Academic Calendar of VTU, Belagavi for EVEN Semester of 2019-2020 (Jan 2020 – July 2020)

	II Sem B. E. / B. Tech. / B. Arch	IV & VI Sem B. E. /B. Tech. IV, VI&VIII Sem B. Arch.	VIII Sem B.E / B.Tech & X Sem B. Arch	IV Sem MCA	VI Sem MCA	IV Sem MBA	IV Sem M. Tech.	IV Sem M. Arch.	II Sem M. Tech.	II Sem MCA	II Sem MBA	II Sem M. Arch.
Commencement of EVEN Semester	10.02.2020	10.02.2020	10.02.2020	27.01.2020	27.01.2020	10.02.2020	27.01.2020	27.01.2020	05.03.2020	05.03.2020	14.02.2020	14.02.2020
Last Working day of EVEN Semester	01.06.2020	01.06.2020	01.06.2020	20.05.2020	20.05.2020	01.06.2020	20.05.2020	20.05.2020	22.06.2020	22.06.2020	05.06.2020	05.06.2020
Practical Examination	03.06.2020 To 13.06.2020	03.06.2020 To 13.06.2020	-	26.05.2020 To 30.05.2020	-	-	-	-	25.06.2020 To 30.06.2020	25.06.2020 To 30.06.2020	-	-
Theory Examinations	15.06.2020 To 04.07.2020	15.06.2020 To 20.07.2020	03.06.2020 To 11.06.2020	03.06.2020 To 18.06.2020	-	03.06.2020 To 28.06.2020	03.06.2020 To 10.06.2020	-	01.07.2020 To 11.07.2020	01.07.2020 To 11.07.2020	08.06.2020 To 20.06.2020	09.06.2020 To 20.06.2020
Viva Voce	-	-	15.06.2020 To 20.06.2020	-	-	-	-	-	-	-	-	-
Summer Project / Professional training	-	-	-	-	22.05.2020 To 30.05.2020 (Submission of report to VTU)	01.04.2020 To 15.04.2020 (Submission of report to VTU)	12.06.2020 To 25.06.2020 (Submission of report to VTU)	-	13.07.2020 To 31.07.2020	-	23.06.2020 To 21.07.2020	01.07.2020 To 25.08.2020
Commencement of ODD Semester	27.07.2020	27.07.2020	27.07.2020	27.07.2020	-	-	-	-	03.08.2020	27.07.2020	27.07.2020	28.08.2020

NOTE

1. College Time Table shall be arranged for five and a half week days and planned to accommodate EDUSAT transmission slots, the schedule of which will be notified separately.
2. The faculty/staff shall be available to undertake any work assigned by the university.
3. If any of the above date is declared to be a holiday then the corresponding event will come into effect on the next working day.
4. Notification regarding Calendar of Events relating to the conduct of University Examination will be issued by the Registrar (Evaluation) from time to time.

10.1.2020.

REGISTRAR

Bapuji Institute of Engineering and Technology

CALENDAR OF EVEN SEMESTER: FEBRUARY 2020 to JULY-2020

PARTICULARS	II sem BE/B Tech	IV & VI sem BE/B Tech	VIII sem BE/B. Tech	II sem MCA	IV sem MCA	VI sem MCA	II sem M. Tech	IV sem M. Tech	II Sem MBA	IV Sem MBA
Commencement of EVEN semester	10-02-2020	10-02-2020	10-02-2020	05-03-2020	05-03-2020	27-01-2020	05-03-2020	27-01-2020	14-02-2020	10-02-2020
Last Working Day	01-06-2020	01-06-2020	01-06-2020	22-06-2020	22-06-2020	20-05-2020	22-06-2020	20-05-2020	05-06-2020	01-06-2020
1st IA Test Series	18-03-2020 24-03-2020	18-03-2020 24-03-2020	18-03-2020 24-03-2020	20-04-2020 22-04-2020	20-04-2020 22-04-2020	-----	20-04-2020 22-04-2020	-----	26-03-2020 28-03-2020	26-03-2020 28-03-2020
2nd IA Test Series	24-04-2020 30-04-2020	24-04-2020 30-04-2020	24-04-2020 30-04-2020	21-05-2020 23-05-2020	21-05-2020 23-05-2020	-----	21-05-2020 23-05-2020	-----	27-04-2020 29-04-2020	27-04-2020 29-04-2020
3rd IA Test Series	23-05-2020 30-05-2020	23-05-2020 30-05-2020	23-05-2020 30-05-2020	18-06-2020 20-06-2020	18-06-2020 20-06-2020	-----	18-06-2020 20-06-2020	-----	26-05-2020 28-05-2020	26-05-2020 28-05-2020
Practical Examination	03-06-2020 13-06-2020	03-06-2020 13-06-2020	-----	25-06-2020 30-06-2020	24-06-2020 29-06-2020	-----	25-06-2020 30-06-2020	-----	------	-------
Theory Examination	15-06-2020 04-07-2020	15-06-2020 20-07-2020	03-06-2020 11-06-2020	01-07-2020 11-07-2020	03-07-2020 11-07-2020	-----	01-07-2020 11-07-2020	03-06-2020 10-06-2020	08-06-2020 20-06-2020	03-06-2020 28-06-2020
Project Viva-Voce/ Summer Project/ Professional training	-------	-------	15-06-2020 20-06-2020	-------	-------	22-05-2020 30-05-2020 (submission of report to VTU)	13-07-2020 31-07-2020	12-06-2020 25-06-2020 (Submission of report to VTU)	23-06-2020 21-07-2020	01-04-2020 15-04-2020 (Submission of report to VTU)
Commencement of Odd sem	27-07-2020	27-07-2020	27-07-2020	27-07-2020	27-07-2020	-------	03-08-2020	-------	27-07-2020	------

DEPARTMENT	EVENT	TENTATIVE DATE
Textile Technology	Special Lecture on English Communication	20-02-2020
	Industrial Visit for pre final year students	28/29-02-2020
	Yoga for Holistic life	02-03-2020
	Texcreative-20, National level Technical Symposium	13/14-03-2020
	Special Lecture on Garment Export	16-04-2020
	Expert Lecture on Position of Spinning Industry	27-04- 2020
	Waste Management	09-05-2020
Electronics & Instrumentation Engineering	Workshop on IoT	27/28/29-02-2020
	Technical Talk-I	28-03-2020
	Industrial Visit	03/04-04-2020
	INTECH -2020	29/30-04-2020
	Technical Talk-II	09-05-2020
Electrical & Electronics Engineering	Technical Talk	15/29-02-2020
	Three days Faculty Development Programme	06/08-03-2020
	Impulse State Level Technical Symposium	27-03-2020
	Technical Talk	18-04-2020
	Department Sports Events	02/05-05-2020
Bio Technology Engg.	Invited lecture	15-02-2020
	One week Hands on Training	03/09-03-2020
	Brainstorm Sessions every week	----------

DEPARTMENT	EVENT	TENTATIVE DATE
MCA	Seminar	20-03-2020
	Workshop	23-04-2020
	Student Seminar/Group Discussion	15-05-2020
	FDP	10-06-2020
Departments of Mathematics Physics, Chemistry	Student Induction Program (SIP) for First Year Students (II Semester) & AICTE Activity Points Program for First Year Students of 2019-20 batch. (II Sem)	10-02-2020 to 17-02-2020
	National Science Day	28-02-2020
	National Conference on "Recent Developments in Physical, Chemical One and Mathematical Sciences(NCRPCM-2020)"	20-03-2020
	"Technology Barrier Reduction Program (TBRP) 2020" for Rural Government High School 10th Standard Kannada Medium Students.	15-04-2020 to 05-05-2020
Chemical Engineering	Guest lecture - I	27-02-2020
	Industrial Visit	06-03-2020
	Guest lecture – II	20-03-2020
	Workshop on soft skills	03-04-2020
	Sports (Interdepartmental)	18-04-2020
Electronics & Communication Engineering	NB Cup Cricket Tournament Inauguration	24-02-2020
	Visit to IISc Open Day 2020 / Industrial Visit	29/02/2020 28/3/2020
	E-Utsav 2020, Papyrus-A State level paper presentation for UG and PG students	08-09/05/2020
	EC Forum valedictory	16-05-2020

DEPARTMENT	EVENT	TENTATIVE DATE
Mechanical Engineering.	Technical Talk	29/02/2020
	RPL Cricket Tournament	04/03/2020
	Workshop (3days)	12th to 14th March 2020
	Technical Talk	28/03/2020
	Industrial Visit	25/04/2020
	Mech-I-Prix (3days)	7th to 9th May 2020
Civil Engineering.	KAAGAZ paper presentation	29th & 30th of April 2020
	GIS training programme	23, 24 & 25 of March 2020
	Primavera & Cost-x training programme	7, 8, 14 & 15 of March 2020
	Valedictory function	21st May 2020
Information Science and Engineering.	Three day workshop on "Mobile App Development"	13th Feb 2020
	One day workshop on "Cloud computing and Cyber Security"	17th Feb 2020
	Industrial Visit	13th March 2020
	Infozest 20	31st March 2020

HoDs are informed to:

1. Submit list of open and professional electives offered along with students registered, on or before 20-02-2020
2. Arrange parents meet after the test series and send the proceedings to the Principals office

Note: If any of the above date is declared to be a holiday then the corresponding event will come into effect on the next working day.

HOD

Dean Academic

M. C. Nirmaje

Principal

VISION OF THE DEPARTMENT

To train the students to become Civil Engineers with leadership qualities, having ability to take up professional assignments and research with a focus on innovative approaches to cater to the needs of the society.

MISSION OF THE DEPARTMENT

1. To provide quality education through updated curriculum and conducive teaching learning environment for the students to excel in higher studies, competitive examinations and professional career.
2. To impart soft skills, leadership qualities and professional ethics among the graduates to handle the projects independently with confidence.
3. To deal with the contemporary issues and to cater to the socio-economic needs.
4. To build industry-institute interaction and to establish good rapport with alumni.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

***PEO 1: Core Competence*:** Graduates will be able to plan, analyse, design and construct sustainable Civil Engineering Infrastructure.

