Roll No.

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20
Course Code: CIV 311
Course Name: ENVIRONMENTAL GEOTECHNICS AND SW MANAGEMENT
Program & Sem: B Tech (CIV) & VII DE

Date: 30.09.2019
Time: 9:30AM to 10:30AM
Max Marks: 40
Weightage: 20%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Use of Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all Questions. Each Question carries five marks. (4Qx5M=20M)

1. Describe the major sources of solid waste. (C.O.NO.1) [Knowledge]

2. State the importance of waste characterization. (C.O.NO.1) [Knowledge]

3. Describe the physical and biological processes which affects the mobility of contaminants in landfills. (C.O.NO.1) [Knowledge]

4. Recall with diagrams, any two scenarios where sub surface contamination happens. (C.O.NO.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer the Question. The Question carries ten marks. (1Qx10M=10M)

5. An area is divided into two layouts, A and B which contributes to solid waste. There are 300 homes in layout A and 200 homes in layout B. Every day the wastes from layout A is collected by compactor trucks and the wastes from layout B is collected by flat bed trucks. The volumes of the compactor trucks and the flat bed trucks are 12m^3 and 4.4m^3 respectively. The density of material in those trucks are 235kg/m^3 for compactor trucks and 156kg/m^3 for flat bed trucks. Estimate the following.

i) Unit waste generation rate of layout A [3M]

ii) Unit waste generation rate of layout B [3M]

iii) Unit waste generation rate in the entire area (including layout A and layout B) if the wastes from both the layouts are collected by compactor trucks of $8m^3$ capacity with density of material filling them as $100kg/m^3$ [4M]

(C.O.NO.1) [Knowledge]

Part C

Answer the following Question. The Question carries ten marks. (1Qx10M=10M)

6. Estimate the moisture content of the solid waste sample.

Components	% by mass	% moisture content
Food wastes	64	70
Paper	10	6
Cardboard	9	5
Plastic	5	2
Textiles	3	10
Rubber	2	2
Leather	4	10
Misc. organics	3	30

The total mass of solid waste is 100 kg. [10M]

(C.O.NO.1) [Knowledge]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: VII
Course Code: CIV 311
Course Name: Environmental Geotechnics and SW Management
Branch & Sem: B Tech – Civil Engineering, VII

Date: 30-09-2019
Time: 1 hour
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			**Total** Marks
			K			C			A			
1	1	Module 1	5									5
2	1	Module 1	5									5
3	1	Module 1	5									5
4	1	Module 1	5									5
5	1	Module 1				3	3	4				10
6	1	Module 1							10			10
	Total Marks		20			3	3	4	10			40

K =Knowledge Level   C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. Sarah Jacob]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

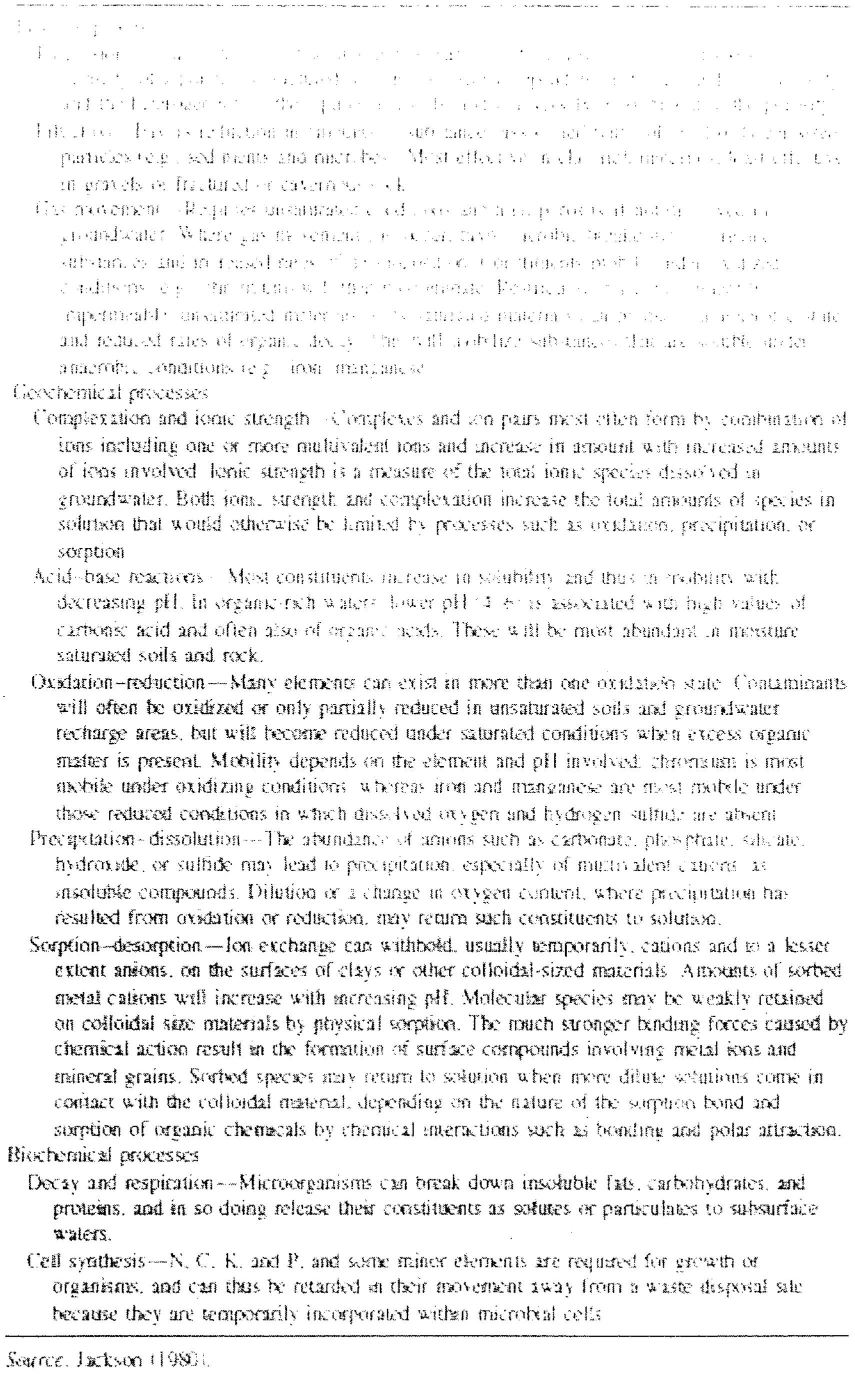
Semester: VII
Course Code: CIV 311
Course Name : Environmental Geotechnics and SW Management
Branch & Sem: B Tech – Civil Engineering, VII

