesticides - Toxic: Inorganic & Organic Pollutants - Soil Deterioration - Poor Fertility, Septicity. Ground Water Pollution, Concentration of Infecting Agents in Soil

**SOLID WASTE DISPOSAL**

Dumping domestic & Industrial Solid Wastes: Advantages & Disadvantages -Incineration: Advantages & Disadvantages - Sanitary Land Field: Advantages & Disadvantages - Management of Careful & Sanitary Disposal of Solid Wastes

**NOISE & ENVIRONMENTAL MANAGEMENT SYSTEM NOISE POLLUTION & CONTROL**

Noise Pollution: Intensity, Duration - Types of Industrial Noise - Ill effects of Noise -Noise Measuring & Control - Permissible Noise Limits

**ENVIRONMENTAL LEGISLATIONS, AUTHORITIES & SYSTEMS**

Air & Water Pollution Control Acts & Rules (Salient Features only) - Functions of State / Central Pollution Control Boards - Environmental Management System ISO 14000 (Salient Features only).

**ENGINEERING MECHANICS  
(FOR ALL BRANCHES EXCEPT PRINTING AND  
AGRICULTURAL ENGINEERING)**

**GROUP - A**

**Module 1 INTRODUCTION**

Concept of Engineering Mechanics - Statics & Dynamics - Scalar Quality –Vector Quality-Addition & Subtraction of Vectors- Basic units- Derived Units-Si units-Prin-ciples of dimensional homogeneity.

**Module 2 SYSTEM OF FORCES**

Definition of a force with explanation - Linear representation of force - System of co-planar forces - Parallelogram Law of Forces - Composition and Resolution-Transmissibility of forces - Action and Reaction - Triangle Law & Polygon Law of forces - Determination of Resultant by Analytical and graphical method with equal-train space diagram – Vector diagram.

**Module 3 MOMENTS & COUPLES**

Definition of moment of a force about a point - Physical significance of moment -Moment of a system of parallel and inclined forces - Varignon's Theorem -Defini-tion of moment of a couple - Physical significance of Couples Equivalent couples -Resultant of any number of coplanar couples - Replacement of a force about a point by an equal like parallel force together with a couple -Properties of couples.

**Module 4 CONDITION OF EQUILIBRIUM**

Lami's Theorem - Triangle Law & Polygon Law of equilibrium - Conditions of equi-librium of co-planer system of concurrent forces - Conditions of equilibrium of co-planar system of non-concurrent parallel forces (like & unlike) -Conditions of equi-librium of co-planar system of non-concurrent non-parallel forces (simple problems excluding statically indeterminant).

**GROUP - B Module 5 FRICTION**

Definition - Useful and harmful effects of friction - Laws of Static friction - Coeffi-cient of friction -Angle of friction -Angle of repose - Equilibrium of a body on a rough inclined surface with and without external force.

**Module 6 CENTRE OF GRAVITY**

6.1 Concept & definition - Centre of mass - Centroid

6.2 Methods of finding out centroids of simple area by :

(i) Geometrical consideration and (ii) Method of Moments.

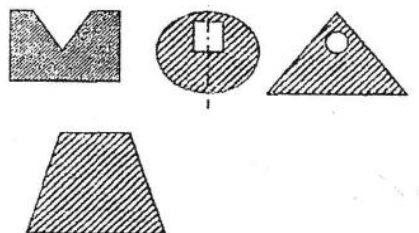
[\*\*Method of integration should be learnt in Strength of materials on 2nd Semester]

Finding the centroid of the following areas by any method :

(i) uniform triangular lamina, (ii) uniform rectangular lamina, (iii) uniform circular lamina,

6.3 Finding the centriod of the following sections using the method of moment :

(i) T-section, (ii) equal and unequal angle-sections, (iii) equal and



unequal I-sections, iv) different cut-out sections as shown in the following figures.

**Module 7 MOMENT OF INERTIA**

7.1 Introduction - definition and unit

7.2 M I of a lamina

7.3 Theorems of finding out M I by :

(i) Parallel axis theorem, and, (It) Perpendicular axis theorem.