***PEO 2: Professional Skills*:** Graduates will be professional engineers with a sense of ethics, creativity, leadership, self-confidence and independent thinking to cater to the needs of the society.

***PEO 3: Societal Needs*:** Graduates will be able to contribute effectively for the development of industry and professional bodies.

***PEO 4: Cognitive Intelligence*:** Graduates will be able to take up competitive examinations, higher studies and involve in research and entrepreneurship activities.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Students after the completion of the Program will be able to

1. Apply the fundamental concepts, software and codal provisions in the analysis, design and construction of sustainable civil engineering infrastructure.
2. Inculcate professional and leadership qualities, sense of ethics and confidence related to civil engineering.

Faculty will be able to

3. Contribute to the overall development of civil engineering community through the professional bodies and offer services to the society.

Vision of BIET

To be a center of excellence recognized nationally and internationally, in distinctive areas of engineering education and research, based on a culture of innovation and invention.

Mission of BIET

BIET contributes to the growth and development of its students by imparting a broad based engineering education and empowering them to be successful in their chosen field by inculcating in them positive approach, leadership qualities and ethical values

Title & Code	Ground Improvement Techniques
CO	Statement
17CV654.1	**Explain** the formation and development of ground
17CV654.2	**Explain** the compaction methods for ground improvement
17CV654.3	**Explain** the drainage and dewatering methods
17CV654.4	**Apply** the chemical modification techniques for soil stabilization
17CV654.5	**Explain** vibration methods, and grouting and injection techniques for ground improvement
17CV654.6	**Apply** geosynthetics and soil reinforcement methods for stabilization

Course Title		Ground Improvement Techniques										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
17CV654.1	2	2		1								2
17CV654.2	2	2		1								2
17CV654.3	2	2		1								2
17CV654.4	2	2		1								2
17CV654.5	2	2		1								2
17CV654.6	2	2		1								2
Average	2	2		1								2

CO	PSO1	PSO2
17CV654.1	2	2
17CV654.2	2	2
17CV654.3	2	2
17CV654.4	2	2
17CV654.5	2	2
17CV654.6	2	2
Average	2	2

TIME TABLE

Day / Time	1	2	10.00 - 10.30	3	4	12.30 - 2.00	5	6	7
	8.00 - 9.00	9.00 - 10.00		10.30 - 11.30	11.30 - 12.30		2.00 - 3.00	3.00 - 4.00	4.00 - 5.00
MONDAY		18CEE241	SHORT BREAK		18CEE241	LUNCH BREAK			
TUESDAY		18CVL47 - B2 - [Dr.BS]							
WEDNESDAY	18CEE241								
THURSDAY		18CEE241			17CV6S4		18CVL47 - B3 - [Dr.BS]		
FRIDAY	17CV6S4	18CVL47 - A1 - [VDV]							
SATURDAY	17CV6S4								

Sign. of the Staff

Sign. of the HOD

Sign. of the Principal

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

GROUND IMPROVEMENT TECHNIQUES

Course Code	18CV654	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Understand the fundamental concepts of ground improvement techniques
2. Apply knowledge of mathematics, Science and Geotechnical Engineering to solve problems in the field of modification of ground required for construction of civil engineering structures.
3. Understand the concepts of chemical compaction, grouting and other miscellaneous methods.
4. Impart the knowledge of geo synthetics, vibration, grouting and Injection.

Module -1

Formation and Development of Ground : Introduction, Formation of Rock, soil and soil profile, Soil distribution in India, Alterations of ground after formation, Reclaimed soils, Natural offshore deposits; Ground Improvement Potential – Hazardous ground conditions, poor ground conditions, favourable ground conditions, Alternative Approaches, Geotechnical processes.

Compaction: Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control.

Module -2

Drainage Methods: Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering systems, Design of dewatering system including pipe line effects of dewatering. Drains, different types of drains.

Pre-compression and Vertical Drains: Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading.

Module -3

Chemical Modification-I: Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics. Criteria for cement stabilization. Stabilization using Fly ash.

Chemical Modification-Ii: Lime stabilization – suitability, process, criteria for lime stabilization. Other chemicals like chlorides, hydroxides, lignin and hydrofluoric acid. Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization.

Module -4

Vibration Methods: Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping

Grouting And Injection: Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting.

Module -5

Geosynthetics: Introduction, Geosynthetic types, properties of Geosynthetics – materials and fibre properties, Geometrical aspects, mechanical properties, Hydraulic properties, Durability ; Applications of Geosynthetics - Separation, Filtration and Fluid Transmission, Reinforcement,

Miscellaneous Methods (Only Concepts & Uses): Soil reinforcement, Thermal methods, Ground improvement by confinement – Crib walls, Gabions and Mattresses, Anchors, Rock bolts and soil nailing. Stone Column, Micro piles.

Course Outcomes: After studying this course, students will be able to:

1. Give solutions to solve various problems associated with soil formations having less strength.
2. Use effectively the various methods of ground improvement techniques depending upon the requirements.
3. utilize properly the locally available materials and techniques for ground improvement so that economy in the design of foundations of various civil engineering structures

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.

- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Purushothama Raj P, "Ground Improvement Techniques", Laxmi Publications, New Delhi.
2. Koerner R.M, "Construction and Geotechnical Method in Foundation Engineering", McGraw Hill Pub. Co.

Reference Books:

1. Bell, F.G., "Methods of treatment of unstable ground", Butterworths, London.
2. Nelson J.D. and Miller D.J, "Expansive soils", John Wiley and Sons.
3. Ingles. C.G. and Metcalf J.B , "Soil Stabilization; Principles and Practice", Butterworths
4. Manfred Hausmann , "Engineering principles of ground modification", McGraw Hill Pub. Co.,

Bapuji Institute of Engineering and Technology
Davanagere-577004

Department of Civil Engineering

M.Tech programme in Environmental Engineering

CERTIFICATE

Certified that the seminar report entitled **"HEAVY METALS IN COSMETICS"** carried out by **Ms.SANDHYA.V**, **USN: 4BD13CEE10**, a bonafide student of Environmental Engineering is submitted in partial fulfillment for the award of **Master of Technology in Environmental Engineering** of the **Visvesvaraiah Technological University, Belgaum**. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The seminar report has been approved as it satisfies the academic requirements in respect of seminar-1 prescribed for the said Degree.

GUIDE

.....

VEENA KUMARA ADI
Asst. Professor
Dept. Civil Engineering
B.I.E.T, Davangere

HOD

.....

H.B.ARAVINDA
Professor & HOD
Dept. Civil Engineering
B.I.E.T, Davangere

Subject : Ground Improvement Techniques Subject Code : 17CV654 Class : 6th Sem A and B

Period	Date	Topics Planned	Date	Topics Covered	Remarks
1	12/02/2020	MODULE-01 Introduction. formation of Rock. Soil and soil profile	05/05/2020	MODULE-01 Introduction. formation of Rock. Soil and soil profile	
2	13/02/2020	Soil distribution in India. alterations of ground after formation Rock mass soils	9/05/2020	Soil distribution in India alterations of ground after formation Rock mass soils	
3	14/02/2020	natural offshore deposits Ground improvement potential hazardous ground conditions	11/05/2020	natural offshore deposits Ground improvement potential hazardous ground conditions	
4	19/02/2020	poor ground conditions. favourable ground condition alternative approaches geotechnical processes	12/05/2020	poor ground conditions favourable ground condition alternative approaches geotechnical processes	
5	20/02/2020	compaction. Introduction compaction mechanics.	15/05/2020	compaction. Introduction compaction mechanics.	
6	26/02/2020	Field procedure. surface Compaction. Dynamic compaction	16/05/2020	Field procedure surface compaction Dynamic compaction	
7	27/02/2020	Selection of field Compaction procedure	18/05/2020	Selection of field compaction procedure	
8	28/02/2020	Compaction quality control	21/05/2020	Compaction quality control	
9	04/03/2020	MODULE-02, Drainage method. Introduction. Seepage. Flow regimen	14/02/2020	MODULE-02. Drainage method. Introduction seepage. Flow regimen	
10	05/03/2020	Ground water and Seepage control	20/02/2020	Ground water and seepage control	
11	06/03/2020	methods of dewatering systems. Design of dewatering system. principle effects of dewatering	21/02/2020	methods of dewatering systems. Design of dewatering system. principle effects of dewatering	
12	11/03/2020	Drains. Different types of drains	26/02/2020	Drains. Different types of drains	
13	12/03/2020	Importance. Vertical drains.	27/02/2020	Importance. Vertical drains	
14	13/03/2020	Sand drains.	28/02/2020	Sand drains	
15	18/03/2020	Drainage of slopes	05/03/2020	Drainage of slopes	
16	19/03/2020	electrokinetic dewatering. problem	06/03/2020	electrokinetic dewatering. problem	
17	21/03/2020	MODULE-03 Chemical modification. Principles	11/03/2020	MODULE-03 Chemical modification. Principles	

Subject : Ground Improvement techniques Subject Code : 17CV654 Class : 6th A and B

