

K J Somaiya College of Science & Commerce, Vidyavihar , Mumbai 400 077
Autonomous (affiliated to University of Mumbai),Reaccredited A grade by NAAC
In Collaboration with
National Solid Waste Association of India (NSWAI)
Reg. PTR No 77213(Mumbai)

TEACHING AND EXAMINATION SCHEME

Program Name: PG DIPLOMA IN INTEGRATED SOLID WASTE MANAGEMENT & ENGINEERING

Program Code : 18PGDSWM

Duration Of Course : ONE YEAR

Year/Semester: First Year (Implementation From 2018-19)

Pattern : Full Time – Yearly **Scheme - B**

Sr. No.	Teaching Scheme				Examination Scheme & Maximum Marks					
	Subject Title With Code No.	Subject Code	TH	PR	Paper Hours	TH	PR#	SW	TW@	
1	Introduction to Solid Waste Management	18PGD SWM1	4		3	75		25		
2	Hazardous Waste Management	18PGD SWM2	4		3	75	50	25		
3	Environmental Policies And Legislation	18PGD SWM3	4		3	75		25		
4	Sustainable Techniques In Municipal Solid Waste Management Plan- Case Studies	18PGD SWM4	4		3	75		25		
5	Management Of Urban Waste Services	18PGD SWM5	4		3	75		25		
6	Integrated Solid Waste Management	18PGD	4		3	75	50	25		

		SWM6							
7	Elective paper 1 Engineering Design And Technological Aspects Of ISWM	18PGD SWM7	4	3	75	50	25		
8	Elective Paper 2- Waste to resources	18PGD SWM8	4	3	75	50	25		
9	Project Work	18PGD SWMP	8	Dissertation /project report and Viva				200	
					800	200			1200

STUDENT CONTACT HOURS PER WEEK (FORMAL TEACHING): **33 HRS.THEORY AND PRACTICAL PERIODS OF 45 MINUTES EACH.**

TOTAL MARKS: **1320**

ABBREVIATIONS : TH - THEORY, TU - TUTORIAL, PR - PRACTICALS, OR - ORAL,

TW -TERM WORK, # - EXTERNAL, @ - INTERNAL

- **Assessment of practical, oral and term work are to be done as per the prevailing norms for curriculum implementation and assessment.**
- **Exemption shall not be granted to any student under any circumstances.**
- **External examiner shall not insist upon practical on Appliances/ Vehicles in practical examination of Fire Service Equipment & Appliances.**
- **For sessional marks - 2 theory class tests of 25 marks each are to be conducted. Average is to be considered. Total marks are to be converted to the base of 100.**

COURSE NAME: Introduction to Solid Waste Management

COURSE CODE: 18 PGD SWM1

YEAR: FIRST

SEMESTER: FIRST

SUBJECT CODE:

Teaching and Examination Scheme

Teaching Scheme (Hrs)			Examination Scheme (Marks)				
TH	PR	TW	TH	PR	TW	OR	SW
3	4	10	75			--	25

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)

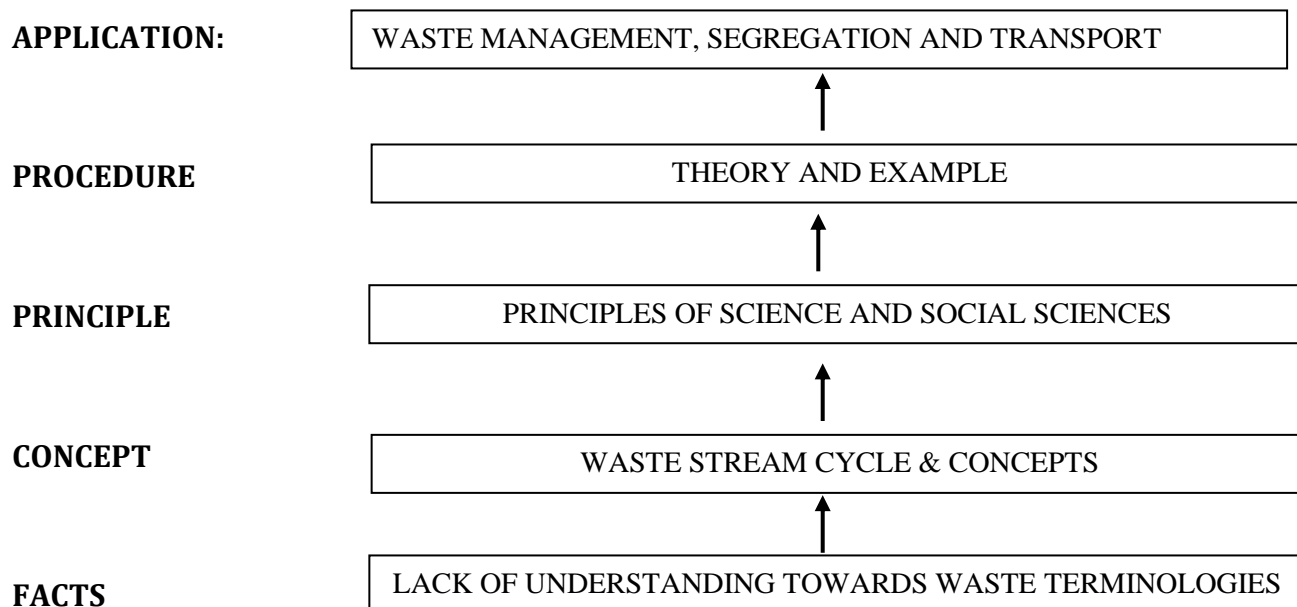
RATIONALE:

This paper is a knowledge built up for chapters that are to come in this course. It will build a basic understanding of solid waste management and help in shaping positive attitude towards understanding waste cycle

LEARNING OBJECTIVES

- Introduction to working biological system and its importance in waste management
- Introduce participants to various terminologies and definitions in waste management.
- Understand basics of waste disposal cycle.
- Understand precursors of waste processing

