DEPARTMENT OF CIVIL ENGINEERING, MANIPAL UNIVERSITY JAIPUR

M. Tech. Non Sewered Sanitation

Year	FIRST SEMESTER						SECOND SEMESTER					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
I	CV61XX	Sanitation Technology	3	1	0	4	CV62XX	Emergency Sanitation	4	0	0	4
	CV61XX	Sanitation Flow Analysis	3	1	0	4	CV62XX	Project Management	3	1	0	4
	CV61XX	Sanitation and Public Health	3	1	0	4	CV62XX	Sanitation Behavior and advocacy	3	1	0	4
	CV61XX	Program Elective – I	4	0	0	4	CV62XX	Program Elective – II	4	0	0	4
	MA6104	Statistics, Probability and Reliability	3	0	0	3	CV62XX	Program Elective – III	4	0	0	4
	CV6170	Research Methodology	3	0	0	3	------	Open Elective	3	0	0	3
	CV6130	Environmental Engineering Lab - I	0	0	2	1	CV6230	Environmental Engineering Lab - II	0	0	2	1
	CV6180	Minor Project	0	0	2	1	CV6235	Seminar	0	0	2	1
							CV6280	Minor Project	0	0	2	1
			19	3	4	24			21	2	6	26
	Total Contact Hours (L + T + P)		26				Total Contact Hours (L + T + P) + OE		26 + 3 = 29			
II	THIRD & FOURTH SEMESTER											
	CV7080	Dissertation							0	0	0	25
									0	0	0	25
	Total Contact Hours (L + T + P) + OE								0			

Program Elective – I

1. CV61XX Leadership in Sanitation

Program Elective – II

2. CV62XX Sanitation Governance

Program Elective – III

3. CV62XX Research Theory & Practices

Open Elective

1. CV62XX Sanitation Financing

Syllabus of M. Tech. Non Sewered Sanitation

1st SEMESTER

CV61XX **Sanitation Technology** **[3 1 0 4]**

Introduction to types of onsite sanitation system – Introduction to different type of user interface, Types of containment system, Treatment mechanism of onsite sanitation system Twin pit latrine, septic tanks etc. Determination of Qualities and Quantities (Q&Q) of FS. Innovation in treatment technology such as solar septic tank, tiger toilet etc. Onsite sanitation treatment technologies :- Carbon, nitrogen and phosphorus removal & recovery; sludge treatment, Case Studies in Sanitation, Faecal sludge treatment technologies, Innovation processes, collection and transport, Introduction to Urban Drainage and Sewerage**.**

References

1. Elizabeth Tilley, Lukas Ulrich, Christoph Lüthi,Philippe Reymond, Roland Schertenleib and Christian Zurbrügg. *Compendium of*
2. *Sanitation Systems and Technologies*. Eawag,IEEE, Vancouver: IWA Publishing, 2016.
3. Ligon, David M robbins and Grant C. *How to design wastewater systems for local conditions in developing countries*. London SW1H 0QS, UK: IWA publishing, 2014.
4. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.
5. Miriam Englund, Linda Strande. *Faecal Sludge Management: Highlights and Exercises*. Switerzland: IWA publishing, 2019.
6. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.
7. Shubhra Singh, Riya Rachel Mohan etal. "Technology options for faecal sludge management in developing countries: Benefits and revenue from reuse." *Environmental Technology & Innovation* (2017).

CV61XX **Sanitation Flow Analysis** **[3 1 0 4]**

Analysis of sanitation streams, Details of Solid in sludges , measure of organic and inorganic in FS, determination of quantity of faeces and urine, parameters tested should include chemical, physical and biological, Classification of waste types, Current legislation, Introduction to sanitation streams as a raw material, Introduction to FSSM policy India and Implementation status, Analysis using Shit Flow Diagram, Review of potential Laboratory - Review of pollution and health issues associated with sanitation streams, Sanitation streams and typical characteristics.

References

1. Development, Ministry of Urban. *National Policy on Faecal Sludge & Septage Management*. National Policy. New Delhi: Government of India, 2017.
2. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.
3. Miriam Englund, Linda Strande. *Faecal Sludge Management: Highlights and Exercises*. Switerzland: IWA publishing, 2019.
4. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.
5. Suresh Kumar Rohilla, CSE, Bhitush Luthra, CSE. *SFD Promotion and Initiative* . Annual Report. Delhi: Centre of Science & Environment , 2016. English.

