

## **M.E programme in ‘Sanitation Science Technology and Management’**

It is a **Four semester Master of Engineering (M.E)** programme in ‘**Sanitation Science Technology and Management**’.

Details of the programme (Input criteria, List of Core courses and Electives, curriculum structure) are given below

**Preamble:** BITS Pilani K K Birla Goa campus has competency in the area of Sanitation and Wastewater treatment. Department of Biological Sciences has been discussing to introduce a master’s programme in the area of sanitation. We are already offering two courses in the area of Sanitation for the First Degree students. This is also recognized by EAWAG, Switzerland. A total of 119 students have completed these courses and another 148 students have registered for the same in this semester.

BITS Pilani K K Birla Goa campus have a strong research programme wherein Bill & Melinda Gates foundation have funded several research projects. BITS Pilani K K Birla Goa campus had also recently signed an MoU with International Water Association with an objective to focus on the same area of research.

In the meanwhile Bill and Melinda Gates Foundation and Institute for Water Education (IHE) Delft has launched a new Master of Science Program in Sanitation. IHE, Delft with sponsorship from Gates foundation would like to transfer this programme to other universities in other countries with partial funding. Their target is to generate 1000 professionals through their partnership with various Institutes across the world. BITS Pilani K K Birla Goa campus has been short listed as one of the university in this partnership.

### **Background**

Sustainable Development Goal 6 (SDG 6) focusses on Water and Sanitation and the tasks mentioned in SDG 6. Sanitation is also high on agenda of the Indian Government. Trained Postgraduate and working professionals are of high demand. Bill and Melinda Gates foundation had significantly invested in Water, Sanitation and Hygiene programme and they had funded UNESCO IHE and its 8 partners in developing e learning alliance. The foundation’s investment strategy in sanitation requires qualified and trained professionals. International Water Association (IWA) is an association of water professionals around the world and they too predicted the requirement of professional capacity needs in Water and Sanitation. According to IWA “The gap in 2014 was 700,000 individuals, but that gap has widened with the adoption of the Sustainable Development Goals.” [www.iwa-network.org/iwa-learn](http://www.iwa-network.org/iwa-learn).

## Input Qualification

Integrated First degree of BITS or its equivalent in the areas of Biology, Civil, Chemical Engineering, Chemistry. Any other M.Sc or BE with adequate preparations may be considered for this programme.

**Normal Duration:** Four semesters

## Program Structure

<b>M.E. Sanitation Science, Technology and Management</b>							
Semester-wise Pattern for Students Admitted in the First Semester							
Year	First Semester			U	Second Semester		U
I	SAN G511	Sanitation Technology		5	SAN G514	Sanitation financing, and Project Management	5
	SAN G512	Sanitation and Public Health		5	SAN G515	Emergency Sanitation & Leadership	5
	SAN G513	Sanitation Governance, Behaviour change and Advocacy		5	BITS G540	Research Practice	4
		Elective I		*		Elective II	*
			<b>18</b>			<b>17</b>	
II	BITS G562T Dissertation			16	BITS G563T Dissertation		16
				<b>16</b>			<b>16</b>

## Description of Courses

### Sanitation Technology

This course aims to give the participants a review of the fundamentals as well as the latest technological developments applied in the field of sanitation. Urban Drainage and Sewerage, Carbon, nitrogen and phosphorus removal & recovery; sludge treatment, Site evaluation; toilets; onsite sanitation systems; emptying and transport; established and transferring technologies for dewatering, stabilization, pathogen inactivation and nutrient management, urban low cost drainage, Innovation processes, Intro & Exercise technology selection tool / decision support system; discuss outcomes.

### Sanitation and Public Health

This course will have four modules – Introduction to Sanitation, Sanitation system and services, Public Health and Analysis of sanitation flow. Background on urban sanitation, Material flow analysis, Monitoring frameworks, Shit Flow Diagrams, Human Health Hazards and Waste,

Review and Assessment of Transmission Routes, Review and Assessment of Transmission Routes, Disease Cycles – Lifecycles & Vectors, Control Measures, Risk Evaluation Tools, Urban development trends, demography, Urban sanitation planning & programming.