LEARNING STRUCTURE



PAPER - I			
Introduction to Solid Waste Management			
Chapter	Contents	Marks	Hours
1	Introduction to Environment Ecosystem and Waste What is Waste – definition by various organizations such as World Bank, WHO, UNEP etc	5	1
	Types of Waste and segregation categories: Municipal solid waste; Bio - medical waste; E-waste; Construction & Demolition waste and Hazardous waste, Plastic	4	1
	Sources of Generation of Solid Waste: The changing nature, quantity, composition in urban and rural areas of India and World. (Households, Vegetable Markets, Street Cleaning, Recreational Grounds and Parks, Education Institutions, Corporate and Business Centers, Religious Institutions, Function Halls/Grounds, Hotels, Hospitals, Recreational and Entertainment Places)	6	3
2	Composition and Characteristics: Physical characteristics of waste: quantity, moisture content, bulk density, size, chemical nature of waste. Reasons for changing composition of waste: Consumption pattern, economic growth and purchase power in developed and developing countries.	10	5

	Effect of regional and cultural attributes in waste composition		
3	<p>Collection, Transfer and Storage Collection of Solid waste – collection services – collection system, equipments – time and frequency of collection – labour requirement – factors affecting collection – analysis of collection system – collection routes – preparation of master schedules.</p> <p><u>Transfer and Transport</u>: Need for transfer operation – transfer stations – types – transport means and methods – location of transport stations - Manpower requirement – collection routes: Transfer stations – selection of location, types & design requirements, operation & maintenance.</p> <p>Mechanical and Manual road sweeps</p> <p>Storage:- Colour coding, type of storage equipment, types of storage bins</p>	30	18
4	<p>Processing Techniques and Recovery of Energy Processing techniques – purposes mechanical volume reduction – necessary equipments – chemical volume reduction – incinerators – mechanical size reduction selection of equipments – components separation – methods – drying and dewatering.</p> <p>Recovery of Resources Conversion products and energy recovery – recoverable materials – processing and recovery systems – incineration with heat recovery.</p>	25	15
5	<p>Disposal of Solid Wastes various methods – incinerations – principle features of an incinerator – site selection and plant layout of an incinerator - sanitary landfill- methods of operation – advantages and disadvantages of sanitary land fill - site selection – reactions accruing in completed landfills – gas and leachate movement and control – equipments necessary. Organic waste treatment technologies</p>	25	15
Total		100	60
PRACTICAL COMPONENT			
TERM WORK			

References:

Sr. No.	Author	Title	Publication
1	GeorgeTechobano glousetal.	IntegratedSolidWasteManagemement	McGraw-Hill, 1993
2	Techobanoglous,	SolidWasteEngineeringPrinciples	McGraw-Hill, 1997

	ThiesenEllasen	andManagement	
3	R.E.Landrefh and P. A. Rebers	MunicipalSolidWastes- Problems&Solutions	Lewis, 1997.
4	Ministry of Urban Development	Manual on Municipal 1 Solid waste Management,	CPHEEO Ministry of Urban Development, Govt. Of. India, New Delhi, 2000.
5	Blide A.D.&Sundaresa n, B.B.	Solid Waste Management in Developing Countries	INSDOC, 1993.
6	Claude Fourie, Christian Ferra, Paul Medori, TeanDevaux,	Ecology Science and Practice	Oxford and IBH Publishing Co (Pvt) LTD, special Indian edition.
7	P.S.Verma, V.K.Ag arwal	PrinciplesofEcology	S.Chand&Compan y(Pvt)LTD 1989.

COURSE NAME: Hazardous Waste Management

COURSE CODE: 18 PGD SWM2

YEAR: FIRST

SEMESTER: FIRST

SUBJECT CODE:

Teaching and Examination Scheme

Teaching Scheme (Hrs)			Examination Scheme (Marks)				
TH	PR	TW	TH	PR	TW	OR	SW
3	4	10	75	50		--	25

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)

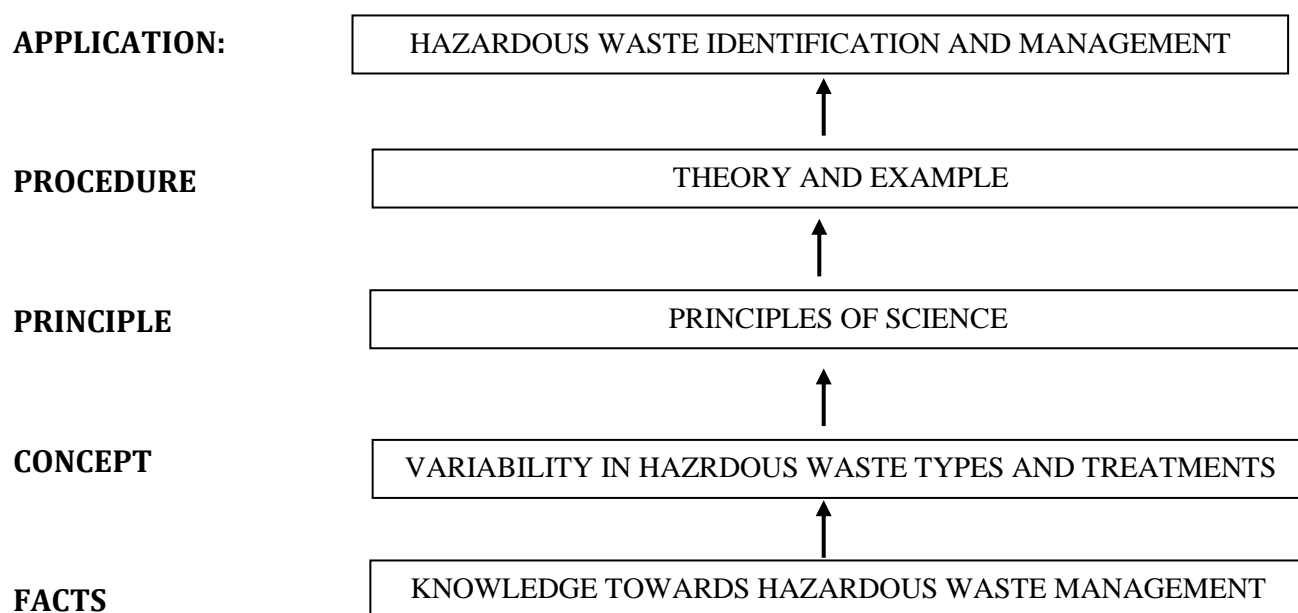
RATIONALE:

Paper will enhance knowledge of participants regarding various hazardous waste that are present in the waste stream and will build their acumen towards handling and disposal of these wastes. This will not only enable them to segregate the waste but also develop a better and safe working environment.