CV61XX **Sanitation and Public Health** **[3 0 1 4]**

Biological characteristics and lifecycles of sanitation-relevant pathogens – Introduction, human health hazards related to excreta, pathogens and transmission routes associated with human excreta, non-infectious health issues related to sanitation, and control measures to protect public health Control Measures, Human Health Hazards and Human Excreta – enteric infection and its impact. Introduction to Public Health – Child Undernutrition , Non-infectious Public Health Issues Related to Sanitation, Review and Assessment of Transmission Routes, Risk Evaluation Tools.

References

1. Development, Ministry of Urban. *National Policy on Faecal Sludge & Septage Management*. National Policy. New Delhi: Government of India, 2017.
2. Elizabeth Tilley, Lukas Ulrich, Christoph Lüthi,Philippe Reymond, Roland Schertenleib and Christian Zurbrügg. *Compendium of Sanitation Systems and Technologies*. Eawag,IEEE, Vancouver: IWA Publishing, 2016.
3. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishi
4. ng, 2014.
5. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.

MA6104 **Statistics, Probability and Reliability** **[3 0 0 3]**

Basics of Statistics: Random Variables and its Properties. Applications of Mean, Median, Mode, Standard Deviation, Correlation Coefficient in Analyzing Quality Related Data, Preliminary Analysis of Data by Graphical Representation, Measure of Central Tendency Dispersion, Peakedness in Context with Construction Industry and Quality Control Problems, Dependent Variables, Co-Relation, Co-Relation Coefficient and It's Significance; Basic Probability: Probability of Discrete and Continuous Variables, Probability Mass Function, Probability Density Function, Cumulative Density Function, Discrete and Continuous Standard Probability Distributors and their Properties, Central Limit Theorem, Equivalent Normal Distribution for Non-Normal Distributions, Utilization of Random Events, Measures of Probability Concepts for Quality Control Related Issues, Applications of Frequency Distribution and Probability, Probability Distributors, Continuous And Discrete Distributions in Analyzing Data Related to Process and Quality Control, Goodness of Fit Tests, Chi-Square Test, Kolmogorov-Smirnov Goodness of Fit Test and Two Sample Test, Monte-Carlo Simulation; Reliability Analysis: Concept of Reliability, Risk and Safety Factors. Safety Margin Function, Reliability Index, FOSM Method of Reliability Analysis, Application of FOSM to Linear and Non Linear Safety Margin Functions-Hasofer-Lynd Method.

References:

1. B. Leland, "*Stastical Procedure for Engineering, Management and Science*", Mc-Graw Hill Series in Industrial Engineering and Management Science, 1982.
2. T. Angand , "*Probability Concepts in Engineering Planning and Design"*, Vol. I and II, Wiley International, 1984.
3. N.T. Kottegoda, R. Rosso, "*Statistics, Probability and Reliability for Civil and Environmental Engineers"*, Mc-Graw Hill International, 1998.
4. D.D. Wackerly, W. Mendenhall and R. L. Scheaffer, "*Mathematical Statistics with Applications"*, 7th Edition, Thomson Brooks Cole, 2008.
5. K.M. Ramachandran, C.P. Tsokos, *"Mathematical Statistics with Applications*", Academic Press, 2009.

CV6170 **Research Methodology** **[3 0 0 3]**

Research: Meaning, Definitions, & Purpose of Research, Review of Literature, Problem Formulation (How to Select a Topic for Research), Research Proposal, Variables, Hypothesis, Objectives of Research Topic, Population; **Sampling**: Meaning & Types; **Data**: Types, Techniques - Characteristics of a Good Test, Classification, Tabulation & Graphical Re-Presentations & Coding of Data, Use of SPSS Software; **Analysis of Data**: Mean, Median, Mode, Correlation, Regression, Normal Distribution, Hypothesis Testing, Report

Writing; ***Thesis Writing And Journal Publication**: Writing Thesis, Writing Journal and Conference Papers, IEEE and Harvard Styles of Referencing, Effective Presentation, Copyrights, and Avoiding Plagiarism.