Period	Date	Topics Planned	Date	Topics Covered	Remarks
18	25/03/2020	admixtures. hydration effect of cement stabilization on permeability	30/04/2020	admixtures. hydration effects of cement stabilization on permeability	
19	26/03/2020	Swelling and shrinkage and strength and deformation characteristics	04/05/2020	Swelling and shrinkage and strength and deformation characteristics	
20	27/03/2020	Criteria for cement stabilization. stabilization using flyash	05/05/2020	Criteria for cement stabilization. stabilization using flyash	
21	01/04/2020	Lime stabilization. Suitability process. Criteria for lime stabilization.	08/05/2020	Lime stabilization. Suitability process. Criteria for lime stabilization	
22	02/04/2020	other chemicals like Chlorides. hydroxides lignin and humaflume	04/05/2020	other chemicals like chlorides. hydroxides lignin and humaflume	
23	03/04/2020	Acid. properties of chemical components reaction and effects	06/05/2020	Acid. properties of chemicals components reaction and effects	
24	08/04/2020	Bitumen. tar or asphalt. Principle	07/05/2020	Bitumen. tar or asphalt. Principle	
25	09/04/2020	MODULE-04 vibration methods Introduction vibrocompaction blasting	11/03/2020	MODULE-04 vibration methods Introduction vibro compaction blasting	
26	15/04/2020	vibratory probe vibro displacement compaction	12/03/2020	vibratory probe vibro displacement compaction	
27	16/04/2020	displacement piles. vibroflotation. Sand compaction piles	13/03/2020	displacement pile vibroflotation. Sand compaction piles	
28	17/04/2020	Stone columns. heavy tamping	16/04/2020	Stone columns heavy tamping	
29	22/04/2020	Grouting and injection Introduction effect of grouting	16/04/2020	Grouting and injection Introduction effect of grouting	
30	23/04/2020	Chemicals and materials used	17/04/2020	Chemicals and materials used	
31	24/04/2020	types of grouting Grouting procedure	17/04/2020	types of grouting Grouting procedure	
32	29/04/2020	Applications of Grouting	18/04/2020	Applications of Grouting	
33	30/04/2020	MODULE-05 Geosynthetics Introduction, geosynthetic types.	20/04/2020	MODULE-05 geosynthetics Introduction. geosynthetic types	
34		Properties of geosynthe	20/04/2020	Properties of geosynth	

LESSON PLAN

Subject : Ground Improvement techniques Subject Code : 17CV654 Class : 6th A and B

Period	Date	Topics Planned	Date	Topics Covered	Remarks
35	06/02/2020	Geometrical aspects, mechanical properties, hydraulic properties, durability properties	24/02/2020	Geometrical aspects, mechanical properties, hydraulic properties, durability properties	
36	07/02/2020	applications of grouting the seperation, filtration and fluid transmission pertaining to cement	24/02/2020	applications of grouting the seperation, filtration and fluid transmission pertaining to cement	
37	08/02/2020	miscellaneous methods soil reinforcement	25/02/2020	miscellaneous methods soil reinforcement	
38	13/02/2020	thermal methods, Ground Improvement by confinement	25/02/2020	thermal methods, Ground Improvement by confinement	
39	14/02/2020	Cribwalls, gabions and mattresses Anchors	27/02/2020	Cribwalls, gabions and mattresses Anchors	
40	15/02/2020	Rocks bolts and soil nailing stone column micro piles	27/02/2020	Rocks bolts and soil nailing stone column micro piles	

LESSON PLAN

Period	Date	Topics Planned	Date	Topics Covered	Remarks

Text Books :

1. Purushottama Raj. P. "Ground Improvement techniques" Laxmi Publications New Delhi
2. Koerner R.M. construction and Geotechnical methods in foundation Engineering " mcgraw hill pub co

Reference Books :

1. Bell. R.G. methods of treatment of unstable ground ' Butterworths London
2. Nelson J.D. and Miller D.J. Expansive soil. John Wiley and sons
3. Ingles O.G. and Metcalf J.B. Soil stabilization principles and practice. Butterworths
4. manfred Hausmann Engineering principles of ground modification mcgraw hill pub co
5.

INSTRUCTIONS

1. This register is for attendance and assessment record of class work to be maintained by every faculty member handling classes.
2. This record is an important document and the faculty members should make the entries in the relevant columns and keep the same upto date and correct.
3. Attendance must be marked on a cumulative basis.
4. At the end of each period, the total number of absentees should be clearly noted at the bottom of each column on each page as a check.
5. The names of students who absent themselves continuously to the classes may be brought to the notice of the HOD by the concerned staff.
6. The register should be handed over to the HOD whenever the teacher goes on long leave/at the end of semester/leaving the institution with all details filled up.
7. At the end of the semester, the cumulative attendance should be worked out, entered in the relevant column for each student and the register should be submitted to the HOD.
8. Staff shall get this record reviewed by the HOD on a monthly basis.

Period : From January-2020 To July-2020 Semester : Odd/Even ✓

Name of the Teacher : Shankramma. H. Halavar

Designation : Assistant professor

Department : BE Civil Engineering

Sl. No.	Sem. / Sec. / Branch	Subject Name	Subject Code
1	6th Civil Engineering	Ground Improvement technique	17CV654
2	2nd MTech Environ -mental engineering	Environmental Biotechnology	18CEE241
3	4th A1	Engineering Geology laboratory	18CVL47
4	4th B2, B3	Engineering Geology laboratory	18CVL47
5			
6			
7			

	Reviews at the end of the				End of Semester
	1st Month	2nd Month	3rd Month	4th Month	
Signature of Staff					
Signature of the Head of Department					
Signature					

Class : 6th Sem | Subject Code : 17CV654 | Subject : Environmental Engineering | Total No. of Classes : 48

Offline Class

Sl No.	USN	NAME	DATE	13/02/2020	14/02/2020	20/02/2020	22/02/2020	26/02/2020	27/02/2020	28/02/2020	5/03/2020	6/03/2020	12/03/2020	13/03/2020
1	4BD17CV003	Akash		A	A	1	2	3	4	5	A	6	7	8
2	4BD17CV007	Anjan kumar TC		A	A	1	2	A	3	A	A	4	A	5
3	4BD17CV009	Anusha Nyamati		1	2	A	A	3	4	5	6	A	A	7
4	4BD17CV011	Arunkumar malagar		1	2	3	A	A	4	5	6	7	A	8
5	4BD17CV015	Bharathkumar H		1	2	3	4	A	5	6	7	8	A	9
6	4BD17CV017	Bhoomika S.P		1	2	A	A	3	4	5	A	A	A	6
7	4BD17CV019	Chandana R.G		1	2	A	A	3	4	5	A	6	A	7
8	4BD17CV037	Jayashree. K.R		A	1	2	A	A	A	A	A	A	A	3
9	4BD17CV049	manjunath. Pnaik		1	2	3	A	A	4	5	6	7	A	8
10	4BD17CV067	Piyush Ranjan		1	A	2	3	4	5	6	A	A	7	8
11	4BD17CV069	Prathvi R Nafedar		1	2	3	A	A	4	5	6	7	A	8
12	4BD17CV127	Shrutha R.M		1	2	3	4	5	6	7	8	A	A	9
13	4BD17CV014	Bharath K.A		A	A	A	A	1	A	A	2	3	A	4
14	4BD17CV016	Bhargav G.T		A	1	2	3	4	5	6	A	7	A	8
15	4BD17CV018	Bindushree R		A	A	A	A	A	A	1	2	3	4	A
16	4BD17CV020	Chethan N G		A	1	2	A	3	4	5	A	6	A	7
17	4BD17CV022	Chethana M.P		A	A	A	A	1	2	A	A	A	A	3
18	4BD17CV024	Darshankumar Mutt		A	A	A	A	1	2	3	4	5	A	6
19	4BD17CV026	Devya.H		A	A	1	A	2	3	4	5	A	A	6
20	4BD17CV030	Eshwar R		A	1	2	3	4	5	6	A	7	A	8
21	4BD17CV032	Harini K.P		A	A	1	A	2	3	4	5	A	A	6
22	4BD17CV034	Holeraja P Kapler		A	1	2	3	4	5	6	7	8	A	9
23	4BD17CV046	Mallikarjun Huggar		A	A	A	A	1	A	2	3	4	A	A
24	4BD17CV048	manjula. M.G		A	A	A	A	1	2	3	A	A	A	4
25	4BD17CV050	manoj M		A	A	1	2	3	4	5	A	A	A	6
26	4BD17CV058	Nandini. G.L		A	A	A	A	A	1	A	A	A	A	A
27	4BD17CV062	Nisha V Shet		A	A	A	A	1	2	3	A	A	A	4
28	4BD17CV066	Pavithra B.G		A	A	A	A	1	2	3	4	5	A	6
29	4BD17CV074	Rakesh A.C		A	A	A	A	1	2	3	4	5	A	6
30	4BD17CV076	Rakshitha A.M		A	A	A	A	1	A	2	A	A	A	3
		Initials of Teacher												
		Initials of H.O.D.												

Online Class

13/03/2020	16/03/2020	17/03/2020	18/03/2020	20/03/2020	23/03/2020	24/03/2020	25/03/2020	27/03/2020	30/03/2020	01/04/2020	02/04/2020	04/04/2020	07/04/2020	08/04/2020	09/04/2020	No. of Days Present	%	Test Marks I (20)	Test Marks II	Test Marks III	Assignment/Average (5)	Total Remarks (20+20)
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			20			20	40
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			19			20	39
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			18			20	38
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			18			20	38
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			20			20	40
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23			17			20	37
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			18			20	38
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			19			20	39
9	10	A	11	12	13	14	15	16	17	18	19	20	21	22	23	24			20			20	40
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			20			20	40
9	10	A	11	12	13	14	15	16	17	18	19	20	21	22	23	24			18			20	38
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			19			20	39
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			19			20	39
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			20			20	40
5	6	7	8	9	10	11	12	A	13	14	15	16	17	18	19	20			18			20	38
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			19			20	39
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			19			20	39
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23			18			20	38
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			17			20	37
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			18			20	38
6	7	8	9	10	11	12	13	14	15	16	A	17	18	19	20	21			17			20	37
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			19			20	39
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			19			20	39
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			18			20	38
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			19			20	39
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			17			20	37
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			17			20	37
7	8	9	10	11	A	12	13	14	15	16	17	18	19	20	21	22			18			20	38
7	8	9	10	11	12	A	13	14	15	16	17	18	19	20	21	22			20			20	40
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			19			20	39

Class : 6 'A' (Sem) Subject Code : 17CV6SA Subject : Environmental Engineering Total No. of Classes : 40

