Syllabus for Chemical, Polymer & Thermal Engg. (PGQP56)

Types of fluids, Properties of Fluids, Equation of state, Coefficient of compressibility, Bulk

modulus of elasticity, Newtonian and non- Newtonian fluid, Coefficient of thermal expansion, Surface tension, capillarity, concept of viscosity, Effect of temperature on viscosity. Fluid Static, Fluid Kinematics, Fluid Rotation, Fluid dynamics.

Dimensional and Model Analysis, Laminar flow, Turbulent Flow. Cement, Concrete, Special Concrete, Properties of bricks and stones, forms of bricks, tests on bricks and stones, relevant codes, Timber.

Physical properties of Rock forming Minerals, introduction of Rocks, mode of formation and classification of sedimentary and igneous rocks, agents of metamorphism and zone of metamorphism, physical and engineering properties of some important rocks, Weathering; mechanical and chemical weathering: Erosion.

Surveying and Levelling:

Plane and geodetic surveying; classification of surveying; basic principles; measurement of horizontal distance by conventional methods; taping on sloping ground, offsets, errors and sources of errors, field book. Levelling: definition of terms; levelling principle; levelling, instruments; types of spirit levelling; methods of booking and reduction of levels; sensitiveness of level tube; errors in levelling; curvature and refraction correction. Compass Survey, Plane Table Surveying, Area and Volume Computation: computation of area by different methods.

Mechanics of Solids:

Theories of Elastic Failure: Introduction; Comparison and Significance of Various Theories, Distribution of Bending and Shear Stresses across cross-section of Beams; Shear Centre; Theory of

Shear Flow; Shear Flow Diagrams; Shear Centre for Thin-Walled Symmetrical Sections, Basic Elastic Theorems and Energy Methods; Theorem of Complementary Energy; Principle of Minimum Strain Energy; Concepts of Stiffness and Flexibility.

Functions of Project Management, Project Life Cycle, the Project Environment, Project Selection, Project Proposal, Project Scope, Work Breakdown Structure. Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Assumptions in PERT Modelling, Time-cost Trade-offs, Linear Programming and Network Flow Formulations, PERT/COST Accounting.

Hydrology:

Hydrological cycle, storage, water balance. Atmospheric Circulation: Atmospheric circulation patterns, cyclones, typhoons, water vapor, precipitable water. Hydrologic Elements: Precipitation types, measurements, analysis, mean precipitation, depth-area- duration relation, maximum intensity duration-frequency relation. Evapotranspiration: Evaporation processes, influencing factors, measurement, potential and actual evapotranspiration. Infiltration: Infiltration processes, influencing factors, measurement, and infiltration models, infiltration capacity.

Geotechnical Engineering: Nature of Soil, Phase Representation and Relationships, Structure of soil; soil texture; Size and range of soil particles; shapes of individual sand and clay particles; field identification of soils; Introduction to particulate behaviour. Three-phase system : representation by Phase diagram – soil solids, water and air; Basic definitions and relationships : Specific gravity; Void ratio; Porosity; water content; Unit Weights : bulk, dry, saturated, submerged and natural; Degree of saturation and Density index. Nature of Soil, Phase Representation and Relationships, Structure of soil; soil texture; Size and range of soil particles; shapes of individual sand and clay particles; field identification of soils; Introduction to particulate behaviour. Three-phase system: representation by Phase diagram

– soil solids, water and air; Basic definitions and relationships : Specific gravity; Void ratio; Porosity; water content; Unit Weights : bulk, dry, saturated, submerged and natural; Degree of saturation and Density index. Compaction, Consolidation and Shear Strength of Soil. Bearing Capacity of Shallow and Deep Foundations.

Irrigation Engineering and Hydraulic Structures: Irrigation Development Planning, Irrigation Network and Hydraulics, Planning and Design of Irrigation Systems, Kenneady and Lacey's theory, Wastewater Quantity Estimation, Wastewater Quality Enhancement, Physical Unit Processes: Screening, Introduction to Microbiology, Basic Features of Open Channel Flow, Uniform Flow, Critical flow, Specific Energy, Hydraulic Jump. Fundamentals of Groundwater Flow and Groundwater Wells, Groundwater Resources Assessment, Introduction to watershed hydrology.

Section-II (Aquacultural Engineering, Water Resource Development and Management, Farm Machinery and Power Engineering, Food Processing Engineering)

I) Farm Machinery

Machine Design: Design and selection of machine elements – gears, pulleys, chains and sprockets and belts; overload safety devices used in farm machinery; measurement of force, torque, speed, displacement and acceleration on machine elements.

Farm Machinery: Soil tillage; forces acting on a tillage tool; hitch systems and hitching of tillage implements; functional requirements, principles of working, construction and operation of manual, animal and power operated equipment for tillage, sowing, planting, fertilizer application, inter-cultivation, spraying, mowing, chaff cutting, harvesting, threshing and transport; testing of agricultural machinery and equipment; calculation of performance parameters - field capacity, efficiency, application rate and losses; cost analysis of implements and tractors.