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7.5 Finding out M I of the following sections using formula only.

(i) Rectangular section, (ii) Square section , (iii) circular section, (iv) triangular section.

7.6 M I of irregular areas such as I-sections, T-sections, - Related simple problems.

### **Module 8 SIMPLE MACHINES**

Definition of Machine - Difference between Machine & Lever - Mechanical Advantage, Velocity Ratio and Efficiency with their relationship - Frictional Effort Load -Condition of reversibility / irreversibility - Law of Lifting Machines -Maximum mechanical advantage - Maximum efficiency - Effort vs. load curve -Efficiency vs. load curve -Different types of lifting machine with their mechanical advantage, velocity ratio & efficiency such as wheel and axle (simple & differential), Crab winch (single & double purchase), Weston pulley block, worm & worm wheel, simple screw jack.

### **GROUP-C**

#### **Module 9 RECTILINEAR MOTION**

Motion equations (with deduction  $S=V \times t$  :  $V=u \pm at$ ;  $S=ut \pm \frac{1}{2}at^2$ ;  $V^2=U^2 \pm 2as$ ) Newton's Second Law of linear motion  $P = mf$  (deduction) -Conservation of momentum of a body -No Numerical problems.

#### **Module 10 CURVILINEAR MOTION**

Angular displacement -Angular speed -Angular velocity- Relation between angular speed & angular velocity -Angular acceleration - Relation between linear & angular velocity - Relation between linear & angular acceleration -Centripetal and centrifugal force (numerical problems)

#### **Module - 11 WORK POWER ENERGY**

2 Definitions. Units, Potential Energy (mgh). : Kinetic Energy ( $\frac{1}{2}mv^2$ ), Laws of conservation of Energy. Change of Kinetic energy=Work done by acting force. Simple numerical problems.

## **STRENGTH OF MATERIALS**

**(FOR ALL BRANCHES EXCEPT PRINTING AND AGRICULTURAL ENGINEERING)**

### **GROUP — A**

#### **Module 1 SIMPLE STRESSES & STRAINS**

- 1.1 Scope of subjects Use of structure, importance of knowledge of stress, strain and deformation in structure, safety and economy. Engineering materials: Definitions and examples Mechanical properties of engineering materials : Elasticity, Plasticity, Ductility, Hardness. Fatigue, Creep Brittleness (definition, examples and applications).
- 1.2 Stress and strain: Tensile, Compressive, Shear
- 1.3 Stress-strain diagram: Principles of tensile testing in universal testing machines showing salient points such as elastic limit, proportional limit, yield points, breaking points etc., ultimate stress, working stress and factor of safety.
- 1.4 Stress - Strain relations: Hooke's law, Young's Modulus, Modulus of rigidity, Poisson's ratio.

### **GROUP — B**

#### **Module 2 SHEAR FORCE & BENDING MOMENT**

- 2.1 Definition and Types of beams, supports and loads.
- 2.2 Shear force and bending moment in beams: Definitions, sign conventions and inter-relationships 2.3 Shear force and bending moment diagrams (with simple problems) :
  - (i) Cantilever beams with point loads and Uniformly Distributed Loads (DDL),
  - (ii) Simply supported beams with point loads and UDL.
  - (iii) Simply supported overhanging beam with point load.

#### **Module 3 BENDING STRESSES IN BEAMS**

- 3.1 Pure bending of beam: Assumptions, deduction of bending equation with usual notations, moment of resistance, section modulus.
- 3.2 Problems on bending stress about axis parallel to the plane of bending: For rectangular circular & I-section.

### **GROUP — C**

#### **Module 4 DEFLECTION OF BEAMS**

- 4.1 Differential equation of elastic curve — Relation among deflection, slope, shear force, bending moment and rate of loading — Sign convention of slope and deflection.
- 4.2 Standard formula (no proof, only simple problems) for maximum slope of deflection of

- (a) cantilever beam subjected to point load at free end, uniformly distributed load on entire span;
- (b) simply supported beam carrying a point load at mid span, uniformly distributed load on entire span.