References:

1. Cooper D.R., Schindler P.S., *"Business Research Methods"*, Tata McGraw Hill Publication, New Delhi.
2. Kothari C.R., "*Research Methodology Methods and Techniques*", New Age International Publication, New Delhi, 2006.
3. Sharma K.R., "*Operational Research & Quantitative Techniques*", Kalyani Publications,
4. Kapoor V.K., "*Operational Research*", Sultan Chand & Co.
5. Creswel J.W., "*Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*", SAGE, 2004.
6. Beat John W., Kahn James V., "*Research in Education*", 10th Edition, Eastern Economy Edition, PHI Leaning Pvt. Ltd. New Delhi.
7. Wagner W.E. III, IBM, "*SPSS Statistics*", 4th Edition, SAGE Publication.Com.
8. Khan A.J., Raeside R., White D., "*Research Methods for Graduate Business & Social Sciences Students*", Response Book, Business Books from SAGE, New Delhi.

CV6130 Environmental Engineering Lab – I [0 0 2 1]

Analysis of water/wastewater for physicochemical parameters: Turbidity, alkalinity, pH, hardness, chlorides, sulphates, ammonical nitrogen, nitrates, sulphate, oil and grease, available chlorine, dissolve oxygen, biochemical oxygen demand, chemical oxygen demand. Residual chlorine and chlorine demand, determination of available chlorine in Bleaching powder, Determination of Calcium, Potassium and Sodium. Determination of heavy metals in aqueous solution – Chromium, Lead and Zinc. Coagulation and flocculation of water – optimization of dose / pH / time of flocculation. Characteristics of Industrial wastewater. Analysis of solid wastes: characterisation of wastes from different industries.

References

1. Standard Methods for the Examination of Water and Waste Water - ALPHA - AWWA – WPCF.
2. Sawyer C. McCarty P. and, Parkin G., *Chemistry for Environmental Engineering,* McGraw Hill, New York. 1994.

CV6180 Minor Project [0 0 2 1]

Second Semester

CV62XX Emergency Sanitation [4 0 0 4]

Development of a sanitation plan, Humanitarian contexts; Humanitarian reform and standards; Cluster approach, Humanitarism; History of humanitarian action; Humanitarian principles and dilemma's; Code of conduct and guiding principles of humanitarian action, Identification of key diseases in emergencies and their link to the Bradley classification; Vectors of importance in emergencies related to excreta and solid waste; Case study: vector control, Introduction to the WASH cluster; SPHERE standards, Key excreta disposal, collection, transportation and treatment options; Adaptability; Cultural and behavioural aspects; Inclusiveness and inter-sectoral considerations; Putting planning into practice , Needs assessment; Monitoring and evaluation , Solid waste management standards and planning; Health-care waste management concepts and technologies , The legal framework; International Relief System; Key actors in humanitarian relief.

References

1. Cross, group of NGOs and the Red. *The Humanitarian Charter and Minimum Standards in Humanitarian Response*. Hampshire, United Kingdom: The Sphere Project, 2011. Handbook.

2. Elizabeth Tilley, Lukas Ulrich, Christoph Lüthi,Philippe Reymond, Roland Schertenleib and Christian Zurbrügg. *Compendium of Sanitation Systems and Technologies*. Eawag,IEEE, Vancouver: IWA Publishing, 2016.

3. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.

4. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.

CV62XX **Project Management** **[3 1 0 4]**

Context analysis, Finalize project plan, Good practices and criteria for good project proposals**,** Indicators for project implementation and operation, Indicators for validation of results/impact, Introduction to case study and group assignment, Key elements of project planning, Monitoring, evaluation and learning (MEL) frameworks/Monitoring for Results vs Implementation, MS Project, Options Analyses, Multi-Criteria Analyses, Problem analysis, Project Human Resources, Project management cycle, Project plan to implementation plan, Project Planning Software, Recap/Transfer Exercise of previously developed project plan, Resource disposition, Results-based Project Management, Risk assessment and mitigation, Stakeholder analysis, Stakeholder management, Task Planning and Work Breakdown Structure (WBS), Theory of Change - Assumptions and justifications, Map Conditions, select a path of change