Sl No.	USN	NAME	DATE	13/02/2020	14/02/2020	20/02/2020	22/02/2020	26/02/2020	27/02/2020	28/02/2020	5/03/2020	06/03/2020	11/03/2020	12/03/2020	13/03/2020	13/03/2020	16/04/2020	17/04/2020	18/04/2020	20/04/2020	23/04/2020	24/04/2020	25/04/2020	27/04/2020	30/04/2020	01/05/2020	04/05/2020	05/05/2020	07/05/2020	08/05/2020	09/05/2020	No. of Days Present	%	Test Marks I (20)	II	III	Average (20)	Remarks
																				online class																
31	4BD17CV082	Sahana. K		A	A	1	A	2	3	4	5	A	A	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23			17			20	37
32	4BD17CV094	Shreeradha. S V		A	A	A	A	1	2	A	A	A	4	5	6	7	8	A	9	10	11	12	13	14	15	16	17	18	19	20	21			19			20	39
33	4BD17CV110	Varshitha. S		A	A	1	A	2	3	4	5	A	A	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23			17			20	37
34	4BD17CV120	monica. R.S		A	A	A	A	1	2	3	4	A	A	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			18			20	38
35	4BD17CV097	Soumya. N		1	A	2	3	4	5	6	A	7	8	9	10	11	12	13	14	15	16	17	A	18	19	20	21	22	23	24	25			19			20	39.
36	4BD17CV121	Rakshitha. K		1	A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27			19			20	39
37	4BD17CV090	Shankar. T. R		1	2	A	3	4	A	A	5	6	7	A	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			18			20	38
38	4BD17CV093	Shameer reyasat		1	A	A	2	3	4	5	6	7	A	8	9	10	11	12	13	14	15	16	17	A	18	19	20	21	22	23	24			19			20	39
39	4BD17CV078	Rakshitha V.T.N																																			37
			Initials of Teacher																																		
			Initials of H.O.D.																																		

Subject code : 17CV654

Subject name :- Ground Improvement Techniques

MODULE-01

Formation and development of Ground And Compaction

MODULE - 01

Formation and development of ground

Introduction

1> earth's crust is broadly classified into two categories as rock and soil

2> rock is a material strongly bonded of minerals where as soil is an assemblage of solid particles formed by disintegration of rocks

3> It spreads beneath rivers and seas and on land along with all organic and inorganic materials overlying the bedrock

4> the types and characteristic properties of the soils depend on its formation and deposition by transportation agents

5> changes in ground after formation occurs due to different natural causes and man's activities other than that produced by structures

6> man made lands called reclaimed lands are formed on low lying areas and on water by fillings

7> additional particles binding takes place due to the presence of carbonates, oxides and organic matter

8> the exposure of soil with time develops a weathering profile from the ground surface down

Formation of Rock, soil and soil profile

Rock is a consolidated material composed of natural aggregate that are connected by strong bonding forces

soil on the other hand is an unconsolidated material composed of natural aggregate of.

mineral grains which have resulted from the disintegration of rock

Principal Rock types

earth or beneath the surface soil are classified under three major groups. viz. Igneous. sedimentary and metamorphic rocks. based on their mode of origin

1> Igneous Rock

* Igneous rocks are formed by the cooling of the molten magma or by the recrystallization of the older rocks under heat and pressure great enough to render them fluid.
* Igneous rocks are classified primarily on the basis of texture and colour.
* They are generally very hard and have textures that vary from coarsely crystalline to glossy depending upon the rate of cooling
* The igneous rocks are generally massive without any structural features but joints and cracks are usually found in all igneous rocks
* most of the igneous materials that cooled very rapidly may contain gas bubbles or else have a fragmental structure
* The principal mineral constituents are light coloured quartz and feldspar and dark coloured hornblende. biotite. augite and olivine

2> Sedimentary Rocks

* Sedimentary rocks are the products of minerals

formed by physical disintegration of any kind of rock and chemical decomposition and deposits of plant and animal remains.

* sedimentary rocks may be further divided into three groups. viz. @ clastic, organic, and chemical in accordance with the origin of the sediment.
* Rock or mineral fragments derived from pre-existing mineral belong to clastic group.
* those deposited from organisms living in water are grouped as organic and those precipitated by chemical activity or left to evaporation is referred to as chemical.
* The texture of chemical sediments are usually microscopic whereas clastic and organic may vary from coarse grained to microscopic.
* the predominent minerals of sedimentary rocks are quartz, limestone or shale
* The most important structural characteristics of sedimentary rocks from the geological point of view is their bedding or stratification.

3> metamorphic Rock

* metamorphic rocks are those produced by internal processes such as heat pressure and plastic flow. acting on rocks of any kind with the limitation that the rocks concerned remained essentially solid during their transformations.
* metamorphic rock are distinguished from others primarily on the basis of structure and mineralo-gical composition
* The agents of metamorphism such as heat. pressure. and hydrothermal solutions lead to the crystallization and orientation of minerals not found on parent rocks.

* metamorphic rocks are characterised by the foliated structure.
* these rocks also show structural defects as cracks and joints
* By metamorphism limestone, sandstone and shale are changed to marble, quartzite, and slate.
* metamorphic rocks formed from sound igneous or sedimentary rocks can be good materials for construction.
* the most important engineering characteristics of metamorphic rocks are the softness of schists and the high susceptibility of all foliated rocks to weathering.

origin of soils

* up to a depth of about 20 km the earth's crust comprises of both rock and weathered rock (as soil)
* soils (weathered rock) originated from the rocks and minerals of the earth's crust
* the principal minerals subjects to weathering to produce soil at or near the earth's surface and available in the order of abundance are quartz, feldspar, pyroxene, amphibole, etc
* solid rocks are decomposed to fragments creating soils by the continuous weathering processes in combination with crystal deformations.
* Rocks containing quartz or orthoclase minerals with high silica content [e.g. granite and rhyolite] mostly decompose into sands or gravelly soils with a little clay.
* fine textured silty and clayey soils are formed due to decomposition of rocks

Subject code : 17CV654

Subject name: Ground Improvement Techniques

MODULE - 02

Drainage methods

pre-compression and vertical drains

MODULE-02
Drainage methods

Introduction

* Groundwater is usually considered as one of the most difficult problems that has to be handled in any civil engineering construction
* many field situations during construction operation it may be necessary to eliminate seepage pressure to increase the shearing resistance or to reduce the danger of frost damage
* Dewatering system and drains are the two methods which are used to improve the ground condition before, during and after construction
* Dewatering system essentially consists of lowering the water table to a required elevation and to establish below this level a system of collectors located in wells, galleries or ditches
* The collected water to at the collectors are pumped. continuous pumping from excavation or from natural ground causing danger to the stability of adjacent structures,
* If any heavy inflow may lead to erosion or collapse of the sides in an open excavation
* In certain situations there may be instability of the base of excavation due to upward seepage
* drains are provided to serve to control the flow. In case of lowering the water table. In others for reducing pore pressure and seepage forces

(i) Excavation below the water table in granular soils require dewatering

(ii) Sudden water table rise can cause uplift of basement floors

(iii) Fluctuation in water table position affects the active zone in swelling soils

(iv) Excess ground water pumping may result in ground subsidence or even ground collapse

Groundwater and seepage control

* Groundwater and seepage control needs a most significant consideration in many of the civil engineering works such as in the stability of natural slopes and cuts, dams and levees, excavations for structures, open-pit, mines, tunnels and shafts, pavements and side hill fills
* control should be ensured during construction period and as well after construction

The necessary controls required during construction

(i) provide a dry excavation and permit construction to proceed efficiently

(ii) reduce lateral loads on sheeting and bracing in excavations

(iii) stabilize quick bottom conditions and prevent heaving and piping

(iv) Improve supporting characteristics of foundation materials

(v) Increase stability of excavation slopes and side-hill fills

Filter requirements

* drainage system perforated pipes and conduits or perforated pipes or pipelines with open joints are usually provided.
* the space between soil and the pipe is filled with a coarse-grained material known as a filler.
* If the voids of filler are larger than the finest grains of the adjoining soil, there is a possibility of fine particles to fill the voids and accumulate and block the flow.
* if the void in the filler are as small as those in the soil, then there is a possibility of the filler material washed into the conduits and pipes. and thus leading to erosion of natural soil
* filters are also used in earthdams, cofferdams and sheet pile structures as a transmission medium or to prevent piping

General a filter or a drain material should satisfy the two requirements

(i) gradation of filter materials should be forming small size pores and migration of adjacent particles through the pores is prevented

(ii) gradation of the filter material should be allows a rapid drainage without developing large seepage forces

The above requirements are satisfied by adopting suitable grain-size distribution for the filter material based on the material to be protected

$$\frac{D15\ [filter]}{D85\ (protected\ soil)} < 4\ to\ 5$$

D15 filter soil should not be more than 4 or 5 times the D85 size of the protected soil

$$\frac{D15\ [filter\ soil]}{D85\ [protected\ soil]} > 4\ to\ 5$$

D15 filter soil should be more than 4 or 5 times of the D85 size of the protected soil

* loss of head due to percolation through the filter should be smallest possible large filters are usually made up of serveral layers.

Groundwater.