### Modules COLUMNS & STRUTS

- 5.1 Definitions of Columns & Struts — Long, Medium & Short columns — Effective Length — Slenderness Ratio — Critical load — Safe load — Different kinds of end conditions — Euler's formula for critical load (no deduction and no problem).

## BASIC ENGINEERING FOR PRINTING (FOR PRINTING TECHNOLOGY ONLY)

### SIMPLE STRESSES & STRAIN

Introduction — Elasticity — Stress and Strain.

Types of Stresses : Tensile Stress and Compressive Stress.

Elastic Limit— Hook's' Law— Modulus of Elasticity (Young's Modulus) Deformation of a body due to Force acting on it — Simple problems. Principle of Superposition — Simple problems on uniform cross-section.

### MECHANICAL DRIVE

Different types of Mechanical drive and their uses only.

Belt & pulley drive: Different types belt and pulley drive — Open belt drive and cross belt drive.

Types of belt and types of pulley — Velocity ratio. Simple problems.

### GEAR DRIVE

Types of gear and their uses. Definition of different parts of Spur gear. Velocity ratio of spur gear. Simple problems.

### MEASURING INSTRUMENTS

Types of measuring instruments and their uses.

Description, working principle, care & maintenance of Vernier Callipers and outside micrometer.

Reading of Vernier callipers and outside micrometer.

### FASTENING METHOD

Different types of fastening method with examples. Types of nuts, bolts and their uses.

Welding, Soldering & Brazing and their uses. Different types of rivet and riveted joints.

### PRINTERS' MATERIAL SCIENCE (FOR PRINTING TECHNOLOGY ONLY)

**Colloids** - Definition of colloid, properties of lyophilic and lyophobic colloids, stability of colloids, protective action of lyophilic colloids, gold number, definition of gel and emulsion, application of colloids, gels and emulsions in printing.

**Polymers** - Uses of natural polymers (casein, cellulose, dextrin, egg albumen, gelatine, fish glue, gum Arabic and starch) and synthetic polymers (polyethylene, polypropylene, Teflon, polyvinyl acetate, polyvinyl alcohol, polyvinyl chloride, phenolic resin, amino resin and polyester resin) in printing.

**Chemistry of photography** - Constituents of a photographic emulsion, uses of gelatine, preparation of the emulsion, lattice structure of silver chloride and silver bromide, lattice defects, latent image formation by Gurney-Mott Theory, chemistry of photographic development, fixing, photographic reduction and chemical intensification, chemical reversal, elementary idea of silverless films.

**Chemicals required for image carriers** - a) letterpress and flexography –photo polymeric stereo making, b) lithography - (graining, coating, developing, etching, lacquering, stencil removing, gumming, desensitising) (i) negative working plates-albumen plate, P.S. diazo and photopolymer plates, driographic (waterless) plate (ii) positive working plates - gum deep etch plate, P.S. plate, diffusion transfer plate c) gravure - cylinder making (sensitising, developing, etching, finishing) d) silk screen - (coating, developing, hardening, stencil removing) direct, indirect, direct- indirect and capillary method.

**Surface tension** - Definition, contact angle, choice of metals for image carriers on the basis of contact angle, role of surface tension in wetting of the non-image areas of a lithographic plate by water and the image areas by ink.

**Fountain solution** - Constituents, use of each constituent, PH and conductivity.

**Printing ink** - Differences between liquid ink and paste ink, Raw materials of ink -colourant (pigment and dyestuff), solvent, plasticiser, resin, oil, drier and additives (wax antioxidant, surfactant), ink strength, ink drying - penetration, oxidation, quickset, evaporation, radiation polymerisation (UV and electron beam), IR radiation, rheology of paste inks in terms of viscosity, thixotropy, visco-elasticity, tack, length and flow. Different types of inks - quick set, heat set, moisture set inks, sheet fed, web fed inks, water-based inks. Characteristics of letterpress, offset, gravure, flexographic and screen inks.

**Paper** - Paper manufacture - sulphate process of chemical pulp preparation, bleaching, beating, internal and external sizing, coating. Paper characteristics - paper grain, dimensional strength, paper acidity, runnability & printability. Requirements of letterpress, lithographic, gravure, flexographic and screen-printing papers.