References

1. Basyal, Isha. "Faecal Sludge Management Toolbox." 2017. Document.
2. Cross, group of NGOs and the Red. *The Humanitarian Charter and Minimum Standards in Humanitarian Response*. Hampshire, United Kingdom: The Sphere Project, 2011. Handbook.
3. Elizabeth Tilley, Lukas Ulrich, Christoph Lüthi,Philippe Reymond, Roland Schertenleib and Christian Zurbrügg. *Compendium of Sanitation Systems and Technologies*. Eawag,IEEE, Vancouver: IWA Publishing, 2016.
4. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.
5. Miriam Englund, Linda Strande. *Faecal Sludge Management: Highlights and Exercises*. Switerzland: IWA publishing, 2019.
6. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.

CV62XX **Behaviour Change & Advocacy** **[3 0 0 3]**

Behaviour: Definitions & concepts; & Change & advocacy Sanitation & behaviour change: Actors and behaviour across the sanitation chain; Evolution and current thinking in urban sanitation programming; & Behaviour change strategies - Promoting change via persuasion & policy vs education/awareness raising, Behaviour change frameworks, Behaviour change intervention design, Occupational health & safety, Community-Led Total Sanitation (CLTS), Public policy & behaviour, Media & advocacy, Sanitation, behaviour change & advocacy

References

1. D.J. Barringtona, b,c,∗, S. Sridharana,1, K.F. Shieldsd,2, S.G. Saundersa,3, R.T. Souterb,4, J. Bartramd,2. "Sanitation marketing: A systematic review and theoretical critique using the capability approach." *Social Science & Medicine* (2017): 128-134. Research Paper.
2. Development, Ministry of Urban. *National Policy on Faecal Sludge & Septage Management*. National Policy. New Delhi: Government of India, 2017.
3. Elizabeth Tilley, Lukas Ulrich, Christoph Lüthi,Philippe Reymond, Roland Schertenleib and Christian Zurbrügg. *Compendium of Sanitation Systems and Technologies*. Eawag,IEEE, Vancouver: IWA Publishing, 2016.

4. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.

5. Miriam Englund, Linda Strande. *Faecal Sludge Management: Highlights and Exercises*. Switerzland: IWA publishing, 2019.

6. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.

CV6230 Environmental Engineering Lab – II [0 0 2 1]

Examination of micro-organisms: Microscopic examination – preparation of bacterial smear – Hanging drop technique – plate count test, MPN tests and MFT tests, staining techniques, isolation and growth of bacteria. Sampling and analysis of inorganic and organic substances. Determining Calorific value, BMP of Faecal Sludge.

References

1. Standard Methods for the Examination of Water and Waste Water - ALPHA - AWWA – WPCF.

2. Sawyer C. McCarty P. and, Parkin G., *Chemistry for Environmental Engineering,* McGraw Hill, New York. 1994.

3. IS - 3025 - 1964 - *Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry*, IIT New Delhi.

CV6235 Seminar [0 0 2 1]

CV6280 Minor Project [0 0 2 1]

PROGRAMME ELECTIVES

1st Semester

CV61XX Leadership in Sanitation [4 0 0 4]

Concepts of leader, leadership, and management, Change Management and Theory of Change. 70:20:10 rule in leadership development, negotiation in wash projects, role of vision and strategy in wash intervention, conesus buiilding and conflict management in wash projects – source of confluict, structure, systems, culture and individuals. concept of emotional intelligineee and components of e motional intelligence. Individual leadership development plan for wash related project.

References

1. André TaylorA, Wouter T. Lincklaen ArriënsB and Matthew LaingC. "Understanding Six Water Leadership Roles: A Framework to Help Build Leadership Capacity." *Water Policy & Practice* (2015): 4-31. Journal Paper.

2. Cross, group of NGOs and the Red. *The Humanitarian Charter and Minimum Standards in Humanitarian Response*. Hampshire, United Kingdom: The Sphere Project, 2011. Handbook.

3. David V. Day a, ∗, John W. Fleenor b, Leanne E. Atwater. "Advances in leader and leadership development: A review of 25 years of research and theory." *The Leadership Quarterly* (2013): 63-82.

4. Development, Ministry of Urban. *National Policy on Faecal Sludge & Septage Management*. National Policy. New Delhi: Government of India, 2017.

5. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.