LEARNING OBJECTIVES

- Understand various types of hazardous wastes and their source of origin.
- Create knowledge base towards various ways of generation of biomedical waste, impacts and its management
- Understand various ways of generation of nuclear waste, impacts and its management
- Apprehend the hazardous waste management cycle and concept of sanitary landfill.

LEARNING STRUCTURE



PAPER - II			
Hazardous Waste Management (Total Hours - 60)			
Chapter	Contents	Marks	Hours
1	Introduction to Hazardous Waste Need for hazardous waste management – Sources of hazardous wastes – Effects on community – terminology and classification – Storage and collection of hazardous wastes – Problems in developing countries – Protection of public health and the environment	10	5
2	Nuclear wastes and e-waste Characteristics – Types – Nuclear waste – Uranium mining and processing – Power reactors – Refinery and fuel fabrication wastes – spent fuel– Management of nuclear wastes – Decommissioning of Nuclear power reactors– Health and environmental effects.	25	15
3	Biomedical and chemicalwastes Biomedical wastes – Types – Management and handling – control of biomedical wastes Chemical wastes – Sources – Domestic and Industrial - Inorganic pollutants – Environmental effects – Need for control – Treatment and disposal techniques – Physical, chemical and biological processes – Health and environmental effects.	25	15
4	The scientific landfill Concept – function – site selection and approval –	15	10

	acceptable wastes – Design and construction – Liners: clay, geo-membrane, HDPE, geo-net, geotextile– Treatment and disposal of leachate – Combined and separate treatment. Site remediation – Remedial techniques.		
5	Management of hazardous wastes Hazardous waste – methods – Quantities of hazardous waste generated – Components of a hazardous waste management plan – Hazardous waste minimization – Disposal practices in Indian Industries – Future challenges.	25	15
	TOTAL	100	60
	PRACTICAL COMPONENT	50	30
	TUTORIAL WORK		

Reference

Sr. No.	Author	Title	Publication
1	J. Glynn Henry and Gary. W. Heinke,	Environmental Science and Engineering	Pretice Hall of India, 2004.
2	A. D.Bhide and B.B.Sundaresan	Solid Waste Management – Collection, Processing and disposal	Mudrashilpa Offset Printers, Nagpur, 2001
3		Biomedical waste (Management and Handling) Rules	GOV, 1998. 10

COURSE NAME: ENVIRONMENTAL POLICIES AND LEGISLATION

COURSE CODE: 18 PGD SWM3

YEAR: FIRST

SEMESTER: FIRST

SUBJECT CODE:

Teaching and Examination Scheme

Teaching Scheme (Hrs)			Examination Scheme (Marks)				
TH	PR	TW	TH	PR	TW	OR	SW
3	4	10	75			--	25

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)

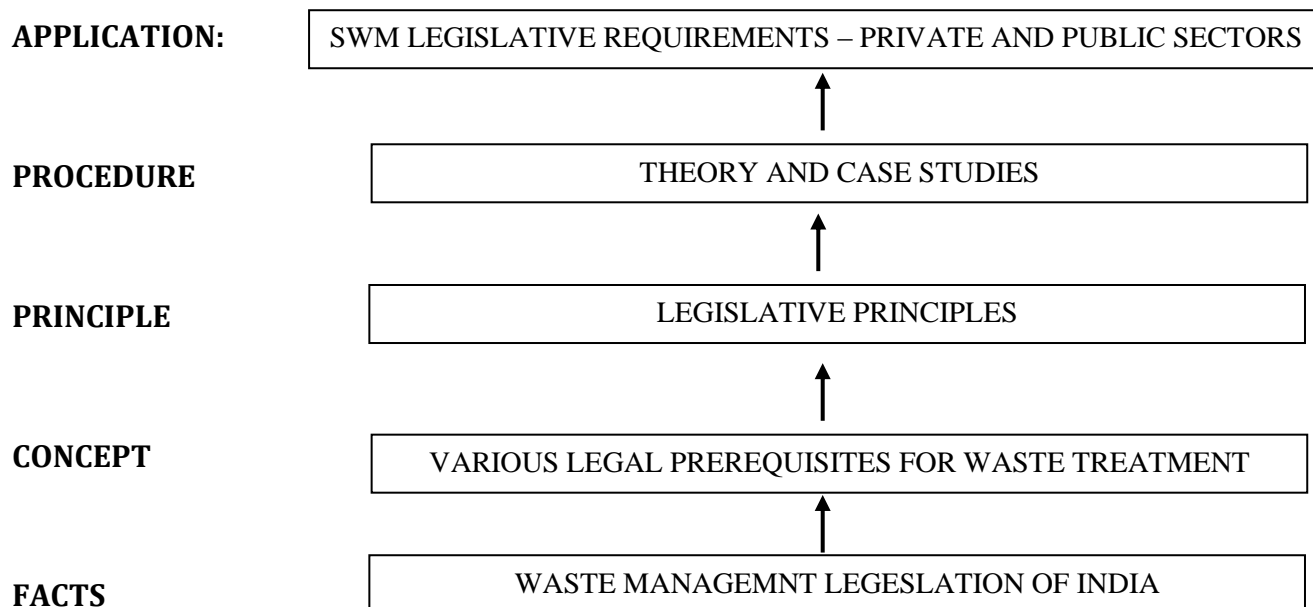
RATIONALE:

This course Paper will enhance knowledge of participants regarding various environmental laws existing in India

LEARNING OBJECTIVES

- To introduce the History and background of Environmental protection act and other environmental laws in India
- Understand various types of rules and laws pertaining to solid waste management.
- Enable analytical and thinking abilities for critical analysis of existing environmental policies for municipal solid waste management
- .to discuss case studies on Impact of environmental protection and waste management legislations .