**Adhesives** - Characteristics of class-1,2 & 3 adhesives, adhesives used in lamination & book binding, requirement of an adhesive pH of ink, paper and adhesives.

## **SOIL AND WATER ENGINEERING (FOR AGRICULTURAL ENGINEERING ONLY)**

### **Module 1 : Watershed Hydrology**

Hydrologic cycle, Precipitation-forms, rainfall measurement, mass curve, point rainfall, frequency analysis of point rainfall, plotting position, Interception, infiltration, evapotranspiration- estimation and measurement, Stream number, stream length, stream area, stream slope, Runoff-factors affecting, measurement of runoff, Hydrograph -Components, base flow separation, Unit hydrograph theory, Synthetic unit hydrograph, Flood routing - graphical methods of reservoir flood routing, Drought and its classification.

### **Module 2 : Surveying and Leveling**

Introduction-classification and basic principles, Principle and method of Chain surveying, Plane table surveying, Compass surveying. Errors in measurements-their elimination and correction. Leveling, Contouring. Computation of area and volume, Theodolite surveying, traversing and adjustment of errors.

### **Module 3 : Fluid Mechanics**

Definition and Properties of fluids, Unit measurement, Fluid statics, Dynamics of fluid flow, Bernoulli's theorem, venturi-meter, orifice-meter and nozzle, siphon; Laminar flow: Stress-strain relationships, General equation for head loss in pipes, energy losses through pipe fittings, Darcy Equation, flow through network of pipes, hydraulic gradient and energy gradient, Measurement of discharge through pipes and open channel.

### **Module4: Soil Mechanics**

Classification of soil, Index properties of soil- void ratio, porosity, density, water content, particle size distribution, consistency limits and permeability, seepage flow-net and drain-age, compaction, consolidation, earth pressure and retaining structure, shear strength, soil stabilization, soil exploration, stability of slope, Foundation Engineering.

### **Module 5: Soil and Water Conservation**

Mechanics and types of erosion and their causes, Estimation of Soil loss, Biological con-trol measures, Stream bank erosion, Wind erosion control, Design of permanent soil con-servation structure: chute, drop and drop inlet spillways, Design of Contour bunds, contour trenches, contour stone walls, contour ditches, Terraces.

### **Module 6 : Ground Water, Pump and Well Technology**

Introduction: geologic formations, Types of aquifer and wells, Ground water exploration technique, Aquifer properties, aquifer properties, Various types of tube wells, hydraulics of well and well performance, installation of well screen, Joining of pipes, Completion and development of well, Water lifting devices, Pump Characteristics and Pump selection, installation and troubleshooting.

### **Module 7: Irrigation and Drainage**

Soil-water-plant relationship, irrigation and drainage for sustainable crop production, Land grading and land preparation for Irrigation and Drainage, Design of Irrigation channel, Water conveyance and Control Structures, Irrigation water requirement, Methods of Irrigation-Flood, boarder, furrow, check basin, Sprinkler and drip irrigation systems. Types of drain- age systems and drainage materials.

### **Module 8 : Building materials and Structures**

Simple Stress-strain, Stress-Strain-Tension, Compressive, shear, Stress-Strain relation-ship, Elasticity, Hooke's law, Young's modulus, Modulus of rigidity, Poisson's ration, Mohr's circle, Shear force and bending moments diagram, moment of inertia, middle third rule, Column and struts.

### **Modules 9 : Remote Sensing and GIS**

Definition: History of Remote Sensing: Abroad \ India, Concepts of scale, Resolution, Elec-tromagnetic Spectrum: Optical \ Microwave, Visible region: Blue, Green and Red wave-length portion, Wavelength and frequency: their relation and units of measurement, Polar-ization; Coherent & Incoherent radiation; Doppler Effect, Energy transmission, atmospheric characteristics, Map - Definitions - Representations - Point line polygon common coordi-nate systems.