II) **Farm Power**

Sources of Power: Sources of power on the farm - human, animal, mechanical, electrical, wind, solar and biomass; bio-fuels.

Farm Power: Thermodynamic principles of I.C. engines; I.C. engine cycles; engine components; fuels and combustion; lubricants and their properties; I.C. engine systems – fuel, cooling, lubrication, ignition, electrical, intake and exhaust; selection, operation, maintenance and repair of I.C. engines; power efficiencies and measurement; calculation of power, torque, fuel consumption, heat load and power losses.

Tractors and Power tillers: Type, selection, maintenance and repair of tractors and power tillers; tractor clutches and brakes; power transmission systems – gear trains, differential, final drives and power take-off; mechanics of tractor chassis; traction theory; three point hitches- free link and restrained link operations; mechanical steering and hydraulic control systems used in tractors; tractor tests and performance.

Human engineering and safety in design of tractor and agricultural implements.

III) **Soil and Water Conservation Engineering**

Fluid Mechanics: Ideal and real fluids, properties of fluids; hydrostatic pressure and its measurement; hydrostatic forces on plane and curved surface; continuity equation; Bernoulli's theorem; laminar and turbulent flow in pipes, Darcy- Weisbach and Hazen- Williams equations, Moody's diagram; flow through orifices and notches; flow in open channels.

Soil Mechanics: Engineering properties of soils; fundamental definitions and relationships; index properties of soils; permeability and seepage analysis; shear strength, Mohr's circle of stress, active and passive earth pressures; stability of slopes.

Hydrology: Hydrological cycle and components; meteorological parameters, their measurement and analysis of precipitation data; runoff estimation; hydrograph analysis, unit hydrograph theory and application; stream flow measurement; flood routing, hydrological reservoir and channel routing.

Surveying and Leveling: Measurement of distance and area; instruments for surveying and leveling; chain surveying, methods of traversing; measurement of angles and bearings, plane table surveying; types of leveling; theodolite traversing; contouring; computation of areas and volume.

Soil and Water Erosion: Mechanics of soil erosion, soil erosion types, wind and water erosion, factors affecting erosion; soil loss estimation; biological and engineering measures to control erosion; terraces and bunds; vegetative waterways; gully control structures, drop, drop inlet and chute spillways; earthen dams.

Watershed Management: Watershed characterization; land use capability classification; rainwater harvesting structures, check dams and farm ponds.

IV) **Irrigation and Drainage Engineering**

Soil-Water-Plant Relationship: Water requirement of crops; consumptive use and evapotranspiration; measurement of infiltration, soil moisture and irrigation water infiltration.

Irrigation Water Conveyance and Application Methods: Design of irrigation channels and underground pipelines; irrigation scheduling; surface, sprinkler and micro irrigation methods, design and evaluation of irrigation methods; irrigation efficiencies.

Agricultural Drainage: Drainage coefficient; planning, design and layout of surface and sub- surface drainage systems; leaching requirement and salinity control; irrigation and drainage water quality and reuse.

Groundwater Hydrology: Groundwater occurrence; Darcy's Law, steady flow in confined and unconfined aquifers, evaluation of aquifer properties; groundwater recharge. Wells and Pumps: Types of wells, steady flow through wells; classification of pumps; pump characteristics; pump selection and installation.

V) **Agricultural Processing Engineering**

Drying: Psychrometry – properties of air-vapors mixture; concentration and drying of liquid foods – evaporators, tray, drum and spray dryers; hydrothermal treatment; drying and milling of cereals, pulses and oilseeds.

Size Reduction and Conveying: Mechanics and energy requirement in size reduction of granular solids; particle size analysis for comminuted solids; size separation by screening; fluidization of granular solids-pneumatic, bucket, screw and belt conveying; cleaning and grading; effectiveness of grain cleaners; centrifugal separation of solids, liquids and gases.

Processing and By-product Utilization: Processing of seeds, spices, fruits and vegetables; By- product utilization from processing industries.

Storage Systems: Controlled and modified atmosphere storage; perishable food storage, godowns, bins and grain silos.

VI) **Dairy and Food Engineering**

Heat and Mass Transfer: Steady state heat transfer in conduction, convection and radiation; transient heat transfer in simple geometry; working principles of heat exchangers; diffusive and convective mass transfer; simultaneous heat and mass transfer in agricultural processing operations; material and energy balances in food processing systems; water activity, sorption and desorption isotherms.

Preservation of Food: Kinetics of microbial death – pasteurization and sterilization of milk and other liquid foods; preservation of food by cooling and freezing; refrigeration and cold storage basics and applications.