* water level, water table or phreatic surface has been defined as the level within a body of subsurface water at which water pressure are equal to atmospheric pressure
* The neutral stress on this surface is zero.
* This water may be found as gravity water, hydroscopic moisture, perched water or in the capillary fringe.
* below water table is saturated and present in natural formations such as aquifers, aquitards and aquicludes
* aquifers are relatively pervious soil and rock formation through which groundwater flows induced by gravity

Fig: water table and aquifers

* rainwater that seeps underground is trapped in the pervious layer and forms an aquifer
a layer of rock capable of holding water and allowing it to pass through
* capillary fringe on perched water table → above the water table where capillary force pull water into pore spaces
* aquifer → The large body of permeable that in all water holding is saturated zone
is confined aquifer → two impervious layers does not allow flow of liquid or water.
is unconfined aquifer → it is usually exposed to atmospheric surface
* aquifer is having pores & its hold water and permeability means its passing water
ex:- fine sand and coarse silt

MODULE -03

Chemical Stabilization

Definition

Soil Stabilization : It is defined as a procedure in which a special soil is proportional or added or cementing material or other chemical material is added to a natural soil material to improve its properties

The stabilizing material provide cement lime bitumen / asphalt

addition and chemical causes a physico-chemical alteration and referred as chemical stabilization

Cement Stabilization

1) Soil cement and its influencing factors

* The soil stabilised with cement (portland) is known as soil cement
* The cementing action is belived to be the result of chemical reaction of cement with the soil/clay soil during hydration
* The binding action of individual particles through cement may be possible only in coarse-grained soils
* The grained cohesive soils only some of the particles can be expected to have cement bonds and the rest will be bonded through natural cohesion
* The important factors affecting soil cement are natural of

(2) nature of soil

* almost every inorganic soil capable of pulverisation can be successfully stabilised with cement, although the cement requirement will increase with the increase in the specific surface of a soil
* Expansive soils are particularly difficult to be stabilised.
* organic matter and sodium sulphate are harmful and weaken the soil-cement
* well-graded soils with less than 50% fraction finer than 75-micron sieve and plasticity index less than 20. are found to give best results.
* approximate gradation limits of soil for economic stabilization with cement

(3) cement content

* the strength of soil cement increases with an increase in the amount of cement added to a soil and if such an increase in strength does not result the soil may normally be considered unsuitable
* The ordinary portland cement is generally used for stabilization high early-strength cement can also be used and is usually more effective than normal cement
* The amount of cement required expressed as a percentage by weight of dry soil generally varies between 3 to 13% finer soils requiring more cement.

* The actual amount required is determined experimentally by performing compressive strength and durability tests
* The amount of cement giving a compressive strength of 2.8 to 3.0 kg/cm² should normally prove satisfactory for tropical climates
* The approximate amounts needed for different types of soils may be as follows gravels 5 to 8%, sands 7 to 12%, silts 12 to 18%, and clays 12 to 20%

* mixing compaction and curing

* a stronger and more durable soil-cement will be produced if the soil cement water mixture is more intimately mixed
* mixing will however result in decreased strength if it is continued long after the cement hydration has begun
* The amount of water to be added is decided from the considerations of good compaction and this amount is considered adequate enough for cement hydration also
* better strength and stability develops if the fine grained soils are compacted wet of optimum water contents and the coarse grained soil on the dry side of the optimum water content
* the greater is the compacted density the stronger and more durable will be the soil cement
* like concrete the strength of soil-cement increases with age

* admixtures
* certain chemicals are sometimes added to soil cement with the purpose either to reduce the cement consumption or to make a soil suitable for stabilisation which is not responsive to cement alone in its natural state.
* lime and calcium chloride are commonly used with clays and soils containing organic matter.
* sodium carbonate and sodium sulphate have also been tried. fly ash as additive

* construction methods
* shaping the sub-grade and scarifying the soil
* pulverising the soil
* adding and mixing cement
* adding and mixing water
* compacting
* finishing
* curing
* adding wearing surfacing
* mix-in place method
* travelling plant method
* stationary plant method

Lime stabilization

* hydrated (or slaked) lime is very effective in treating heavy plastic clayey soils
* lime may be used alone or in combination with cement, bitumen or fly ash
* sandy soils can also be stabilised with these combinations
* lime has been mainly used for stabilising the road bases and sub-grades
* on addition of lime to soil two main types of chemical reactions occur
  (i) alteration in the nature of the absorbed layer through base exchange phenomenon
  (ii) cementing or pozzolanic action. lime reduces the plasticity index of highly plastic soils making them more friable and easy to be handled and pulverised
* the plasticity index of soils of low plasticity generally increases
* There is generally an increase in the optimum water content and a decrease in the maximum compacted density but the strength and durability increases
* The amount of lime required may be used on the unconfined compressive strength or the CBR test criteria
* normally 2 or 8% of lime may be required for coarse grained soils, and 5 to 10% for plastic soils
* The amount of fly ash as admixture may vary from 8 to 20% of the soil weight

Subject Code : 17CV654

Subject name : Ground improvement techniques

MODULE - 04

Vibration methods

Grouting and injection

MODULE-04

Vibration methods

Introduction

* This characteristic behaviour could be used in any ground improvement technique by way of adopting some form of vibration which could bring in deformation and displacement resulting in densification
* These techniques for compacting cohesionless soils arranged in the order of decreasing effectiveness are vibration, watering and rolling
* These techniques have been used in improving the properties of in-situ soils
* Cohesionless soils get densified largely by fracture and reorientation of the grains
* Both vibration and shock are helpful in reducing the wedging and aiding densification in cohesionless soils
* Vibration and shock are less effective in cohesive soils

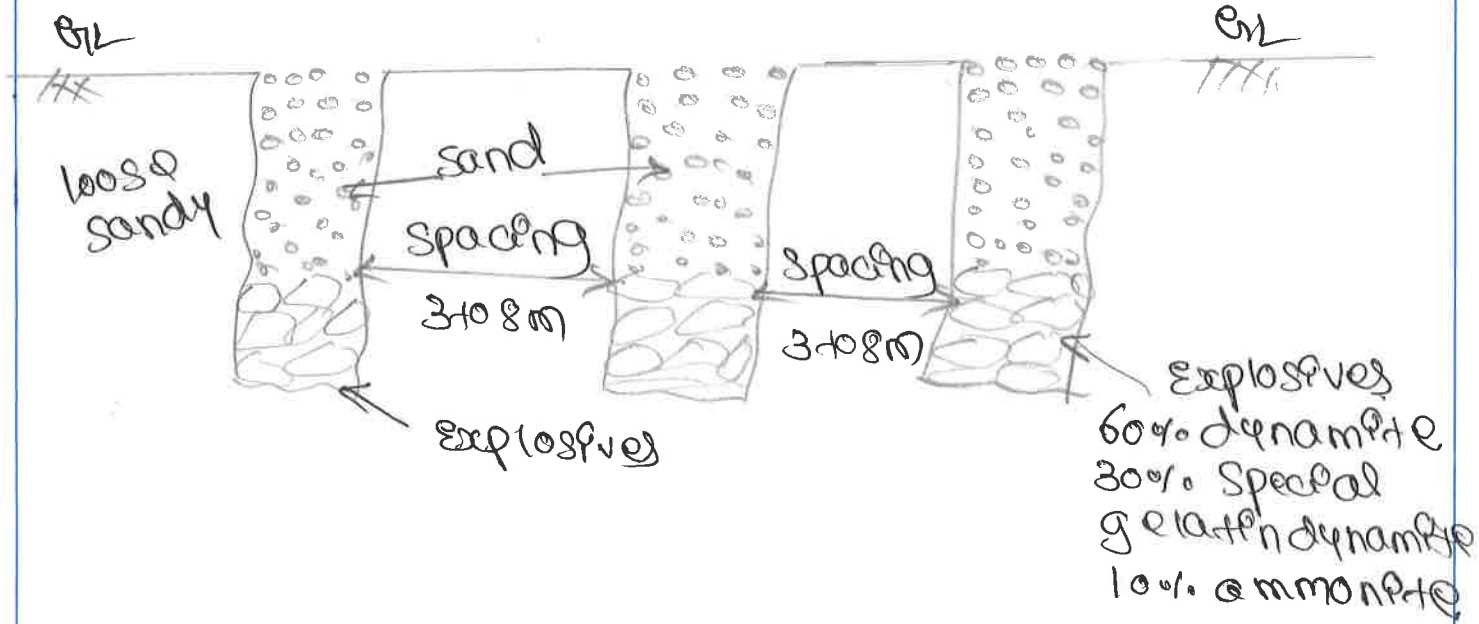
Vibro compaction

* loose sand deposits the density index can be increased by vibro compaction
* vibro compaction method is a rapid densification technique which could be used effectively in saturated cohesionless soils
* The load due to shock is temporarily transferred to the liquid and the soil particles take a much denser pattern aided by the soil particles
* dry soils due to shock and vibration the particles move from the original position and take a more

compact pattern

* Compaction of sand can be achieved up to distance of 2.5 m from axis of vibrator.
* Compaction can be carried out to significant depths up to 12 m
* It can be adopted in sands and silty sands with excellent to good results
* Its applicability is poor in silts and cannot be adopted for clays
* more than 20% of silt or 5% of clay may reduce the effectiveness of the method
* The effectiveness of these methods decrease with increase in the percentage of fines in the soil because the permeability is too low to prevent rapid drainage following liquefaction
* reduce settlements. reduce liquefaction hazard and permit construction on granular fills

compaction by blasting



* In this method buried explosive are used to densified loose sandy soils
* In this method series of holes is bored and explosives are placed in them
* The holes are filled back with the soil these explosives when detonated by shocked waves in the ground causing densification of loose surrounding soil
* Explosive charges consists of 60% dynamite and 30 % special gelation dynamite 10% ammonate the charges are generally placed at 2/3 rd of thickness of stratum to be densified
* The spacing of holes is kept between 3 to 8 m
* 3 to 5 blast at each point.
* The radius of influence of the compaction from the blast point is given by the relation

$$R = [MC]^{1/3}$$

where R = Radius of influence from blast
M = mass of explosive charges (kg)
C = constant = 0.04 was 60% of dynamite

* The surface soil upto a depth of 1m gets displaces or disturbed in the radam manner
* This surface zone is compacted by conventional method using compacted by rollers
* Densification by blast is effective upto a depth of 25 m it is quite effective when sand is clean [no fines] and fully saturated

* the shock waves cause liquefaction of sand it is followed by densification of sand
* this method is not very effective in partly effective soil because compressive stress developed due to capillary action which prevent the sand particle from taking closer position
* the method is less common than the vibro compaction and dynamic compaction methods
* even 80 cm surface settlements are observed
* 70 - 80 % relative density achieved

Vibratory probe

* used for cohesionless soil
* consist of open ended pipe about 75 cm diameter and 1 m length
* vibratory pile driver at it bottom the vibratory pile driver when activated use vertical vibration
* the vibratory probe and it goes down into the sand
* after it has reach the desired depth the vibratory probe is gradually raised upward by the vibratory driver continuously operated
* the soil within or around the probe is densified
* spacing of the hole is 1.8 m
* this method can be used for upto a depth 20 m
* this method is ideal for compaction of saturated sand deposits