## **FARM MACHINERY AND POWER (FOR AGRICULTURAL ENGINEERING ONLY)**

### **Module1 1 : Crop Production Technology**

Climatic zones of West Bengal and its characteristics, Classification of crop, Effect of different weather parameters on crop growth and development, Principles of tillage, Tilth and its characteristics, Tillage implements, Conservational Tillage, Conventional Tillage,

Soil-water-plant relationship, Crop rotation, cropping systems, mono, double and multiple cropping, Sowing, Intercultural operation, harvesting, processing, storage and protection of crops, Soil forming rocks and minerals- origin, classification and composition, Weathering of rocks and minerals, Soil forming process and the factors, Soil profile, Soil Properties- Physical - soil texture, structure, densities, pore spaces, Chemical properties - pH, Soil water composition and classification, Soil moisture constants and function, Soil air, Soil temperature.

#### **Module 2 : Farm Machinery**

Status and scope of farm mechanization, Classification and constructional details and principles of operation of manually operated, animal drawn and power operated implements and machinery for primary and secondary tillage, puddling, Sowing and planting equipments, fertilizer application, Description, operation and calibration, Inter-cultivation tools, plant protection equipment, Principle of crop harvesting and threshing, Chaff cutters and silage filling equipment, Land development machinery, Human engineering and safety in farm machinery, Selection.

#### **Module 3 : Farm Engine and Tractors**

Power availability on the farms from animate and inanimate sources of energy, their capacities and efficiencies, Tractor engine components and their principle of working, Engine valve and valve mechanism and valve timing diagram, Fuel and Air supply system, Cooling and Lubrication System, Ignition and starting and electrical system, Engine Governing, Transmission systems of wheel and track type tractors, Clutch and brake, gearbox, differential, PTO, Belt pulley and draw-bars and final drive mechanisms, Power tiller and small farm engines for farm operation, Performance and cost analysis of farm tractors and power tillers.

#### **Module 4 : Renewable Energy Sources**

Introduction to conventional and non-conventional energy sources, Patterns of fuel consumption, Potential of solar, wind, biogas, biomass, geothermal and other renewable energy sources, Solar Cooker, Water Heater, Drier, solar still, solar pond, PV system etc. Aerobic and anaerobic bio-conversion process, Pyrolysis, gasification and their economics, selection of size of biogas plants, Wind energy potential, Installed capacity, Study of various types of wind mills.

#### **Module 5 : Thermodynamics and Heat Engines**

Thermodynamics properties, closed and open system, flow and non-flow processes, gas laws, laws of thermodynamics, internal energy, Thermodynamic process of perfect gases, P-V, P-T and T-S diagrams of pure substances, Second law of thermodynamics, Difference between heat and work, cyclic heat engines, Kelvin-Planck and Clausius statements, refrigeration and heat pumps, reversibility and irreversibility of process, Boiler performance; boiler efficiency, Thermodynamic cycles of I.C. engines.

### **FOOD PROCESS AND POST HARVEST ENGINEERING**

#### **(For Agricultural Engineering only)**

Food constituents, micro-organism in deterioration and Preservation of food, Modes of heat transfer, one dimensional steady-state and unsteady-state heat transfer in simple geometries, Newton's law of cooling, Free and forced convection, correlations, heat transfer coefficient, Introductory radiation heat transfer, Types of heat exchanger, log mean temperature difference, heat exchanger performance, Introduction to mass transfer process, Fick's law, Molecular diffusion in fluids and solids, Convective mass transfer coefficients, Mass transfer correlations, Processing equipment and machinery, Utilization of agricultural by product, Unit operation of various dairy and food processing systems; Process flow charts for product manufacture, Manufacture of flavoured milk - cream - butter-condensed milk - Ghee, ice cream etc, Beverages - alcoholic and non alcoholic - carbonated and non carbonated, Working principles of equipment for receiving, pasteurization, sterilization, homogenization, filling and packaging, butter manufacture, evaporation, drying, freezing, juice extraction, filtration, Process parameters and equipment for various operations- Cleaning, sorting and grading, Washing, Handling, Peeling and slicing. Blanching, Mixing, Packaging and storage, Cooling and Cold storage, drying and dehydration-Pre-drying techniques, Theory of drying, Various types of dryers and their operation, Quality changes in dried products, quality control techniques and application.