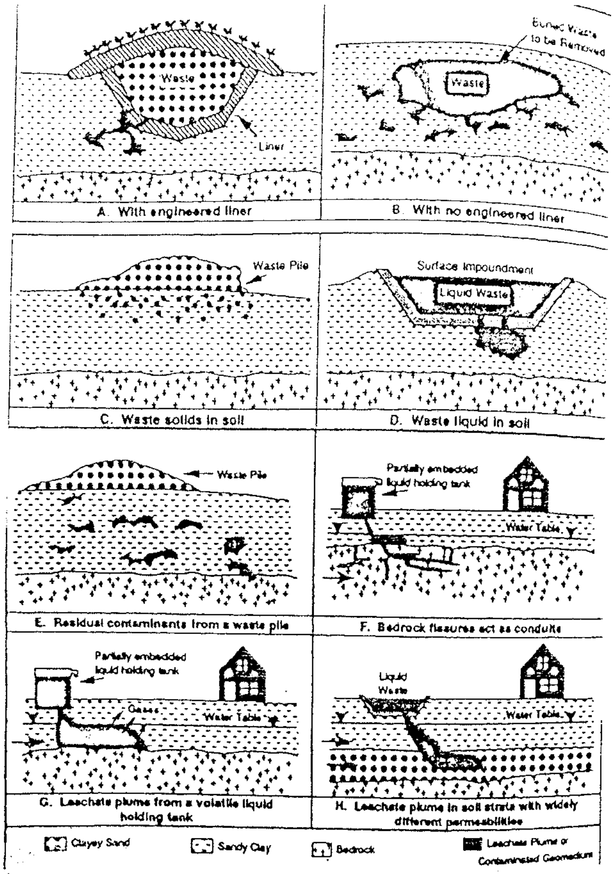
Date: 30-09-2019
Time: 1 hour
Max Marks: 40
Weightage: 20%

Part A (4Q x 5M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	1) **Dredging and irrigation:** Dredging involves the removal of soil or sediments from waterways, harbors, or irrigation canals in order to keep them navigable or flowing properly. 2) **Mining and quarrying:** Mining is necessary for coal, in some cases oil, such as oil sand and oil shale projects, a wide variety of metals and nonmetallic minerals. The wastes generally consist of by-products of mining activities. These wastes, often called mine tailings, are usually composed of silts, fine sands, or other aggregate materials. Quarrying for rocks, aggregates and sands is also an important activity, because these materials are used constantly in industry and construction for building stone, cement products, roofing materials and so on.	Any 5 points,1 mark for each	8 min

	Mining and quarrying wastes may pose significant problems to the environment due to the large quantities of wastes produced and, in some cases, their hazardous nature. 3) **Farming and ranching:** Farming, ranching, or dairy activities produce wastes that are composed largely of spoiled food, manure, excess crop waste, and waste from chemical or pesticide applications. 4) **Residential, commercial and institutional:** Municipal residences, commercial or institutional businesses, construction and demolition activities, municipal services, and treatment plant sites or waste incinerators are all major contributors to the waste stream. Table 1.1 shows the wastes generated from these various sources. 5) **Industrial:** Industries perform services and produce a wide variety of products and materials. Some of the major industries that are sources of industrial wastes include industrial construction and demolition, fabrication, light and heavy manufacturing, refineries, chemical plants, and nonnuclear power plants. 6) **Nuclear power and nuclear defense:** The civilian nuclear power industry generates electrical energy for millions of people, governmental defense facilities produce weapons, and nuclear research projects in a wide variety of fields are advancing technology. Even though the quantity of nuclear waste generated by these organizations is small compared to the energy produced, the radionuclides in this type of waste may be dangerous. The toxicity due to the exposure of radioactive material is still being studied, and concerns over long-range health and environmental effects make nuclear waste extraordinarily difficult to dispose of safely.		
2	Chemical and physical characterization of waste is necessary: 1) To determine the type of waste, 2) To identify possible waste reduction and recycling alternatives 3) To determine whether or not the waste can be landfilled or remediated 4) To determine the probable leachate constituents 5) To determine the physical properties of the waste for design and operation purposes.	1 mark each	8 min