MODULE - 05

Geosynthetics

Introduction

Geosynthetics are artificial fibres used in conjunction with soil or rock as an integral part of a man made project

a. Geotextiles - permeable

b. Geomembrane - impermeable

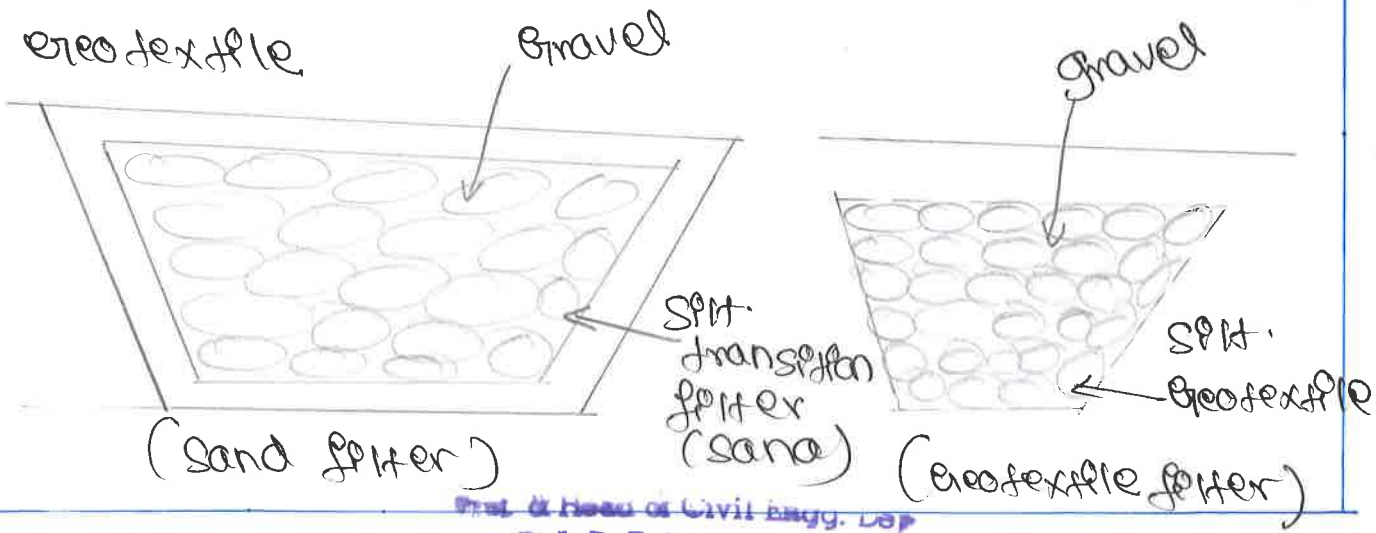
Geosynthetics are man made products. they are flexible and planar. they are manufactured from synthetic polymeric materials and sometimes from natural materials

Types of Geosynthetic

1) Geotextiles
2) Geomembranes
3) Geogrides
4) geonets
5) Geocomposites

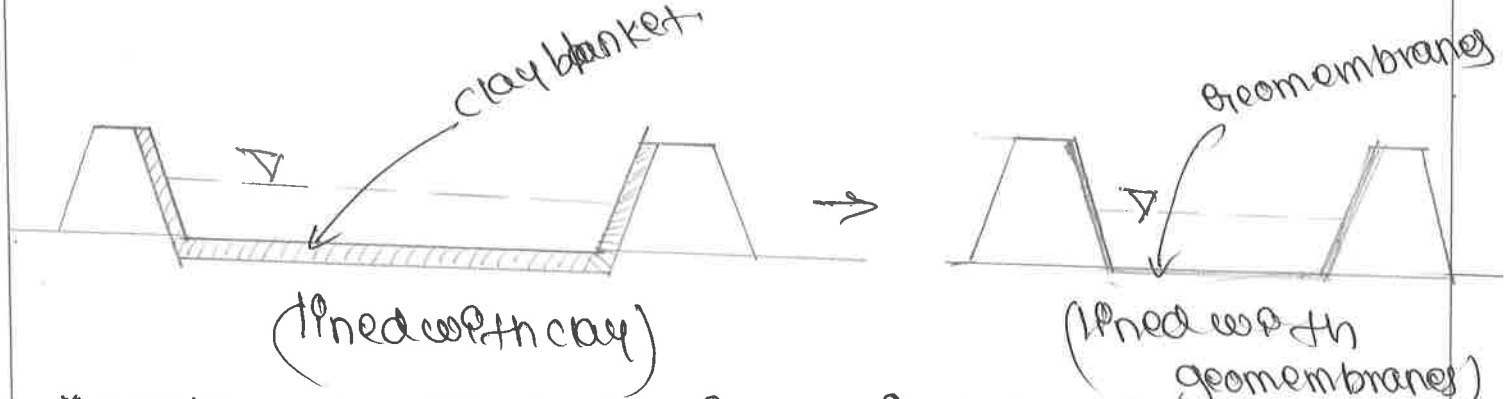
These are used as separators, filters, drains, reinforcement, hydraulic barriers, protectors, and erosion control systems etc. some examples are given below

1) Geotextile



* trench drain is constructed at the toe of an earth dam to carry away seepage and runoff water which requires a transition filter placed in between surrounding soil and the gravel used in trench drain.
* this process can be done by using geotextile filter it can reduce the screening and mixing cost as well as it will that the requirement of filter

2) Geomembranes



* water storage tank. impervious barrier is required to prevent loss of water
* previously clay liner is used now geo
* geomembrane is used as seepage barrier and it is flexible hence not affected by subsoil settlement
* geomembranes (0.25 to 3 mm thick and 250 to 3000 gsm)
* Thick flexible plastic sheet and smooth surface
* impermeable polymeric sheet
* manufactured by high density polyethylene (HDPE), very flexible polyethylene (VFPE), polyvinyl chloride (PVC)

3> Geogrids - (5 to 15mm thickness and 200 to 1500gsm)

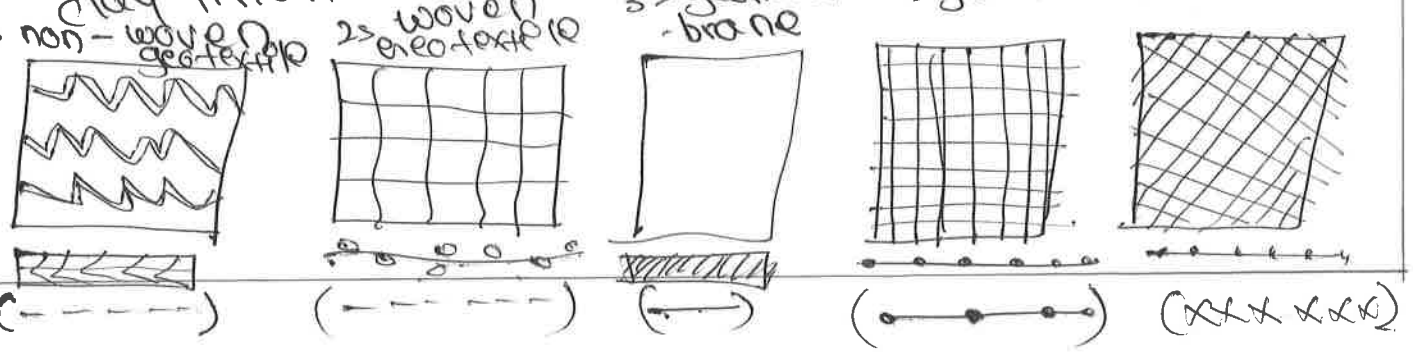
* mesh - like or grid like geosynthetics with square or rectangular shape. plastic meshes used in garden fences
* planer polymeric material of regular open network of connected tensile elements (ribs) with square or rectangular openings
* manufactured from HDPE. polypropylene. polyester
* % age open area > 40 to 95%
  width of opening > 10 to 100mm
  rib thickness > 5 to 15mm

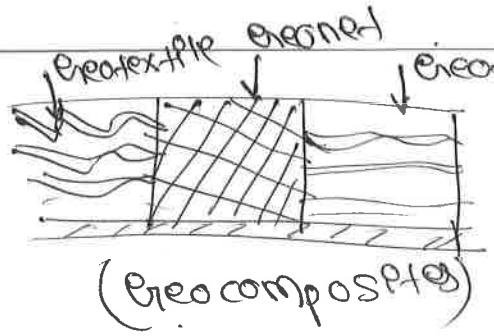
4> Geonets - (property similar to geogrids)

* thin member angular apertures not square or rectangular
* planar polymeric material. parallel sets of ribs overlyings integrally connected to similar sets of ribs at various angles
* width of opening - 5 to 15mm
  rib thickness - 3 to 10mm

5> Geocomposites

* multilayered geosynthetic
* ex- clay / bentonite is bonded to geotextile. to yield a geocomposite known as geosynthetic clay liner.





