39 FARM MACHINERY AND POWER ENGINEERING

Unit 1: Design of Tillage and Planting Machinery

Modern trends, principles, procedures, fundamentals and economicconsiderations for design and development of farm machinery. Design considerations, procedure and their applications in tillage andplanting machinery. Design of coulters, shares, mould boards, landside, frog, jointer.Forces acting on plough bottom and their effect. Draft on ploughs.Design of disk ploughs, concave disk working tools and forces acting on discploughs.Machines and implements for surface and inter row tillage, peg toothed harrow, disk harrows, graders, rollers, cultivators, design of V shaped sweeps -rigidity of working tools. Rotary machines, trajectory of motion of rotary tillertynes, forces acting and power requirement. Machines with working tools executingan oscillatory motion.Methods of sowing and planting. Grain hoppers, seed metering mechanism, furrow openers and seed tubes. Planting and transplanting, paddy transplanters and potato planters.

Unit 2: Design of Plant Protection and Harvesting Equipments

Modern trends, principles, procedures, fundamentals and economicconsiderations for design and development of plant protection and harvestingmachinery. Machines for fertilizer application and discs type broadcasters. Organic fertilizer application, Properties of organic manure and spreading machines. Liquid fertilizer distributors. Function of sprayer, atomization principles, hydraulic sprayers. Air blast spinning disc and electrostalic sprayers. Design of sprayercomponents, pumps, pressure vessel, nozzle, materials of construction. Spraydroplets and distribution pattern. Spray application to orchards. Physico-mechanical properties of grass and cereal stalks, resistance to cutting, speed of cutting of stalks, cutting angle of the knife segment. Kinematics of thedrive mechanisms of cutting equipments. Mowers, Design and construction, mowers with rotary cutting units, mower pick up chopper and loader.Grain harvesting, combines and its features. Threshing unit, types and separation process. Straw walker, separation of straw in oscillating straw walker.Grain cleaning and grading and principal parameters.Root crop harvesting, potato other root crop.

Unit 3: Testing and Evaluation of Agricultural Machinery

Types of tests; test procedure, need for testing & evaluation of farm equipments and standardization of testing machinery, available national and international codes. Need of test codes and advantages of certification. Measurement & calculation of operating speed, wheel slip, draft of manual, trailed & mounted implements, fuel consumption, field capacity, Soil moisture, bulk density, soil inversion, soil pulverization, size & shape of furrow, field efficiency, calibration of test equipment and its usage limitations.Prototype feasibility testing and field evaluation. Laboratory and field testing ofprimary & secondary tillage equipment. Test code for performance testing for tractors & power tillers - evaluation and interpretation of results. Dynamometers. Review and interpretation of test reports for selected farm machinery.

Unit 4: Tractor Design Principles

Functional Requirement and Limitations, Systems and power outlets, Technical specifications of tractors available in India and modern trends in tractordesign and development. Special design features of tractors in relation to Indianagriculture.Parameters affecting design of tractor engine and their selection. Design of fuelefficient engine components and tractor systems like transmission, steering, front suspension, hydraulic system. Studying tractor performance. Tractor mechanics, Ideal Analysis with and without losses, Engine Performance, Tractor Drawbar performance. Tractor Performance on a Firm Surface and soft soil. Rolling resistance. Tire selection. Hitching and mechanics of the tractor chassis, Weight transfer. Computer aided design and its application in agricultural tractors. Tractorimplements matching and operation.

Unit 5: Ergonomics and Safety in Farm operations

Ergonomics, scope, concepts and areas of application. System concept to humanfactors. Human factor in system development, basic processes in systemdevelopment. Human Skeletal system, muscle, structure and function. Muscle metabolism. Direct and indirect calorimetry Physiological stress and measurement of human energy expenditure during rest and physical activities. Work physiology invarious agricultural tasks. Mechanical efficiency of work, fatigue and shift work. Anthropometric data and measurement techniques, joint movement and method of measurement, analysis and application of anthropometric data in design of foot and hand controls andoperator' seat for tractors and agricultural equipment. Measurement of physical and mental capacities. Effect of illumination, noise, vibration and dust on work performance and health of workers. Thermal and cold stress and its effect on human performance. Field of vision and colour discrimination. Work psychology, basic concepts, Subjective rating scales and quantification techniques. Safety standards at work place. Accidents and prevention. Occupational health hazards of agricultural workers.

Unit 6: Soil Dynamics in Tillage and Traction

Dynamic properties of soil, stress strain relations and distribution, soil strength. Yield in soil, shear, compression, tension and plastic flow. Rigid body soil movement, momentum, friction, adhesion and absorption. Dynamic versus static properties. Dynamic parameters, measuring in dependent parameters and composite parameters. Measuring gross dynamic behavior and rupture. Mechanics of tillage tools: The reaction of soil to tillage tools, mechanics of simple reactions, soil behavior in simplified systems, geometry of soil toolsystems, mechanics of complex reactions. Dimensional analysis of different variables related to soil-tyre system; soil vehicle models; mechanics of steering of farm tractor; special problems of wet land traction and floatation. Introduction of traction devices, tyres-types, function & size, their selection; mechanics of traction devices. Deflection between traction devices and soil, slippage and sinkage of wheels, evaluation and prediction of traction performance. Design of traction and transport devices - Soil compaction by agricultural vehiclesand machines.

Unit 7: Manufacturing Technology

Specification of materials, surface roughness, production drawing, computer aided drawing heat treatment, workshop practices applied in prototype production, common tools and press operations, metal cutting and machining, jigs, fixtures and gauges, casting and die-casting processes; basic joining processes, welding processes, testing of joints and metallurgy.

Unit 8: Instrumentation and Measurement Techniques

Mechanical measurements, sensors and transducers, application of electrical strain gauges, signal transmission and processing, dynamic measurements; measurement of temperature, pressure, strain, force, torque, power vibrations etc.; determination of calorific value, fluid flow rates etc., signal conditioning and monitoring, data acquisition and storage.

Unit 9: Energy in Agriculture

Conventional and renewable energy sources in agriculture; solar radiation and its measurement; characteristics of solar spectrum; solar energy collection, storage and applications; solar photovoltaic conversion and SPV powered systems. Types of wind mills and their applications; thermo-chemical conversion of biomass, direct combustion, Pyrolysis and gasification, chemical conversion processes, carbonization, briquetting, pelletization and densification of biomass; bioconversion into alcohols, methyl and ethyl esters, organic acids, solvents of amino acids; types of biogas plants, biogas properties, uses and distribution, alternate fuels for IC engines. Energy requirement in agricultural production systems, energy ratio and specific energy value, inflow and outflow of energy in unit agricultural operation, energy audit, accounting and analysis.