LEARNING STRUCTURE



PAPER - III			
ENVIRONMENTAL POLICIES AND LEGISLATION (Total Hours - 60)			
Chapter	Contents	Marks	Hours
1	Unit – I Environment Definitions and Acts Environment definition in Indian law- Different environmental protection legislations- History of Environmental protection in India - Provisions in Indian Penal Code for Environmental protection-The constitutions of India – Union list- State list – Concurrent list - Panchayats and Municipalities role		12
2	Water (prevention & control of Pollution) Act & Air (prevention & control of Pollution) Act Water pollution – definition – Water (Conservation and protection) Act 1974 – Objectives of Water Act – Legislation to control water pollution – Functions of CPCB and SPCB - Local bodies role – Water (prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Water (prevention and control of pollution) Rules 1975 - Water (prevention & control of Pollution) Cess Act 1977 as amended by Amendment Act 1987 and relevant notifications - Tolerance limits for effluents discharge and drinking water - Constitution and Resources management and pollution control – Air (prevention & control of Pollution) Act 1981-Sections of Air (prevention & control of Pollution) Act 19, 20, 21, 22-Penalties -Ambient air quality standards-Noise and the Laws		12

3	Environmental (Protection) Act 1986 (13hrs) Environment and pollution –definition as per Environmental law-General powers of Central and state Government under EPA-Important Notification in EPA 1986- The Indian Forest Act 1927- Forest Conservation Act 1980 - Wild Life (Protection) Act - Constitution of Pollution Control Boards - Powers, functions, Accounts, Audit etc. – Equitable remedies		12
4	Municipal Solid Waste Management Rules Solid waste management – Hazardous Wastes (Handling and Management) Rules 1998-Bio-medical Wastes (Handling and Management) Rules 1998-Recyclled plastics (Manufacture and Usage) Rules, 1999-Municipal Solid Waste Management Act 2003- Rules - E.I.A and Public Hearing- Ecolabeling-Eco Mark		12
5	Coastal Regulation Zone Notification and Green Benches Coastal Regulation Zone - definition-Importance of coral reef-Regulation activities in CRZ - The Biological Diversity Act 2002-Bio diversity Rules 2004- The Intellectual Property Rights (IPR)-National Environment Appellate Authority – Environmental Tribunal and Green Benches - Some Important cases on Environment - International Conventions - Protocols for protection of the Environment and Solid waste		12
	TUTORIAL COMPONENT	100	60
	PRACTICAL /CASE STUDY		
	TUTORIAL WORK		

Reference

Sr. No.	Author	Title	Publication
1	J.N. Pandey 1997 (31st Edn.)	Constitutional Law of India	Central Law Agency Allahabad
2	Law U.P.D. Kesari 1998	Administrative Law	Universal Book Trade Delhi
3	H.N. Tiwari	Environmental Law	Allahabad Law. Agency 1997
4.	Divan and Noble M. Tripathi	Environmental Law and Policy in India (cases, Materials and Statutes) 1991	
5.		Environmental Policy. Forest Policy. Bare Acts	Government Gazette Notifiaciton
6.		Environmental Laws of India	C.P.R. Environmental Education Centre

**COURSE NAME: Sustainable Techniques in Municipal Solid Waste
Management Plan- Case Studies**

COURSE CODE: 18 PGD SWM 4

YEAR: FIRST

SEMESTER: FIRST

SUBJECT CODE:

Teaching and Examination Scheme

Teaching Scheme (Hrs)			Examination Scheme (Marks)				
TH	PR	TW	TH	PR	TW	OR	SW
3	4	10	75			--	25

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)

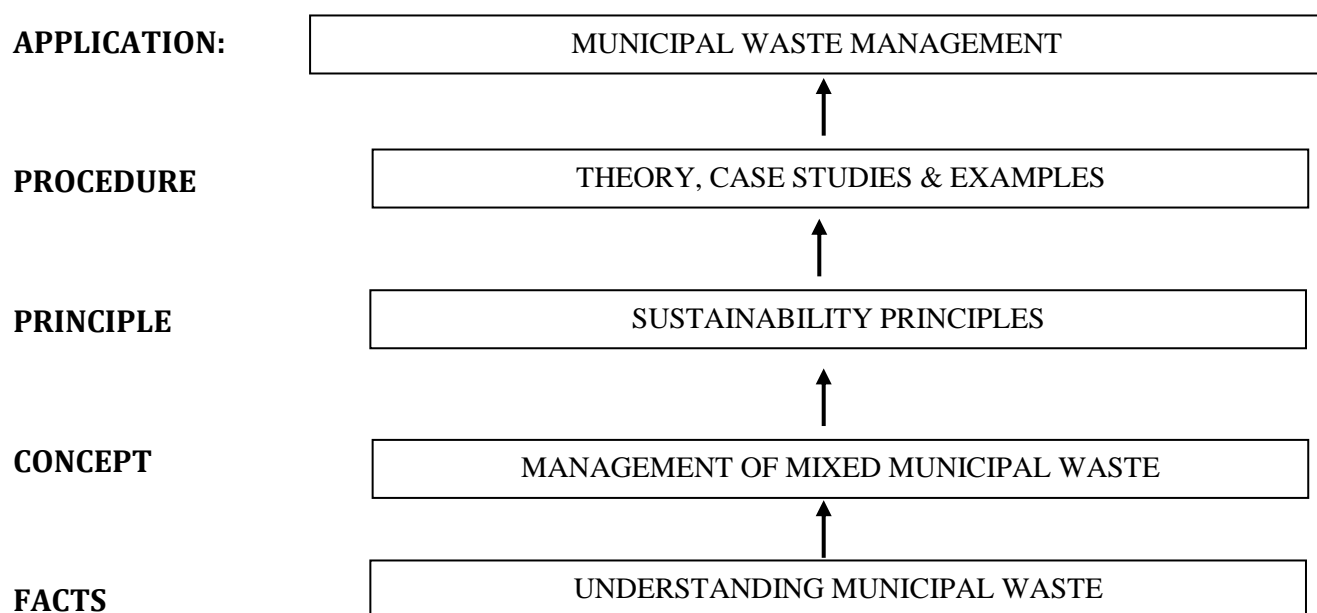
RATIONALE:

Municipal solid waste is a variable mixture of many types of wastes. This poses a greatest challenge towards solution providers. This chapter is designed to enhance the knowledge of this mixed waste and key concepts in its treatment cycle based on sustainability processing.

LEARNING OBJECTIVES

- Acquire knowledge about Municipal solid waste source reduction through household segregation and treatments
- Enhance skills on material recovery and recycling
- Understand the public private partnership projects and rationale behind their execution.