3	 [illegible] processes [illegible] [illegible] and the [illegible] the [illegible] the property Filtration—This is reduction in amounts of substances [illegible] particles (e.g., sediments and microbes). Most effective [illegible] in gravels or fractured or cavernous rock. Gas movement—Requires unsaturated conditions [illegible] groundwater. Where gas is [illegible] substances and in [illegible] conditions [illegible] impermeable unsaturated materials [illegible] and reduced rates of organic decay. This will mobilize substances that are soluble under anaerobic conditions (e.g., iron, manganese). Geochemical processes Complexation and ionic strength—Complexes and ion pairs most often form by combination of ions including one or more multivalent ions and increase in amount with increased amounts of ions involved. Ionic strength is a measure of the total ionic species dissolved in groundwater. Both ionic strength and complexation increase the total amounts of species in solution that would otherwise be limited by processes such as oxidation, precipitation, or sorption. Acid–base reactions—Most constituents increase in solubility and thus in mobility with decreasing pH. In organic-rich waters lower pH (4–6) is associated with high values of carbonic acid and often also of organic acids. These will be most abundant in moisture saturated soils and rock. Oxidation–reduction—Many elements can exist in more than one oxidation state. Contaminants will often be oxidized or only partially reduced in unsaturated soils and groundwater recharge areas, but will become reduced under saturated conditions when excess organic matter is present. Mobility depends on the element and pH involved: chromium is most mobile under oxidizing conditions, whereas iron and manganese are most mobile under those reduced conditions in which dissolved oxygen and hydrogen sulfide are absent. Precipitation–dissolution—The abundance of anions such as carbonate, phosphate, silicate, hydroxide, or sulfide may lead to precipitation, especially of multivalent cations, as insoluble compounds. Dilution or a change in oxygen content, where precipitation has resulted from oxidation or reduction, may return such constituents to solution. Sorption–desorption—Ion exchange can withhold, usually temporarily, cations and to a lesser extent anions, on the surfaces of clays or other colloidal-sized materials. Amounts of sorbed metal cations will increase with increasing pH. Molecular species may be weakly retained on colloidal size materials by physical sorption. The much stronger bonding forces caused by chemical action result in the formation of surface compounds involving metal ions and mineral grains. Sorbed species may return to solution when more dilute solutions come in contact with the colloidal material, depending on the nature of the sorption bond and sorption of organic chemicals by chemical interactions such as bonding and polar attraction. Biochemical processes Decay and respiration—Microorganisms can break down insoluble fats, carbohydrates, and proteins, and in so doing release their constituents as solutes or particulates to subsurface waters. Cell synthesis—N, C, K, and P, and some minor elements are required for growth of organisms, and can thus be retarded in their movement away from a waste disposal site because they are temporarily incorporated within microbial cells. *Source:* Jackson (1980).	5 points – 1 mark each	8 min
4	• Solid waste management units • Land treatment units • Surface impoundments • Waste piles • Incinerators and other industrial installations • Tanks and other containers	Any 2 – 2.5 marks each	8 min

Part B

(1Q x 10M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	i) Unit waste generation of layout A = 12*235/300 = 9.4kg/house ii) Unit waste generation of layout A = 4.4*156/200 = 3.43kg/house iii) Unit waste generation in the entire area= 8*100/500 = 1.6kg/house	3 3 4	16 min

Part C

(1Q x 10M =10Marks)

<table>
<tr><th>Q No</th><th>Solution</th><th>Scheme of Marking</th><th>Max. Time required for each Question</th></tr>
<tr><td>6</td><td><table><tr><th>Components</th><th>% by mass</th><th>% moisture content</th><th>% of dry waste</th><th>Dry Mass of each component</th></tr></table></td><td>7</td><td>20 min</td></tr>
</table>

Food wastes	64	70	30	19.2
Paper	10	6	94	9.4
Cardboard	9	5	95	8.55
Plastic	5	2	98	4.9
Textiles	3	10	90	2.7
Rubber	2	2	98	1.96
Leather	4	10	90	3.6
Misc. organics	3	30	70	2.1

3

MC = 100 – 52.41/100 = 47.59%

Roll No.

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Semester: VII

Course Code: CIV 311

Course Name: Environmental Geotechnics and SW Management

Program & Sem: B Tech (Civil Engineering) VII

Date: 18-11-2019

Time: 1 hour

Max Marks: 40

Weightage: 20%

Instructions:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) *Use of Scientific and Non-programmable calculators are permitted.*

Part A

Answer all Questions. Each question carries four marks. **(4Qx4M=16marks)**

1. Discuss any two advantages and any two disadvantages to incineration. [4] (CO2) [Comprehension]

2. Explain any two factors affecting composting process. [4] (CO2) [Comprehension]

3. Discuss the ideal environment for vermicomposting to take place. [4] (CO2) [Comprehension]

4. Explain the components of an engineered landfill with a neat diagram.[4] (CO2) [Comprehension]

Part B

Answer all Questions. Each question carries six marks. (2Qx6M=12marks)

5. The windrow composting system has a volume rate of material to be composted as 36 m^3/day. The detention time for composting system 40 days. The dimensions of rectangular windrows are length 80m, height 3m and width 2m. Assume space between two windrows 4m and space around perimeter of composting area 4m. Find out

    i. Total volume of material in m^3 available for composting [2]
    ii. Number of windrows required for composting material [2]
    iii. Total area of required for composting [2] (CO2) [Comprehension]

6. Give a small note on leachate collection pipes and access shafts [6]

(CO2) [Comprehension]

Part C

Answer the following Question. The question carries twelve marks. (1Qx12M=12marks)

7. A landfill is to be filled with solid waste which contains two materials – material A and material B. Density and volume of material A is 1400 kg/m^3 and 100m^3 respectively. Density and volume of material B is 1800 kg/m^3 and 70m^3. They were mixed inside the landfill and the mass of combined material of solid waste which was available on field was found to be 100 t and Compaction ratio 2. Find

    a) Density of combined material [3]
    b) Combined volume of material [3]
    c) Final volume of material after compaction [3]
    d) Percentage reduction in volume of solid waste after compaction [3]

(CO2) [Comprehension]

↑
Bulletting

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

Semester: VII
Course Code: CIV 311
Course Name: Environmental Geotechnics and SW Management
Branch & Sem: B Tech – Civil Engineering, VII