### **Research Practice**

This course is designed to train the students towards acquiring competence in research methodologies. The course will be conducted in terms of actual participation in Research and Development Work. Each student will be assigned to a faculty member to work on specified projects. The student will be required to present a number of seminars in his research area in a structured manner.

### **Sanitation Governance & Behavioural change**

This particular course will have two modules – **Sanitation Governance** and **Behaviour change & Advocacy**. Water & sanitation governance: definitions, debates, controversies, Power relations among actors in the local and global levels: Gender, class & race relations and power asymmetries, Practices of coordination & decision, making around contested water distribution, Case studies on regulatory frameworks around the world– how is sanitation managed: where, how and why, Everyday sanitation from different perspectives. Behaviour with reference to Societal and cultural aspects, Types: Knowledge, motivations and reactions, Reinforcements: Norms and behaviour Settings.

### **Sanitation financing & Project Management**

This course will have two modules – **Sanitation Financing** and **Project Management**. Introduction to financial viability, CAPEX, OPEX, business models and PPP of sanitation project, Calculating CAPEX and OPEX of a sanitation project and developing a business model, Local authority/municipal budgeting and public/government financing, Key aspects of project management including stakeholders' relationship, people management, risk management, budget management, reporting, Objective Oriented Project Planning.

### **Emergency Sanitation & Leadership**

This course will have two modules – **Emergency Sanitation** and **Leadership**. The evolution of humanitarian aid: historical events and the humanitarian system as it stands today. Overview of the international legal framework (Refugee law, International Humanitarian Law-IHL, International Disaster Relief Law-IDRL), code of conduct and guiding principles of humanitarian action. Standards applied by relief agencies and global cluster, Sphere, WASH cluster. Disaster cycle, risk reduction/ response/ recovery/ development, emergency response phases. Overview of relief organizations, their mandates, their commitments and priorities in emergencies.

## **Electives**

### **Environmental Biotechnology & Solid Waste Management**

Principles, concepts and applications of Biotechnology to the management of environmental problems, Microbial technologies for waste management, Bioremediation of toxicants, Microbial systems for detoxification, Microbial technologies for waste management, Biochemical kinetics and engineering, Concept of rDNA technology, Regulation and ethics.

### **Environmental Management Systems**

Introduction to air & water pollutants & solid wastes; sampling & analysis techniques; impact of these on environment; national & international regulations; ISO series; conventional & nonconventional energy resources; life cycle analysis; environmental audit; sustainable developments; case studies.

### **Study in Advanced Topics**

In this course students will be assigned study work in advanced areas of professional interest. Each student will work under the overall supervision and guidance of a faculty member and will in the end submit a project report encompassing critical review of the material studied. The organisation and evaluation of the course would be achieved through seminars, group discussions, project report etc. The course will be conducted by the team of teachers who provide guidance for study work.

### **Biostatistics & Computers in Public Health**

Introduction to data classification, analysis and probability; statistical inference, estimation and hypothesis testing; linear regression and correlation; design of experiments; analysis of variance; non parametric procedures & tests; statistical quality control; experimental design in clinical trials and validation; basic techniques in optimization. Introduction to computer and its component, operating systems; principles and use of standard software packages having application in drug design, development, analysis, etc; principles of software creation; processing concepts, flow charting and algorithms, programming constructs, programming languages, program development sequence; information systems; need, significance concepts, their analysis, design and implementation; software life cycle with special reference to software planning and maintenance.

### **Bioconversion Technology**

Waste and by-product utilization; downstream processing; biogas production; principles of biodegradation process parameters; bioreactor design and operation; exploitation of waste streams enzyme-based bioconversions of high value products.

### **Environmental Health**

Environmental Health and its importance, water pollution, air pollution, automobile pollution, pollution due to chemicals used in agricultural sector, handling and disposal of domestic and industrial refuse, incineration of waste materials, techniques for studying, monitoring and controlling pollution, effect on health, vector control, effect of high frequency electromagnetic radiation, nuclear radiation, hazardous wastes, occupational health.

### **Water & Waste Water Treatment**

Water supply and waste water systems; capacity requirements; analysis of water and waste water; treatment requirements; unit operations and processes of treatment, design of treatment units; disposal of waste water and sludge; design of sewers and water distribution networks; rural sanitation; effluent repurification and reuse.