(Geocomposites)

* properties of geosynthetics

properties	parameters
1> physical	thickness, specific gravity, gsm, porosity, percent open area, apparent opening size
2> chemical	polymer type, filter material, carbon black percentage, plasticizer
3> mechanical	tensile strength, compressibility, elongation, burst strength, seam of strength, anchorage in soil
4> Hydraulic	permittivity [cross - plane permeability], transmissivity (in-plane permeability), clogging potential
5> endurcance degradation	Installation damage potential

Geometrical aspects

* selection of a geosynthetic depends upon width and length, thickness, mass per unit area and the available prefabrication technique
* Depending on mass per unit area the length varies from 50 to 200m for woven and non wovens the width is 5 to 8.5m

15CV654

Sixth Semester B.E. Degree Examination, June/July 2018
Ground Improvement Techniques

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing one full question from each module.***

Module-1

1 a. Classify the ground improvement techniques and discuss their suitability. **(08 Marks)**

b. If in a project unsuitable soil conditions encountered, what are the possible alternate solutions of ground modification? **(08 Marks)**

OR

2 a. Explain the effects of compaction on compressibility and permeability properties of soil. **(08 Marks)**

b. With a sketch, explain dynamic compaction. **(08 Marks)**

Module-2

3 a. Briefly explain different methods of dewatering techniques. **(08 Marks)**

b. Explain Electro – Osmosis dewatering and stabilization technique. What is the purpose of replacing electrodes during Electro – Osmosis dewatering? **(08 Marks)**

OR

4 a. With a neat sketch, explain preloading technique with vertical drains of ground improvement techniques. **(08 Marks)**

b. Why drainage of slope is necessary? Give reasons. **(08 Marks)**

Module-3

5 a. Discuss short term and long term soil – lime reaction, when lime is used as stabilizer and what are the engineering benefits of lime stabilization? **(08 Marks)**

b. Describe Cement stabilization. What are the engineering properties of cement additives to soil as stabilizer? **(08 Marks)**

OR

6 a. Explain how fly ash is beneficial in combination with other materials for effective stabilization. **(08 Marks)**

b. Write short notes on : i) Chlorides stabilization ii) Bitumen stabilization. **(08 Marks)**

Module-4

7 a. Explain Blasting method of stabilization. Bring out the advantages of this method. **(08 Marks)**

b. What are Stone columns? Explain the process of installation. **(08 Marks)**

OR

8 a. Give the classification of grouting methods for soils. Describe it in brief. **(08 Marks)**

b. What are the applications of grouting? Explain them briefly. **(08 Marks)**

Module-5

9 a. List the properties of geosynthetics. Explain any two. **(08 Marks)**

b. Explain the four most basic applications of geosynthetics. **(08 Marks)**

OR

10 Write short notes on the following : **(16 Marks)**

a. Soil nailing b. Gabions and Mattresses c. Soil reinforcement d. Micro piles.

CBCS SCHEME

USN | | | | | | | | | | 15CV654

Sixth Semester B.E. Degree Examination, June/July 2019
Ground Improvement Techniques

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Write a short note on the formation of different types of rocks and their nature. **(06 Marks)**
b. Explain Soil distribution in India. **(06 Marks)**
c. How do you ascertain an existing ground condition is poor or favorable for a particular type of construction? Give two examples. **(04 Marks)**

OR

2 a. Explain the different methods of modifications for the ground improvement. **(10 Marks)**
b. Explain Surface compaction in different types of soils. **(06 Marks)**

Module-2

3 a. Explain with a sketch, multiple stage well – point system of dewatering. **(06 Marks)**
b. Mention the various steps involved in the design of dewatering – systems. Explain how pump capacity is computed. **(10 Marks)**

OR

4 a. Explain with a figure pre – compression technique of preloading, with vertical - drains. **(08 Marks)**
b. Explain with a figure the procedure of Electro – kinetic dewatering system. **(08 Marks)**

Module-3

5 a. What is Cement Stabilization? What are the effects of cement stabilization on permeability, swelling – shrinkage and shear characteristics of the soil. **(10 Marks)**
b. Explain the soil stabilization using Fly Ash. **(06 Marks)**

OR

6 a. Explain the process of Lime stabilization with reactions. **(08 Marks)**
b. Explain the stabilization using Ashpalt. **(05 Marks)**
c. How Lignin is used in the soil stabilization? **(03 Marks)**

Module-4

7 a. With a figure, explain the process of 'Vibrofloatation'. **(10 Marks)**
b. Write short notes on Stone columns, with figures. **(06 Marks)**

OR

8 a. Mention various types of grouting. Briefly explain with sketches any two methods of grouting. **(10 Marks)**
b. Explain with sketches, any three major applications of grouting. **(06 Marks)**

Module-5

9 a. Explain any two types of Geosynthetics with sketches. **(08 Marks)**
b. Explain with sketches following two major applications of geosynthetics :
i) Seperation ii) Filtration. **(08 Marks)**

OR

10 *Write short notes with sketches on any four of the following :* **(16 Marks)**
a) Gabions b) Soil Nailing c) Soil Reinforcement d) Rock anchors e) Micro piles.

* * * * *

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Course/Subject Title	GROUND IMPROVEMENT TECNIQUE	Course/Subject Code	17CV654
Semester	VI th A & B Section	Scheme	CBCS – 18
Date	23/05/2020	CIE No.	I
Time	09:00 pm – 10:00 pm	Max. Marks	20

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the formation & development of ground
CO2	**Explain** the compaction methods for ground improvement
CO3	**Explain** the drainage & dewatering methods
CO3	**Apply** the chemical medication techniques for soil stabilization
CO5	**Explain** vibration methods, grouting & injection techniques for ground improvement
CO6	**Apply** Geosynthetics & soil reinforcement methods for soil stabilization

Note : Answer one Full Question From Each Part

Q. No.	Question	Marks	RBT Level	CO
	Part- A			
1 a)	**Write** short notes on 1. Bituminous stabilization 2. Fly ash stabilization	5	L1, L2 & L3	CO3
1 b)	In detail **explain** the effect of cement stabilization on the following properties of soils i)Permeability ,ii) swelling & shrinkage iii) strength & deformation properties	5	L1, L2 & L3	CO3
	OR			
2 a)	**Write** short notes on i) Stabilization using chloride ii) Stabilization using lignins iii) Sand wich tecnique	5	L1, L2 & L3	CO3
2 b)	**Explain** the process of lime stabilization with reactions	5	L1, L2 & L3	CO3
	Part -B			
3 a)	**List the** different types of Geosynthetics & explain in detail about any two types	5	L1, L2 & L3	CO5
3 b)	**Write** short notes on i) Soil nailing & its application ii) Micro piles & its application	5	L1, L2 & L3	CO5
	OR			
4 a)	**Briefly** describe the concept of i) Thermal mehods of ground improvement ii) Gabions & crib walls	5	L1, L2 & L3	CO5
4 b)	**Explain** in detail about the following properties of Geosynthetics i) Geometrical aspects ii) Filtration & fluid transmission iii) Mechanical properties	5	L1, L2 & L3	CO5

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Course Coordinator
(Shankramma H)

19/05/2020
Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Ground Improvement techniques	Course/Subject Code	17CV6SL
Semester	VIth A and B section	CIE No.	I
Date	23/05/2020	Max. Marks	20

1(a) Bituminous stabilization

Ans
* these materials are normally too viscous to be incorporated directly with soil
* fluidity of asphalts is increased by either heating, emulsifying or by cut back process
* tars are heated or cut back
* binding action or the water proofing action or both the actions — 2.5

Fly ash stabilization
* to enhance strength properties
* stabilize embankments
* to control shrink swell properties
* drying agent to reduce soil moisture contents to permit compaction — 2.5

total = 5

1(b) (i) permeability

Soil stabilization using cement has improved the strength and durability — 2
enhanced the performance of the

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Scheme of Valuation

problematic soil such as calcareous

* swelling and shrinkage
* cement increases plastic limits and reduces liquid limit. which may reduces plasticity
* reduction in shrinkage and swell potential
* strength and deformation property

— 2

— 1

total = 2.5

2(a) stabilization using chloride

* stabilizing effects of sodium chloride is similar
* attracts and retains moisture and reduces the rate of evaporation
* using lignin
* lignins one of the major constituents of wood
* stabilizing effects of lignin are not permanent
* used improve the action of lignin the chrome - lignin process was developed

— 2.5

— 2.5

total = 5

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	ground improvement technique	Course/Subject Code	17CV654
Semester	6th A and B	CIE No.	1
Date	23/05/2020	Max. Marks	20

2(b) lime stabilization
* hydrated lime is very effective on treating heavy plastic clayey soil
* sandy soil can also stabilized with these combinations
* lime has been mainly used for stabilising the road bases and subgrades

total mark = 5

3(a) types of geosynthetics
1) geotextile
2) geomembrane
3) geogrid
4) geonets
5) geocomposites

total mark = 5

3(b) soil nailing
soil nailing is a process of retaining soil by the in corporation of a large number of reinforcement in the soil
micro pile
poles not exceeding 250 mm are called micropiles

Course Coordinator (Faculty in charge) | Coordinator DQAC | Program Coordinator (HOD, Civil)

Scheme of Valuation

* they are pressure grouted piles in which instead of the steel bar used in root piles a steel pipe is used in the hole

total 2 M

(a) thermal methods of ground improvement

* heat is very rarely used to stabilize soil
* technically possible to stabilized saturated clay
* a temperature of 100°C causes drying and increase in the strength of clays

gabions wall

* gabions is a welded wire cage or box filled with materials such as stone, concrete sand or soil so gabion is a partially flexible block construction used for stabilization slope and erosion protection