Date: 18-11-2019
Time: 1 hour
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K	C	A	K	C	A	K	C	A	
1	CO2	Module 2		4								
2	CO2	Module 2		4								
3	CO2	Module 2		4								
4	CO2	Module 2		4								
5	CO2	Module 2					6					
6	CO2	Module 2					6					
7	CO2	Module 2								12		
	Total Marks			16			12			12		40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SOLUTION

Semester: VII
Course Code: CIV 311
Course Name : Environmental Geotechnics and SW Management
Branch & Sem: B Tech – Civil Engineering, VII

Date: 30-09-2019
Time: 1 hour
Max Marks: 40
Weightage: 20%

Part A (4Q x 4M = 16Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	**Advantages of incineration** ➢ The volume and weight of the waste are reduced to a fraction of their original size. ➢ Waste reduction is immediate; it does not require long-term residence in a landfill or holding pond. ➢ Waste can be incinerated on-site, without having to be carted to a distant area. ➢ Air discharges can be effectively controlled for minimal impact on the atmospheric environment. ➢ The ash residue is usually non-putrescible, or sterile. ➢ Technology exists to completely destroy even the most hazardous of materials in a complete and effective manner. ➢ Incineration requires a relatively small disposal area, compared to the land area required for conventional landfill disposal. ➢ By using heat-recovery techniques the cost of operation can often be reduced or offset through the use or sale of energy.	Any 2, 2 marks	8 min
	Disadvantages of incineration ➢ The capital cost is high. ➢ Skilled operators are required. ➢ Not all materials are incinerable (e.g., construction and demolition wastes). ➢ Supplemental fuel is required to initiate and at times to maintain the incineration process.	Any 2, 2 marks	
2	1) **Nutrients and Substrate.** In composting, substrate and nutrient supply are synonymous because the substrate is the source of nutrients. In the composting of yard waste and MSW, the biologically originated organic fraction of	Any 2 points, 2 marks	8 min

the wastes is the substrate. The specification "biologically originated" eliminates synthetic organic wastes. The exclusion of synthetic organics has a very practical significance because it eliminates many types of plastics. Wastes of biological origin differ from synthetic organic wastes in terms of molecular structure and arrangement. Examples of organic wastes of biological origin are wood, paper, and plant and crop debris. Plastics and vehicle tires are examples of synthetic organic materials.

Although the ideal waste would contain all necessary nutrients, in practice it may be necessary at times to add a chemical nutrient to remedy a nutrient deficiency.

2) Chemical Elements.

The major nutrient elements ("macronutrients") are carbon (C), nitrogen (N), phosphorus (P), and potassium (K). Among the nutrient elements used in minute amounts ("micronutrients" or "trace elements") are cobalt (Co), manganese (Mn), magnesium (Mg), and copper (Cu). Calcium (Ca) falls between macro and micronutrients. Carbon is oxidized (respired) to produce energy and metabolized to synthesize cellular constituents.

Nitrogen is an important constituent of protoplasm, proteins, and amino acids. An organism can neither grow nor multiply in the absence of nitrogen in a form that is accessible to it.

3) Particle Size.

Theoretically, the smaller the particle size, the more rapid the rate of microbial attack. In practical composting, however, there is a minimum size below which it is exceedingly difficult to maintain an adequate porosity in a composting mass. This size is the "minimum particle size" of the waste material. In composting, the practical "optimum" is a function of the physical nature of the waste material.

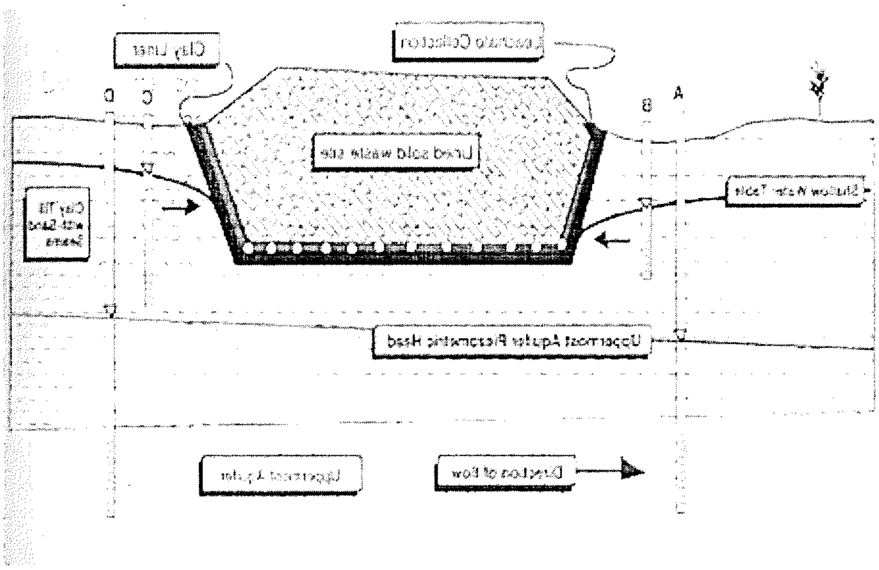
4) Oxygen.

Oxygen availability is a prime environmental factor in composting, in as much as composting is an aerobic process. Oxygen is a key element in the respiratory and metabolic activities of microbes. Interruption in the availability leads to a shunt metabolism. The microbes involved in the composting process obtain their oxygen from the air with which they come in contact. Consequently, the oxygen content of this air must be continually replenished or the air itself must be continually replaced. Determination of the amount of aeration that would meet a specific demand adds another level of complexity, because the capacity and performance of the aeration equipment and the physical nature of the composting mass must be taken into account. The straightforward methods (procedures) used for determining oxygen demand in wastewater treatment (e.g., COD, BOD) are poorly or not at all applicable to composting.