LEARNING STRUCTURE



PAPER - IV			
SUSTAINABLE TECHNIQUES IN MUNICIPAL SOLID WASTE MANAGEMENT PLAN- CASE STUDIES (Total Hours - 60)			
Chapter	Contents	Marks	Hours
1	Principles of Sustainability Concept of Sustainable development, climate change and waste management	17	10
2	Sustainable Techniques for MSWM Introduction Segregation on-Sorting-Composting-Vermi composting- Home composting- Recycling and Reuse- Incineration method-Scientific Land filling Energy development	17	10
3	Composting, Incineration and Land filling Definition and concepts-	25	15
4	Reuse and Recycling Techniques Need for the concept-Variou Types – - Handmade Paper production – Reuse of materials-Recycle of materials Some case studies	25	15
5	Concept of Public Private Partnership Model Definition, Concept and need Energy Development Model - Developed countries model Build Own and Operate; Build Operate and Transfer, Build Operate Own and Transfer and Public Private Partnership	16	10

	models		
	TOTAL	100	60
	PRACTICAL COMPONENT		
	TUTORIAL WORK		

Reference

Sr. No.	Author	Title	Publication
1	J. Glynn Henry and Gary. W. Heinke	Environmental Science and Engineering	Pretice Hall of India, 2004.
2	A. D.Bhide and B.B.Sundaresan	Solid Waste Management – Collection, Processing and disposal	Mudrashilpa Offset Printers, Nagpur, 2001
3	Techobanoglous, ThiesenEllasen	SolidWasteEngineeringPrinciplesandManagement	McGraw-Hill, 1997

COURSE NAME: Management of Urban Waste Services

COURSE CODE: 18 PGD SWM5

YEAR: FIRST

SEMESTER: FIRST

SUBJECT CODE:

Teaching and Examination Scheme

Teaching Scheme (Hrs)			Examination Scheme (Marks)				
TH	PR	TW	TH	PR	TW	OR	SW
3	4	10	75			--	25

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)

RATIONALE:

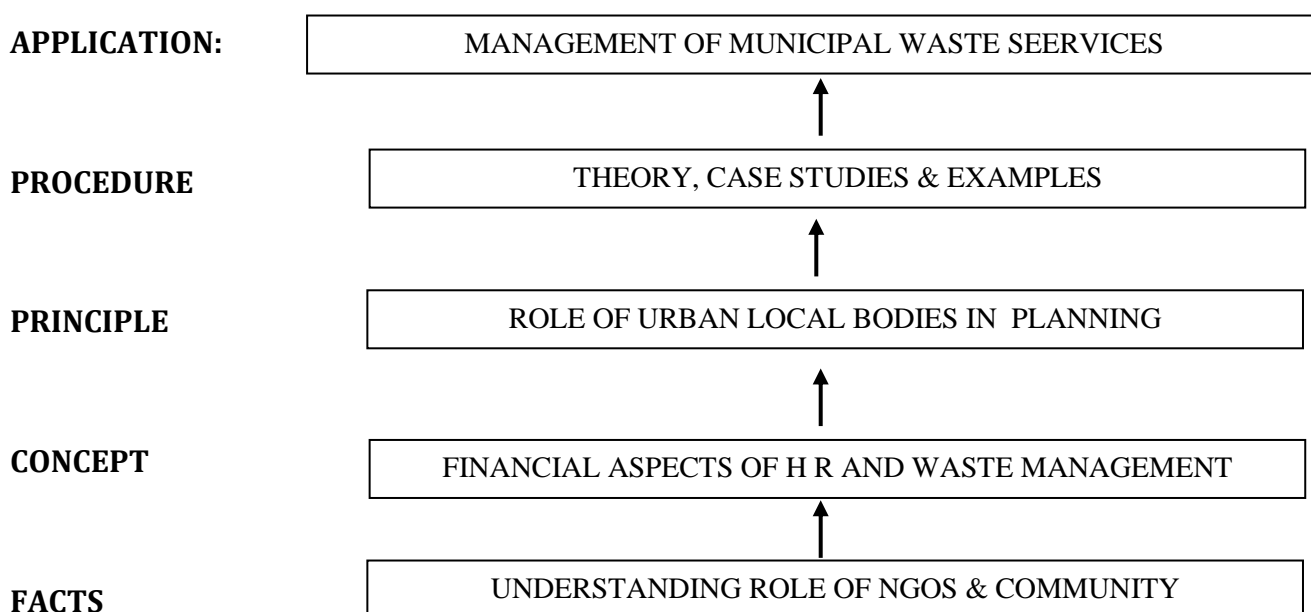
With development leading to urbanization of more and more cities and in turns solid waste management problems associated with it. This chapter focuses on waste treatment and

finance involved in treatment along with finance generation for waste treatment projects along with understanding institutional frameworks involved in the same.

LEARNING OBJECTIVES

- Understand Municipal waste generation and types along with administrative framework operating in the field
- Gain in depth knowledge about role of administrative framework and NGOs in waste management.
- Enhance skills of Financial management in solid waste management cycle and fund raising for solid waste management projects

LEARNING STRUCTURE



PAPER - V			
MANAGEMENT OF URBAN WASTE SERVICES (Total Hours - 50)			
Chapter	Contents	Marks	Hours
1	Introduction Urban growth – Municipal management – Administrative framework – Present scenario of solid waste management in ULBs – Current practices and deficiencies in SWM		10
2	Institutional aspects Governmental organization – Central and State governmental agencies – Non-governmental organization – NGOs – CBOs – concepts – scope – methods and application in SWM – Joint venture of Community and ULBs – Role of rag pickers – Public awareness		10

3	JNNURM and SWM Concept Objectives – Mission – Facilities and Role of JNNURM in SWM – Impact and services – Best examples and practices from Indian perspective – Technological tools – GIS – GPS – MIS – Remote sensing		10
4	Financial aspects Financing of SWM projects Assessment of finance – Financial support of Central, State government and other financial institutions – Pricing of Municipal services – Cost recovery framework – SWM project evaluation techniques		10
5	Personnel Protective aspects and measures in SWM Hygienic and unhygienic practices – Welfare measures – Productivity of SWM staff and equipments – Training – contents, mode and tools – Motivation – stress management – Non-alcoholic practices – Communication – Change management Behavioral aspects of waste management		10
	TOTAL	100	60
	PRACTICAL COMPONENT		
	TUTORIAL WORK		

Reference

Sr. No.	Author	Title	Publication
1	Archana Ghose	Urban Environment Management, Local government and community action	Concept publishing company, New Delhi, 2003
2	Rajeev Narayan	Human Resources Development in Urban Administration	Serials publication, New Delhi, 2006
3	K. Aswathappa	Human Resource Management	Mc – Grow Hill companies, Third edition, 2007.