6. Miriam Englund, Linda Strande. *Faecal Sludge Management: Highlights and Exercises*. Switerzland: IWA publishing, 2019.

2nd Semester

CV62XX Sanitation Governance [4 0 0 4]

Introduction to governance - regulatory frameworks around the world– how is sanitation managed: where, how and why, Contextualizing sanitation: the politics of urban waste, sanitation from different perspectives, Formal and informal regulation, regulatory impact assessment, Governance alternatives amongst the "crisis of imagination", 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, Sanitation history. What does history have to do with all this? : Sanitation in colonial contexts, Sanitation history. What does history have to do with all this? : Sanitation in Europe main cities, Shifting sanitation governance in light of justice concerns, The different actors and decision making processes, Water & sanitation governance: definitions, debates, controversies

References

1. D.J. Barringtona, b,c,∗, S. Sridharana,1, K.F. Shieldsd,2, S.G. Saundersa,3, R.T. Souterb,4, J. Bartramd,2. "Sanitation marketing: A systematic review and theoretical critique using the capability approach." *Social Science & Medicine* (2017): 128-134. Research Paper.
2. Development, Ministry of Urban. *National Policy on Faecal Sludge & Septage Management*. National Policy. New Delhi: Government of India, 2017.
3. Elizabeth Tilley, Lukas Ulrich, Christoph Lüthi,Philippe Reymond, Roland Schertenleib and Christian Zurbrügg. *Compendium of Sanitation Systems and Technologies*. Eawag,IEEE, Vancouver: IWA Publishing, 2016.
4. GUERRERO, TATIANA ACEVEDO. "A tale of an unequal city: Delhi's waters through the eyes of women working as domestic workers." *A tale of an unequal city: Delhi's waters through the eyes of women working as domestic workers* 23 03 2017.
5. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.
6. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.
7. Vidal, Cecilia Alda. *Connecting cultures, practices and sanitary systems, a case study from urban SSA/Malawi*. Manchester: cecilia.aldavidal@postgrad.manchester.ac.uk, 2017.

CV62XX Research Theory & Practices [4 0 0 4]

Critical Reading and Academic writing- Discourse markers, paraphrasing and plagiarism, Ethics in research and consent, Introduction to research portfolio, proposal template instruction, Presentation skills, Referencing guidelines- Plagiarism awareness and basics of literature search, Research - Training on specialised tools according to research needs, Research proposal defence, Field research, Data analysis, Thesis writing, Thesis defence.

References

1. BMGF. "Gender and The Sanitation Value Chain: A review of evidence." 2018. Report.
2. Borja-Vega, Luis Andres Christian. "Overview and Meta-Analysis of Global Water, Sanitation, and Hygiene (WASH) Impact Evaluations." *Water Global Practice* (2018): 1-34. Working Paper.
3. D.J. Barringtona, b,c,∗, S. Sridharana,1, K.F. Shieldsd,2, S.G. Saundersa,3, R.T. Souterb,4, J. Bartramd,2. "Sanitation marketing: A systematic review and theoretical critique using the capability approach." *Social Science & Medicine* (2017): 128-134. Research Paper.

4. DOUCET, ANDREA. *FEMINIST METHODOLOGIES AND EPISTEMOLOGY*. Carleton University, Canada: Carleton University, Canada, 2006. Book.

Open Elective

CV62XX **Sanitation Financing** **[3 0 0 3]**

Business canvas, Business models in sanitation, Financial Flow in business model, FSM Technical and Financial Assessment Tool, Innovative financing for sanitation, National context - sanitation financing: decentralisation and local authority finances, Overview of sanitation financing, Public Private Partnership (PPP) in sanitation, Saniplan Tool - financing model, Sanitation financing - modalities and challenges, Sanitation service and value chain, Sustainability in sanitation

References

1. Linda Strande, Mariska Ronteltap, Damir Brdjanovic. *Faecal Sludge Management: Systems Approach for Implementation and Operation*. London SW1H 0QS, UK: IWA Publishing, 2014.

2. Miriam Englund, Linda Strande. *Faecal Sludge Management: Highlights and Exercises*. Switerzland: IWA publishing, 2019.

3. Organisation, World Health. *Guidelines on Sanitation and Health*. Geneva: World Health Organisation, 2018. English.