5) Moisture Content

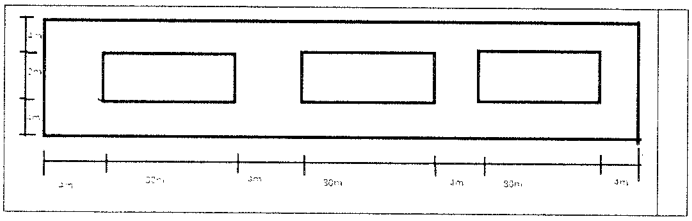
Theoretically, the optimum moisture content of the wastes is one that approaches saturation, provided that the material can be

	sufficiently aerated to meet the oxygen demand. Although meeting the demand is technologically feasible, it also is economically unfeasible. Hence, the term permissible maximum is introduced. The maximum permissible moisture content usually is also the optimum content. Because the air entrapped in interstices between particles is the primary source of oxygen for the microbial population. The penalty for moisture shortage is inhibition of microbial activity. Because almost all biological activity ceases at moisture contents lower than about 12 percent. **6) P^H Level.** The optimum pH range for most bacteria is between 6.0 and 7.5, whereas the optimum for fungi is 5.5 to 8.0. Owing to the activity of acid-forming bacteria, the pH level generally begins to drop during the initial stages of the compost process. These bacteria break down complex carbonaceous materials to organic acid intermediates. Some acid formation may also occur in localized anaerobic zones. Some may be due to the accumulation of intermediates formed by shunt metabolisms. Whatever the cause, the early pH drop in composting MSW may be to 4.5 or 5.0. **7) Temperature.** In the consideration of temperature as an environmental factor, the interest is in the effect of temperature on the well-being and activities of the microbial population. In short, environmentally oriented interest is on the effect of temperature on microbial well-being and activity; whereas operationally oriented interest is on the effect of microbes on temperature. In mesophilic temperature range lesser then thermophilic. So compositing process will take more duration for mesophilic than thermophilic.		
3	**An ideal environment for Vermicomposting** **Temperature** ➢ In Vermicomposting, temperatures are generally kept below 35^0C as most of the worm species used in vermicomposting require moderate temperatures from 10-35^0C. While tolerances and preferences vary from species to species, temperature requirements are generally pretty similar. The activity of vermicomposting worms decrease as temperature move toward the extremes. ➢ Earthworms tolerate cold and moist conditions far better than they can hot and dry conditions. • **Moisture** ➢ Earthworm requires plenty of moisture for growth and survival, they need generally moisture at the range from 60–75%. The soil should not be too wet else it may create an anaerobic condition. ➢ It is very important to moisten the dry bedding material before putting them in the bin, so that the overall moisture level is well balanced.	4 marks	8 min

	- **pH** ➢ The studies have suggested that Earth worms perform best in neutral pH. But it has been recorded that different species of earthworms have their own pH sensitivity and generally most of them can survive at the pH range between 4.5–9. ➢ The alteration of pH in the bedding is due to the fragmentation of the organic matter under series of chemical reaction.		
4	➢ **Liner system:** Liner system at the base for the side of the landfill, which prevents migration of leachate or gas to the soil; so it is impervious to both water and gas. ➢ **Leachate collection facility:** It can be showed as the straw which takes out the leachate from landfill. Leachate collection facility collects an extra leachate from within and from the base of the landfill and then leachate undergoes through leachate treatment process. So leachate collection facility will include both collection and treatment of leachate. ➢ **Gas control facility:** Gas collection facility collects the gas from the top of the landfill and also from inside of the landfill. After collection gas can be used as energy resource. ➢ **Final cover system:** It prevents migration of gas to atmosphere, enhances surface drainage and support surface vegetation. 	One mark each	8 min

Part B

(2Q x 6M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	Solution: a) Given, Volume rate $36m^3/d$ and detention time 40 days. Total volume of material = volume rate * detention time = 36*40 = $1440m^3/d$. b) Given, dimensions of windrow l= 80m, h= 3m, b= 2m Volume of one windrow = l*b*h = 80*3*2 = 480 m^3 So, Number of windrows = (Total volume of material) / (volume of one windrow) = 1440 / 480 = 3 Number of windrows required for composting are 3 c) Area of composting site Given, Distance between windrows = 4m Space around perimeter = 4m  Length of composting pad =L= 4+80+4+80+4+80+4 = 256 m Width of composting pad = B= 4+2+4= 10 m. Area of Composting = L*B = 256*10 = 2560 m^2. So area required for composting = 2560 m^2	2 2 2	10 min
6	1. **Leachate collection pipes and access shafts** ➢ As mentioned before, the bottom of the landfill is profiled in a roof shape and perforated pipes are installed at spaces of 30m or less. ➢ The material of the pipes consists of HDPE or PP. There have been many structural failures of rigid clay and concrete pipes, which were used more than 15 years ago. So, these materials are totally excluded from landfill construction now and only polymers are accepted. ➢ Structural analyses have to be carried out for flexible pipes installed at the bottom of a landfill and this is the subject of research. ➢ Pipes must be accessible for cleaning, maintenance, camera inspection, measurements and for leachate sampling. Pipes	6 marks	10 min

	lead to access shafts or, in some cases, to tunnels where the necessary operations can be executed. ➢ The shafts should be placed outside the landfill body and be manufactured using a polymer material. If they are made of reinforced concrete, their external surfaces have to be lined by geo-membranes. ➢ The same applies to concrete tunnels below landfills. If vertical shafts are placed within the waste body, they are submitted to the internal deformations of the waste, to lateral pressures, vertical frictional forces, to elevated temperatures, chemical attack, gases as a rule, vertical shafts in landfills should be avoided.		