COURSE NAME: Integrated Solid Waste Management

COURSE CODE: 18 PGD SWM 6

YEAR: FIRST

SEMESTER: FIRST

SUBJECT CODE:

Teaching and Examination Scheme

Teaching Scheme (Hrs)			Examination Scheme (Marks)				
TH	PR	TW	TH	PR	TW	OR	SW
3	4	10	75	50		--	25

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
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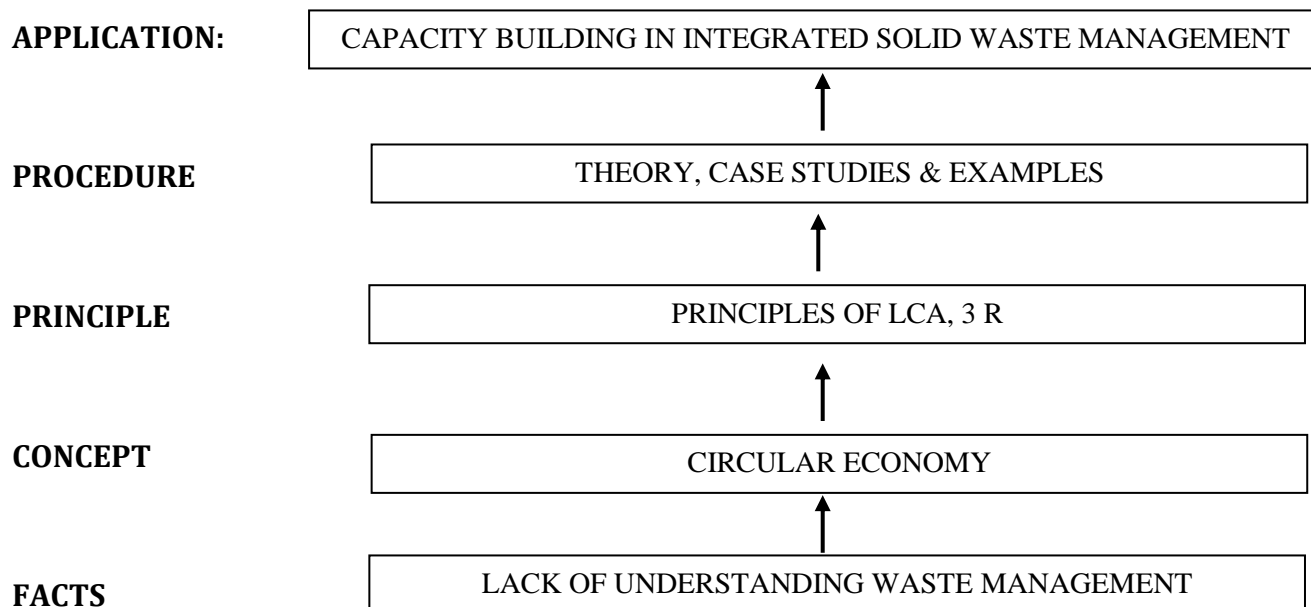
RATIONALE:

This chapter has been designed to outline all the concepts of environmental management in solid waste management along with understanding concepts of Integrated Solid Waste management. It will bring about skill enhancement in participants with respect to management tools applied in solid waste management.

LEARNING OBJECTIVES

- Understand concepts of integrated solid waste management
- Transportation management in solid waste management.
- Gain knowledge about Environmental management tools for SWM
- Study various aspects of Life cycle assessment and industrial ecology

LEARNING STRUCTURE



PAPER - VI			
INTEGRATED SOLID WASTE MANAGEMENT (Total Hours - 60)			
Chapter	Contents	Marks	Hours
1	INTRODUCTION TO ISWM Importance of ISWM as a Waste Management Approach – Definition – Functional Elements of Integrated Solid Waste Management – Reusable products – Refurbishing of goods - redesign of goods - reduction of food spoilage and waste through processing and storage management - avoidance of goods PROCESS OF RECYCLING AND COMPOSTING IN ISWM Recycling process (Accumulation – sorting and recovery processes) – Components of organic recycling – Economic benefits of recycling and composting – Impact of recycling on global greenhouse gas emissions	20	12
2	TRANSPORTATION OF WASTE& TREATMENTS Systematic waste transportation cycle - Curbside waste collection – nodal system of waste management (Transfer stations) – Transportation to disposal sites NON BIOLOGICAL WASTE TREATMENT Material recovery, waste to energy processes, Refuse derived	20	12

	fuels, Plastic to poly-fuel technology BIOLOGICAL WASTE TREATMENT Aerobic Biological treatment - process engineering and economics - impacts Anaerobic Biological Treatment - process engineering and economics - impacts		
3	LIFE CYCLE ASSESSMENT OF WASTE STREAMS Cradle to grave approach in Life cycle assessment – International standards in Life cycle assessment – Applications of LCA – LCA, Eco-labels and international market potentials Concept of Zero Waste Management	15	09
4	ENVIRONMENTAL MANAGEMENT IN SWM Concepts of Environmental Management – Major Tools of Environmental Management (Waste stream economics - Full cost Accounting – Waste audits concept - Procedure – applications –) Waste transport fuel audits – Concept of Green and circular Economy – Industrial Ecology: Concept, Principles and Applications.	25	15
5	CONTINUOUS ENVIRONMENTAL MONITORING Principles of Environmental monitoring – Rationale behind continuous environmental monitoring – Various methods of continuous environmental monitoring – Applications of Continuous monitoring for	20	12
	TOTAL	100	60
	PRACTICAL COMPONENT	50	30
	TUTORIAL WORK		

Reference

Sr. No.	Author	Title	Publication
1		Integrated Solid Waste Management for Local Governments: A Practical Guide	June 2017 by the Asian Development Bank
2		https://www.epa.gov/environmental-topics/land-waste-and-cleanup-topics??	
3		http://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/General_Overview/Zurbruegg_2002_SWM_DC.pdf	
4		http://www.codwap.hs-bremen.de/02%20Material/CHE_5110.Introduction%20to%20Solid%20Waste%20Management.pdf	
5		http://osp.mans.edu.eg/environmental/ch6f.htm?	
6		https://www.britannica.com/technology/solid-waste-management	