total 2 M

(b) geometrical aspects

* selection of geosynthetics depends

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

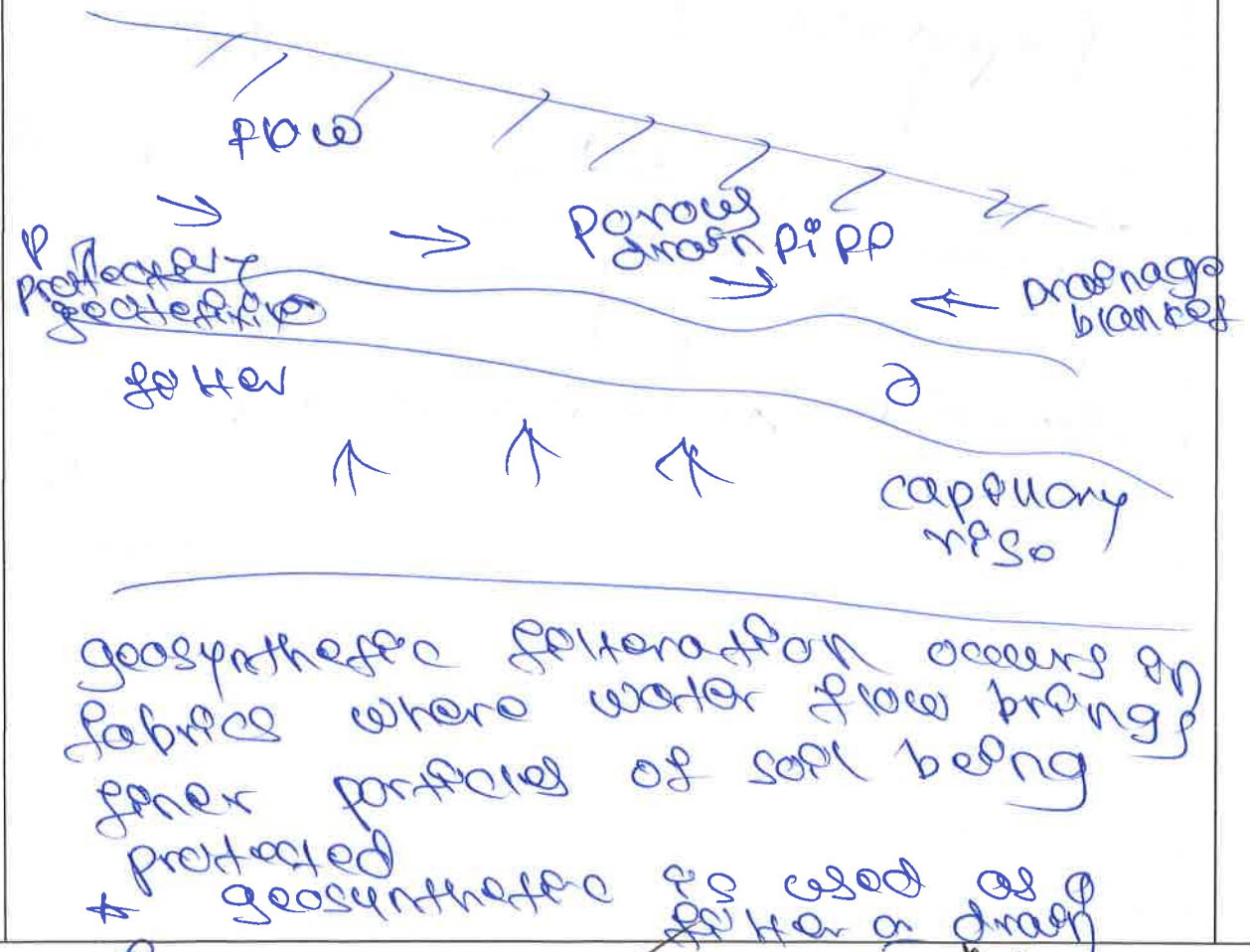
Scheme of Valuation

Course/Subject Title	ground improvement technique	Course/Subject Code	17CV654
Semester	VI th A and B	CIE No.	1
Date	23/09/2020	Max. Marks	20

upon width and length thickness mass per unit area and the available preparation technique

* depending on mass per unit area the length varies from 50 to 200 m for woven and non wovens the width is 5 to 5.5 m

(2) Filtration and fluid transmissivity



geosynthetic filteration occurs in fabrics where water flow brings finer particles of soil being protected

* geosynthetic is used as filter & drain

Course Coordinator
(Faculty in charge)

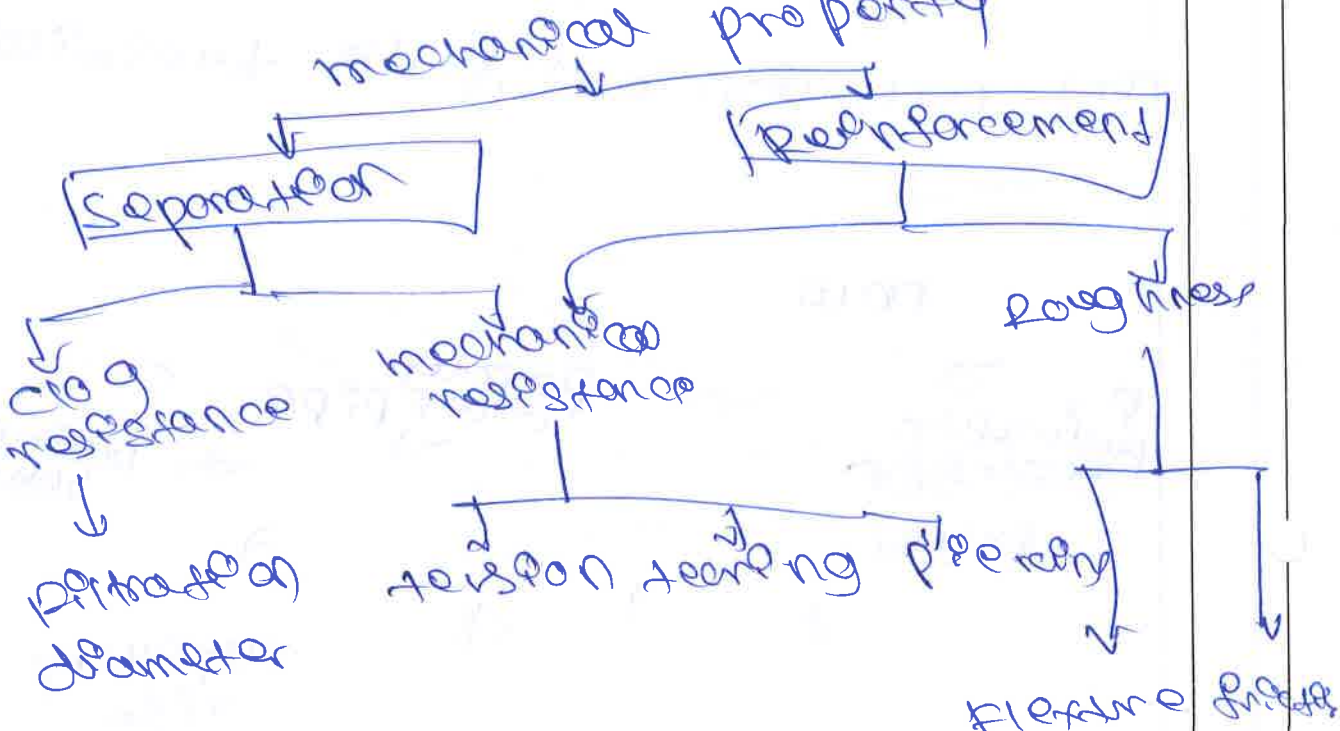
Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Scheme of Valuation

(ii) mechanical properties

* the mechanical properties of geosynthetics depends on the mechanical property of the fibre material to be structure
* mechanical properties are interface friction fatigue resistance creep resistance abrasion resistance



total marks 2

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Subject Title	**GROUND IMPROVEMENT TECNIQUE**	**Subject Code**	**17CV654**
Semester	**VI Sem A section & B section**	**Scheme**	**CBCS**
Date	**05/04/2020**	**Assignment number**	**I**
Last Date	**15/05/2020**	**Max. Marks**	**10**

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the formation & development of ground
CO2	**Explain** the compaction methods for ground improvement
CO3	**Explain** the drainage & dewatering methods
CO4	**Apply** the chemical medication techniques for soil stabilization
CO5	**Explain** vibration methods, grouting & injection techniques for ground improvement
CO6	**Apply** Geosynthetics & soil reinforcement methods for soil stabilization

Note: Answer all the above Questions.

Q. No.	Question	Marks	RBT Level	CO
1	**Explain** vibro floatation method with neat sketch, expain how this method is used to construct stones columns	2	L1, L2 & L3	**CO4**
2	**Write** a note on 1. Compaction by blasting 2. Compaction piles 3. Dynamics compaction or heavy tamping 4. Vibratory probe or terra probe method	2	L1, L2 & L3	**CO4**
3	**Write** a note on 1. Vibro displacement compaction 2. Displacement pile	2	L1, L2 & L3	**CO4**
4	**Explain** types & applications of grouting	2	L1, L2 & L3	**CO4**
5	**Write** a note on grouting procedure	2	L1, L2 & L3	**CO4**
6	**Explain** chemical & material used in grouting	2	L1, L2 & L3	**CO4**
7	**What** are the effect of grouting	2	L1, L2 & L3	**CO4**

RBT (Revised Bloom's Taxonomy) Levels		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Course Coordinator
(Shankramma H)

19/05/2020
Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Subject Title	GROUND IMPROVEMENT TECNIQUE	Subject Code	17CV654
Semester	VI Sem A section & B section	Scheme	CBCS
Date	10/04/2020	Assignment number	II
Last Date	15/05/2020	Max. Marks	10

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the formation & development of ground
CO2	**Explain** the compaction methods for ground improvement
CO3	**Explain** the drainage & dewatering methods
CO4	**Apply** the chemical medication techniques for soil stabilization
CO5	**Explain** vibration methods, grouting & injection techniques for ground improvement
CO6	**Apply** Geosynthetics & soil reinforcement methods for soil stabilization

Note: Answer all the above Questions.

Q. No.	Question	Marks	RBT Level	CO
1	**What** are the methods used to improve the cohesive soil & explain pre compression method with its advantages & disadvantage	2	L1, L2	CO2
2	**Explain** sand drain & vertical drain methods & its advantage with neat sketch	2	L1, L2	CO2
3	**Explain** dewatering methods with neat sketches (two or three method with neat sketches	2	L1, L2	CO2
4	**What** is drains & explain different types of drains with neat sketches	2	L1, L2	CO2
5	**Explain** ground water & seepage controls	2	L1, L2	CO2
6	**Write** a note on 1. Seepage 2. Filter requirement 3. Electro kinetic dewatering	2	L1, L2	CO2
7	**Explain** design of dewatering system including pipe line effects of dewatering	2	L1, L2	CO2
8	**Write** a note on 1. Drainage slopes	2	L1, L2	CO2

RBT (Revised Bloom's Taxonomy) Levels		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Course Coordinator
(Shankramma H)

19/05/2020
Coordinator
DQAC

Program Coordinator
(HOD, Civil)