Part C

(1Q x 12M =12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
			16 min
7	Solution: Given- Density of material A= 1400 kg/m^3 Density of material B= 1800 kg/m^3 Volume of material A= 100 m^3 Volume of material B= 70 m^3	3	
	a) Combined density of material (A+B) = 1635.29 kg/m^3 Where, = bulk density of material A = bulk density of material B = volume of material A = volume of material B	3	
	Combined density of material in solid waste is 1635.29 kg/m^3 . b) Combined volume for mass 100 t is Vi AB = Mass of combined material / combined material Density = M AB / = 100*1000/ = 61.15 m^3 Combined volume of solid waste material is 61.15 m^3 c) Compaction ratio = = = = 30.5756 m^3 Final volume of solid waste is 30.5756 m^3	3	
	d) Percentage reduction in volume = = = 50% Where, V i = Initial volume V f = Final Volume Percentage reduction in volume is 50%.	3	

Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: CIV 311
Course Name: ENVIRONMENTAL GEOTECHNICS AND SW MANAGEMENT
Program & Sem: B.Tech (CIV) & VII (DE-IV)

Date: 24 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) *Use of Scientific and Non-programmable calculators are permitted.*

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 4 marks. (5Qx4M=20M)

1. Name any four ways to detect waste contamination. (C.O.No.1) [Knowledge]
2. Name the four characteristics of hazardous wastes. (C.O.No.1) [Knowledge]
3. What are the disadvantages of incineration? (C.O.No.2) [Comprehension]
4. What is the economic significance of waste recycling? (C.O.No.4) [Knowledge]
5. Name any four types of geosynthetics. (C.O.No.3) [Comprehension]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 5 marks. (4Qx5M=20M)

6. Describe the elements of solid waste management. (C.O.No.1) [Knowledge]
7. Discuss the advantages of biomethanation. (C.O.No.2) [Comprehension]
8. Explain geonets and geogrids with neat diagrams (C.O.No.3) [Comprehension]
9. Explain the recycle potential of flyash. (C.O.No.4) [Knowledge]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 10 marks. **(4Qx10M=40M)**

10. Estimate the density of solid wastes sample on discarded basis

Components	% by mass	% moisture content
Food wastes	60	70
Garden trimmings	14	6
Cardboard	6	5
Plastic	8	2
Textiles	2	10
Rubber	3	2
Leather	3	10
Misc. organics	4	30

The total mass of solid waste is 100 kg. (C.O.No.1) [Knowledge]

11. The windrow composting system has a volume rate of material to be composted as 64 m^3/day The detention time for composting system 35 days. The dimensions of rectangular windrows are length 80m, height 4m and width 1m. Assume space between two windrows 1.5m and space around perimeter of composting area 2m. Find out

    i. Total volume of material in m^3 available for composting [3M]
    ii. Number of windrows required for composting material [2M]
    iii. Total area of windrows [2M]
    iv. Total area of required for composting [3M]

(C.O.No.2) [Comprehension]

12. The tyre inflation pressure for a vehicle on a pavement with average stone diameter 50 mm is 650 kPa. Assume the geotextile is placed beneath stone base course. Calculate required grab tensile strength of the geotextile. Assume 50 % of total ultimate grab strain will mobilize. [6M]

    Also give the derivation for the maximum strain in geotextile without any stone breakage. [4M]

(C.O.No.3) [Comprehension]

13. For the nonwoven heat-bounded geotextile, maximum tensile force of 9kN is taken by 30cm initial length geotextile material and final length was observed to be 48cm. It was observed that upto limit of proportionality, for 12kN/m tensile stress, stain is 10%. Nominal thickness of geotextile is 0.33mm. Calculate

    I. Strength (kN/m) [2M]
    II. Percentage Strain [2M]
    III. Toughness [3M]
    IV. Modulus of elasticity [3M]

(C.O.No.3) [Comprehension]

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	Module 1	4			
2	1	Module 1	4			
3	2	Module 2		4		
4	4	Module 4	4			
5	3	Module 3		4		
6	1	Module 1	5			
7	2	Module 2		5		
8	3	Module 3		5		
9	4	Module 4	5			
10	1	Module 1	10			
11	2	Module 2		10		
12	3	Module 3		10		
13	3	Module 3		10		
	Total Marks		32	48		80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20
Course Code: CIV 311
Course Name: Environmental Geotechnics and SW Management
Program & Sem: B Tech – Civil Engineering, VII

Date: 24.12.2019
Time: 3 HRS
Max Marks: 80
Weightage: 40%

Part A (5Q x 4M = 20Marks)

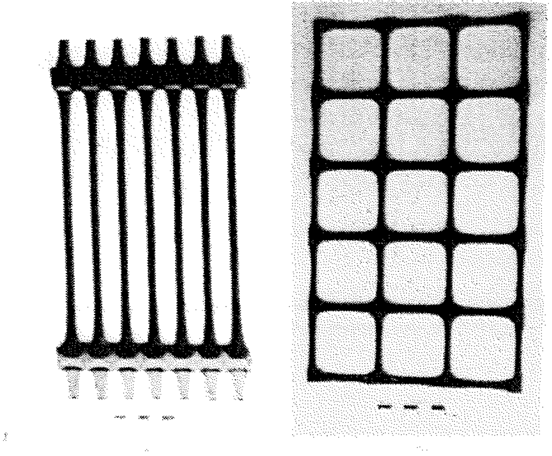
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	1. Ground penetrating radar 2. Electromagnetic resistivity 3. Direct current resistivity method 4. Seismic methods 5. Electrochemical and electroplating sensing methods 6. Traditional soil and ground water sampling	Any 4, 1 mark each	8 MIN
2	Ignitability Corrosivity Reactivity Toxicity	1 mark each	8 MIN
3	• The capital cost is high. • Skilled operators are required.	1 mark each	8 MIN