COURSE NAME: Engineering Design and Technological Aspects of ISWM

COURSE CODE: 18 PGD SWM7

YEAR: FIRST

SEMESTER: FIRST

SUBJECT CODE:

Teaching and Examination Scheme

Teaching Scheme (Hrs)			Examination Scheme (Marks)				
TH	PR	TW	TH	PR	TW	OR	SW
3	4	10	75	50			25

NOTE:

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- Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)

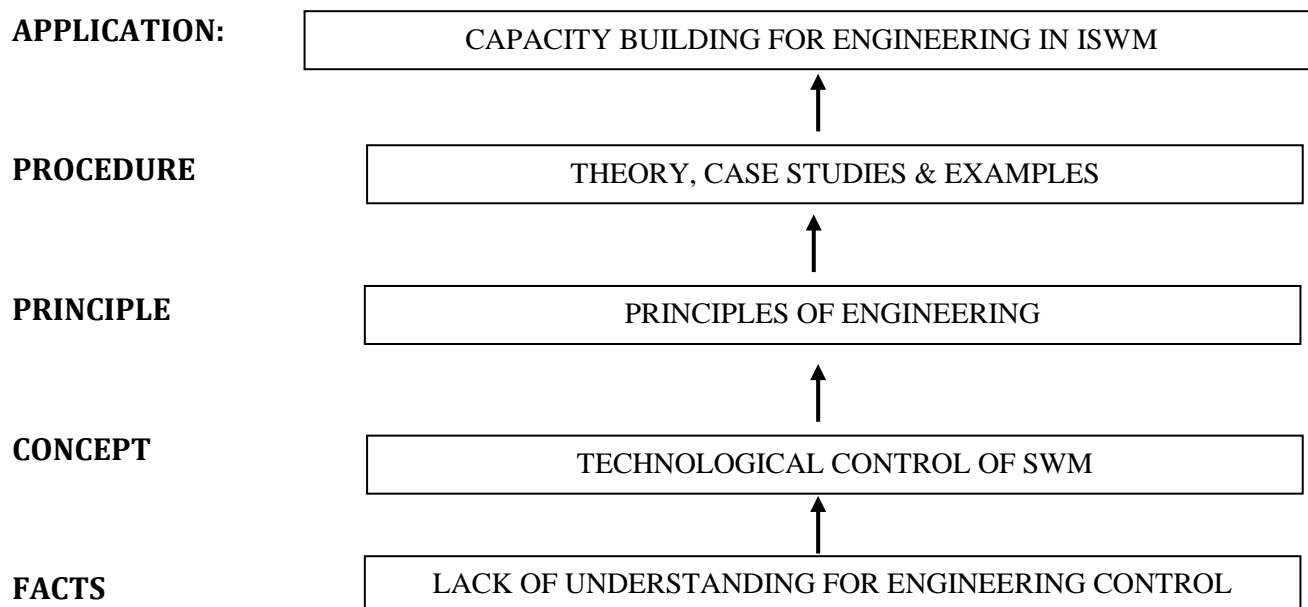
RATIONALE:

Chapter majorly focuses on capacity building in terms of project engineering for solid waste treatment and design criteria considered for their optimal efficiency. This chapter will give a detailed understanding on various processes and it's engineering, available in market for solid waste treatment.

LEARNING OBJECTIVES

- Comprehend the engineering concepts behind various waste to energy technologies and thermal treatment technologies.
- Cognize the rationale behind technological design for resource recovery facilities.
- Apprehend engineering and design concepts for Hazardous waste
- Understand site recovery facility principles.

LEARNING STRUCTURE



PAPER - VII			
ENGINEERING DESIGN AND TECHNOLOGICAL ASPECTS OF ISWM			
Chapter	Contents	Marks	Hours
1	PLANNING AND ENGINEERING PRINCIPLES	10	5
2	GENERAL SITING AND DESIGN CRITERIA Site investigations, Site Selection (NIMBY), Regulatory permitting process ii. RCRA-C and D siting and design requirements iii. CERCLA/SARA siting and design requirements iv. Other federal and state legislation and regulation siting and design requirements v. Summary: Siting criteria vi. Summary: Design	16	10
3	PRINCIPLES AND DESIGN OF SANITARY LANDFILLS i. Landfilling methods ii. Design goals, basis, and variables iii. Design of landfill cover and drainage/liner systems Design of landfill gas migration control and recovery iv. Principles and Design of Transfer and Transport Facilities, Objective of transfer stations v. Types, siting and design criteria of transfer stations vi. Design cases Principles and Design of Sanitary Landfills vii. Design of leachate control and treatment systems viii. Other design variables , Design cases	16	10
4	PRINCIPLES AND DESIGN OF MATERIAL RECOVERY FACILITIES	16	10

	<ul style="list-style-type: none"> i. Types and objectives of material recovery systems ii. Principles, functions, equipment selection and comparisons, design criteria, iii. Operation of different material recycling processes iv. Integrated and specific recycling plants v. Design cases Principles and techniques of Waste minimization. Examples of waste types and phase separation processes vi. Design criteria 		
5	<p>PRINCIPLES AND DESIGN OF ENERGY RECOVERY FACILITIES & THERMAL TREATMENT FACILITIES</p> <ul style="list-style-type: none"> 1) Types and principles of energy conversion processes - Incineration Design, Design of other energy conversion processes, design cases 2) Design of thermal treatment facilities - Status, types, principles, equipment used, application ranges and comparisons of different thermal treatment technologies 3) Design of incinerators as treatment, Design of other thermal systems and design cases 	16	10
6	<p>PRINCIPLES AND DESIGN OF HAZARDOUS WASTE LANDFILLS & HAZARDOUS WASTE STORAGE FACILITIES</p> <ul style="list-style-type: none"> 1) Design configurations and site selection Design of final cover, intermediate cover and drain/liner systems Design of gas and leachate control and treatment systems 2) Principles and Design of Types and design criteria Selection and design of storage facilities Design of containment, run-on/run-off management systems Design examples 	10	5
7.	<p>PRINCIPLES AND DESIGN OF SITE REMEDIATION FACILITIES</p> <ul style="list-style-type: none"> i. Status, types, principles, equipment used, application ranges, and ii. Comparisons of different site remediation technologies iii. Remedial investigations and feasibility studies iv. Soil remediation design examples v. Groundwater remediation design examples <p>PRINCIPLES AND DESIGN OF RADIOACTIVE WASTE TREATMENT/SITE REMEDIATION FACILITIES</p> <ul style="list-style-type: none"> i. Status, Types, technologies, principles, applications ii. Treatment Technologies iii. Site Remediation Technologies iv. Case Examples 	16	10
	TOTAL	100	60
	PRACTICAL COMPONENT	50	30
	TERM WORK		

