Unit-I

Chapter 1 : Sanitation Infrastructure System 1-1 to 1-84

Syllabus : *Sanitation infrastructure and wastewater quantification: wastewater, sources and types, need for safe sanitation, importance of sanitation infrastructure (centralized, decentralized, onsite and offsite sanitation), wastewater collection and conveyance, quantitative estimation of wastewater, sewage, storm water, self-cleansing velocity and non-scouring velocity in sanitary sewer, hydraulic design of circular sanitary sewer, necessity and location of pumping station. Wastewater characteristics: methods of sampling, conventional and emerging contaminants (physical, chemical and biological) in domestic and industrial wastewater (sugar, dairy, distillery), treatability index, effluent discharge standards as per CPCB norms. Self-purification of natural streams: oxygen sag curve, Streeter - Phelps equation and terminology (without derivation and numerical), application and limitations.*

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Unit-II

Chapter 2 : Preliminary and Primary Wastewater Treatment 2-1 to 2-35

Syllabus : *Treatment : stages, (preliminary, primary, secondary and tertiary treatment), sewage/effluent treatment plant - flow diagram, unit operation and process, preliminary and primary treatment, screens: types, hydraulics, velocity and head loss, design of screens, disposal of screenings. Grit chamber : sources of grit, importance of grit chamber, types, control of velocity, proportional flow weir, parshall flume, design of grit chamber, disposal of grit, skimming tanks: sources of oil and grease, importance of removal, methods of oil and grease removal. Equalization and neutralization tanks: introduction, application and benefits. Primary sedimentation tank: types of settling, types of sedimentation tanks, assumptions, efficiency, factors affecting efficiency, design of primary sedimentation tank.*

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Chapter 3 : Secondary Treatment: Aerobic Suspended Growth 3-1 to 3-34

Syllabus : *Aerobic secondary treatment: unit operations and processes for secondary treatment, principle of biological treatment, role of microorganism in wastewater treatment, types of microorganisms, microbial metabolism, microbial growth pattern in batch and continuous system, requirements of microbial growth. Activated sludge process (ASP): Conventional plug flow ASP, biochemical reactions, hydraulic and organic loading, F/M ratio, mean cell residence time, aeration method, oxygen requirement, assumptions, design of ASP, sludge volume index, sludge recycle and rate of return sludge, operational problems and maintenance in ASP, modifications in ASP.*

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Unit-IV

Chapter 4 : Secondary Treatment : Aerobic Suspended and Attach Growth 4-1 to 4-45

Syllabus : *Suspended growth system: oxidation pond: bacteria – algae symbiosis, design of oxidation pond, advantages & disadvantages of oxidation ponds. Aerated lagoons: Principle, advantages & disadvantages of aerated lagoons, design of aerated lagoon. Constructed wetlands, phytoremediation and root zone technology: principle, advantages, disadvantages, applications/attached growth system: trickling filter: principle, different TF media & their characteristics, standard rate and high-rate filters, single stage & two stage filters, design using NRC formula, recirculation, ventilation, under drain system, operational problems, control measures. Rotating biological contactors: Principle, advantages, disadvantages, applications.*

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Unit-V

Chapter 5 : Anaerobic Tertiary and Emerging Treatment 5-1 to 5-18

Syllabus : *Anaerobic treatment: septic tank: suitable conditions and situations, biological principle, method of treatment and disposal of septic tank effluent and design of septic tank. Anaerobic lagoon: principle, advantages & disadvantage, applications. Up-flow anaerobic sludge blanket (UASB) reactor: principle, advantages & disadvantage, applications. Tertiary (advanced) treatment: objectives, introduction to nutrients removal processes, adsorption, ion exchange, membrane processes, advanced oxidation processes, disinfection. Emerging wastewater treatment systems: sequencing batch reactor (SBR), membrane bio reactors (MBR), moving bed bio reactor (MBBR), fluidized membrane bio reactor (FMBR), packed bed reactor (PBR), advantages, limitations and applications.*

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Unit-VI

Chapter 6 : Sludge Management System & Reuse of Water 6-1 to 6-19

Syllabus : *Sludge management system: primary and secondary sludge, quantity and characteristics, sludge thickening by gravity thickener, sludge centrifugation, introduction to aerobic digestion, principle of anaerobic digestion, stages of digestion, bio – gas production, characteristics & applications, factors governing anaerobic digestion, design of sludge digestor, sludge dewatering, sludge drying beds, sludge incineration, sludge disposal/ reuse, challenges in sludge management. Wastewater recycle and reuse: driving factors for recycle and reuse, recycling of grey water, municipal sewage, storm water and industrial effluent, reuse opportunities in municipal, industrial, agricultural sector, regulatory guidelines: WHO, US EPA.*

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