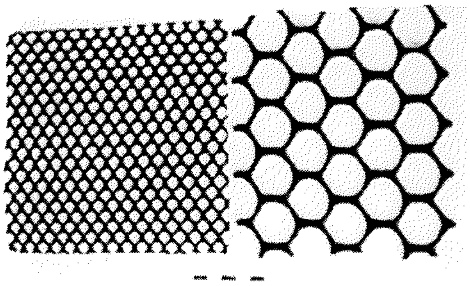
	- Not all materials are incinerable (e.g., construction and demolition wastes). - Supplemental fuel is required to initiate and at times to maintain the incineration process		
4	Cost reduction Employment Energy saving Saving costs for other public utilities	1 mark each	8 MIN
5	- geotextiles - geogrids - geonets - geomembranes - geocomposites	Any 4, 1 mark each	8 MIN

Part B

(4Q x 5M = 20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	1. Waste generation: Wastes are generated at the start of any process, and thereafter, at every stage as raw materials are converted into goods for consumption. 2. Waste storage: Storage is a key functional element because collection of wastes never takes place at the source or at the time of their generation. 3. Waste collection: This includes gathering of wastes and hauling them to the location, where the collection vehicle is emptied, which may be a transfer station (i.e., intermediate station where wastes from smaller vehicles are transferred to larger ones and also segregated), a processing plant or a disposal site. Collection depends on the number of containers, frequency of collection, types of collection services and routes. 4. Waste transport: This functional element involves the transfer of wastes from smaller collection vehicles, where necessary to overcome the problem of narrow access lanes, to larger ones at transfer stations; the subsequent transport of the wastes, usually over long distances, to disposal sites. 5. Processing: Processing is required to alter the physical and chemical characteristics of wastes for resource recovery and recycling. The important processing techniques include compaction, thermal volume reduction, manual separation of waste components, incineration biogas, and composting. 6. Recovery and recycling: This includes various techniques, equipment and facilities used to improve	0.5 0.5 1 1 1	15 MIN

	both the efficiency of disposal system and recovery of usable material and energy. Recovery involves the separation of valuable resources from the mixed solid wastes, delivered at transfer stations or processing plants. 7. Waste disposal: Disposal is the ultimate fate of all solid wastes, be they residential wastes, semi-solid wastes from municipal and industrial treatment plants, incinerator residues, composts or other substances that have no further use to the society.	0.5 0.5	
7	➢ Generation of gaseous fuel; ➢ Can be done on a small-scale; ➢ No external power requirement unlike aerobic treatment; ➢ Enclosed system enables all the gas produced to be collected for use. ➢ Emission to the atmosphere is avoided; ➢ Free from bad odour, rodent and fly menace, visible pollution and social resistance; ➢ Modular construction of plant and closed treatment needs less land area; and ➢ Production of biogas and high grade soil conditioner.	Any 5 points, 1 mark each	15 MIN
8	1. **Geogrid** Geogrid is a polymeric, mesh-like planar product formed by intersecting elements, called ribs, joined at the junctions (Figure 5.2).  Figure 5.2: Geogrid 2. **Geonets** Geonets are extruded polymer meshes and look like geogrids. They are different from geogrids, not in the material or configuration, but in their functions (Figure 5.3).	2.5 2.5	15 MIN

	 Figure 5.3: Geonet		
9	Fly ash is the finely divided residue that results from the combustion of pulverized coal and is transported from the combustion chamber by exhaust gases. Fly ash is produced by coal-fired electric and steam generating plants. Typically, coal is pulverized and blown with air into the boiler's combustion chamber where it immediately ignites, generating heat and producing a molten mineral residue. Boiler tubes extract heat from the boiler, cooling the flue gas and causing the molten mineral residue to harden and form ash. Coarse ash particles, referred to as bottom ash or slag, fall to the bottom of the combustion chamber, while the lighter fine ash particles, termed fly ash, remain suspended in the flue gas. Prior to exhausting the flue gas, fly ash is removed by particulate emission control devices, such as electrostatic precipitators or filter fabric bag houses. There are three types of fly ashes, namely, fly ash, bottom ash and pond ash. Fly ash and bottom ash when transported and disposed to the pond it is termed as pond ash. Fly ash is used in concrete admixtures to enhance the performance of concrete roads and bridges. Portland cement contains about 65 percent lime. Some of this lime becomes free and available during the hydration process. When fly ash is present with free lime, it reacts chemically to form additional cementitious materials, improving many of the properties of the concrete. Some of the advantages of fly ash in concrete are: provide higher ultimate strength, improved workability, Reduced bleeding, Reduced heat of hydration, Reduced permeability, Increased resistance to sulphate attack Increased resistance to alkali-silica reactivity (ASR). Fly ash is an effective agent for chemical and/or mechanical stabilization of soils. The properties of soil which can be change by using of fly ash are density, water content, plasticity, strength and compressibility performance of soils, hydraulic conductivity, and so on. Typical applications include: soil stabilization, soil drying, and control of shrink-swell.	5 marks	15 MIN

Fly ash provides the following advantages when used to improve soil conditions:

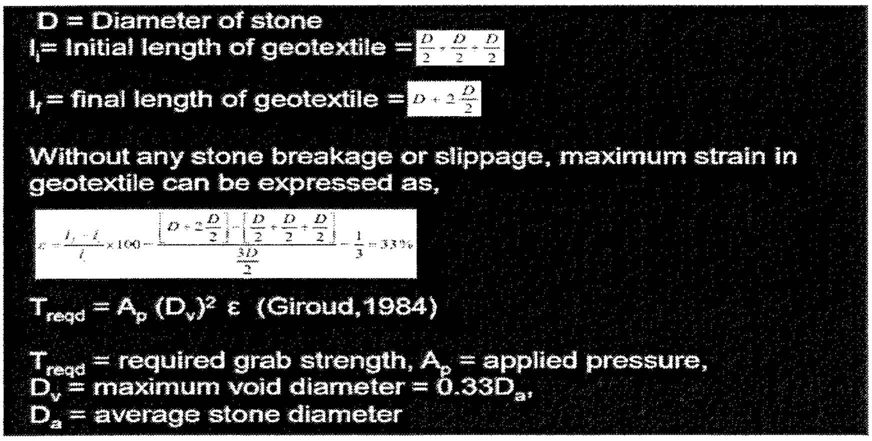
- Eliminates need for expensive borrow materials.
- Expedites construction by improving excessively wet or unstable sub grade.
- By improving sub grade conditions, promotes cost savings through reduction in the required pavement thickness.
- Can reduce or eliminate the need for more expensive natural aggregates in the pavement cross section.

Part C

(4Q x 10M = 40Marks)

<table>
<tr><th>Q No</th><th>Solution</th><th>Scheme of Marking</th><th>Max. Time require for eac Question</th></tr>
<tr><td>10</td><td>
<table>
<tr><th>Components</th><th>% by mass</th><th>% moisture content</th><th>% of dry waste</th><th>Dry Mass of each component</th></tr>
<tr><td>Food wastes</td><td>60</td><td>70</td><td>30</td><td>18</td></tr>
<tr><td>Paper</td><td>14</td><td>6</td><td>94</td><td>13.16</td></tr>
<tr><td>Cardboard</td><td>6</td><td>5</td><td>95</td><td>5.7</td></tr>
<tr><td>Plastic</td><td>8</td><td>2</td><td>98</td><td>7.84</td></tr>
<tr><td>Textiles</td><td>2</td><td>10</td><td>90</td><td>1.8</td></tr>
<tr><td>Rubber</td><td>3</td><td>2</td><td>98</td><td>2.94</td></tr>
<tr><td>Leather</td><td>3</td><td>10</td><td>90</td><td>2.7</td></tr>
<tr><td>Misc. organics</td><td>3</td><td>30</td><td>70</td><td>2.1</td></tr>
</table>
MC = 100 – 54.24/100 = 45.76%
</td><td>% of dry waste – 4 marks
Dry mass of each component – 4 marks
Total dry mass – 1 mark
Moisture content – 1 mark</td><td>20 MIN</td></tr>
<tr><td>11</td><td>Solution:
a) Given, Volume rate 64 m^3/d and detention time 35 days.
Total volume of material = volume rate * detention time = 48*20 = 2240 m^3/d.
b) Given, dimensions of windrow l= 80m, h= 4m, b= 1m

Volume of one windrow = l*b*h = 80*4*1 = 240 m^3
So, Number of windrows = (Total volume of material) / (volume of one windrow)
= 2240 / 320 = 7</td><td></td><td>20 MIN</td></tr>
</table>

	Number of windrows required for composting are c) Area of composting site Given, Distance between windrows = 1.5m Space around perimeter = 2m Length of composting pad =L= 2+80+1.5+80+1.5+80+1.5+80+1.5+80+1.5+80+1.5+80+2 = 596 m Width of composting pad = B= 2+1+2= 5 m. Area of Composting = L*B = 596*5 = 2980 m^2. So area required for composting = 2980 m^2 Area of windrows = 7*80*1= 560m2		
12	Given: Applied Tyre pressure = 650 kPa = 650 kN/m^2 Average stone diameter= D_a= 50mm = 0.05m We know that total ultimate grab strain = 33%. So, the mobilized grab strain = 0.33 x 0.5 = 0.165 Hence, T_{reqd} = 650 × (0.33 × 0.05)^2 × 0.165 = 29.2 Newton  D = Diameter of stone l_i= Initial length of geotextile = $\frac{D}{2}+\frac{D}{2}+\frac{D}{2}$ l_f= final length of geotextile = $D+2\frac{D}{2}$ Without any stone breakage or slippage, maximum strain in geotextile can be expressed as, $\varepsilon = \frac{l_f - l_i}{l_i} \times 100 = \frac{\left[D+2\frac{D}{2}\right]-\left[\frac{D}{2}+\frac{D}{2}+\frac{D}{2}\right]}{\frac{3D}{2}} = \frac{1}{3} = 33\%$ $T_{reqd} = A_p (D_v)^2 \varepsilon$ (Giroud,1984) T_{reqd} = required grab strength, A_p = applied pressure, D_v = maximum void diameter = $0.33D_a$, D_a = average stone diameter	1 mark Formula – 1 mark Answer – 3 marks 4 marks	20 MIN
13	Given: Maximum tensile force = 9kN Initial length = 30cm = 0.3m Final length = 48cm = 0.48m **a)** Strength = Tmax = force / length = 9kN / 30cm = 9/ 0.3 = 30 kN/m b) Strain = Percentage Strain = change in length / original length*100 =18/30*100= 60% Strain = 0.6 c) Toughness approximate = ½* (Tmax*Strain) = ½* 30* 0.6 = 9 kN/m And for 0.33mm thickness Toughness = Toughness approximate / thickness = 9/ (0.33*0.001) = 27272 kN/m^2	2 2 3	20 MIN

	d) Modulus of Elasticity approximate = tensile Stress/ strain = 12 / 0.1 = 120 kN/m And for 0.33 mm thickness Modulus of Elasticity = Modulus of Elasticity approximate/ thickness = 120/ (0.33*0.001) = 363636kN/m2	3	