ELECTIVE COURSE TITLE: Solid Waste to Resources

COURSE CODE: 18PGDSWM8

YEAR: FIRST

SEMESTER: Second

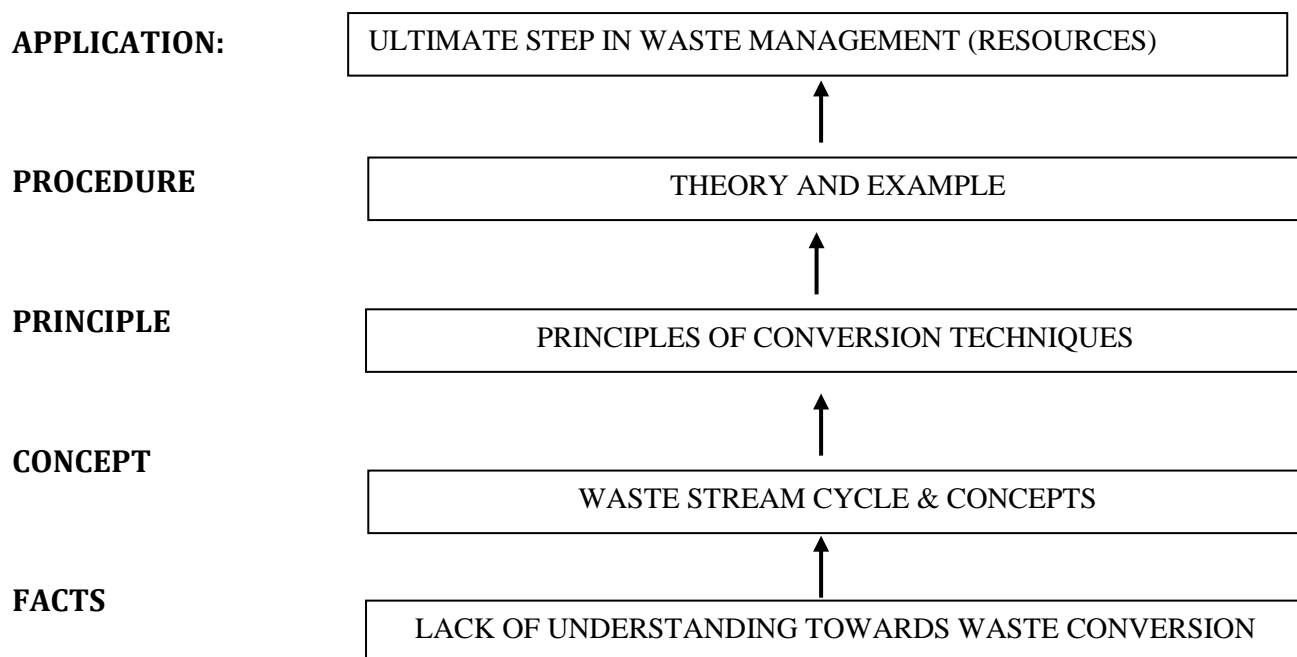
RATIONALE:

This paper is a knowledge build up for chapters that are to come in this course. It will build a basic understanding of conversion &/or disposal of solid waste and help in shaping positive attitude towards understanding the ultimate end of waste cycle

LEARNING OBJECTIVES

- Significance of economic concept for resources from waste.
- GHG Emissions from Waste
- Introduction to waste conversion processes & their importance in waste management
- Project parameters for resource recovery from Waste
- Understand basics of waste conversion cycle.
- Economic & Financial parameters for waste disposal projects.

LEARNING STRUCTURE



Solid Waste To Resources			
Chapter	Contents	Marks	Hours
1	Introduction: Definition of Types of Resources: Compost, Solid/ Liquid Fuel, Carbonized Waste, Heat, Electricity, Paving Blocks, Precious Metals, Plastic Furniture, Recycled Plastic Global Warming & Wastes: Significance of Wastes with respect to GHG Emissions & its effect on Climate.	10	6
	Types of Waste and segregation categories: Municipal solid waste; Bio - medical waste; E-waste; Construction & Demolition waste and Hazardous waste, Plastic Waste, Industrial Wastes.	5	3
	Composition, Characteristics & Unit Processes involved: # Physical characteristics of waste: quantity, moisture content, bulk density, size, chemical nature of waste. # Size reduction, drying, mechanical segregation, densification.	5	3
2	Introduction to Resource Recovery Processes: RDF, Composting-Anaerobic & Aerobic Degradation , Anaerobic Digestion, Biogas Purification, Incineration, Pyrolysis, Gasification, Plasma, Hydrothermal Carbonization, Paving Blocks, Road Construction, CHP concept, Metal Recovery, Plastic to Fuel	20	13
3	Significance of Segregation, Proper Collection, Segregated Transfer and Storage: Segregated & Collection of Solid	10	6

	waste, Transport of Wastes types. Storage of Segregated Waste. Waste Conversion Projects: Requirements of location, infrastructure needs,		
	Waste Dump & Scientific Land Fills: Why dumps & Land-Fill concept is redundant with respect to Developing Countries. Rehabilitation of Dumps, Resource Recovery from Land Fills.	10	6
4	Selection of Resource Recovery Processes With Respect to Waste Type: Anaerobic & Aerobic Degradation, Anaerobic Digestion, Biogas Purification, Incineration, Pyrolysis, Gasification, Plasma, Hydrothermal Carbonization, Paving Blocks, Road Construction, CHP concept, Metal Recovery, Plastic to Fuel	25	15
5	Project Parameters for Disposal of Solid Wastes & Resource Recovery: Location parameters, process parameters, Statutory clearances, Infrastructure parameters, Economical Parameters (Incentives, Tipping Fee, Electricity Tariff, Pre-operative Expenses), Financing Parameters (Debt, Equity, Public Private Participation, Viability Gap Funding)	15	8
Total		100	60
PRACTICAL COMPONENT		50	30
TERM WORK			