INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGINEERING GEOLOGY**				
Course Code	ACEB05				
Programme	B. Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr K Tarun kumar, Assistant Professor, Department of Civil Engineering.				
Course Faculty	Mr K Tarun kumar, Assistant Professor, Department of Civil Engineering. Mr.H Apurva Rama, Assistant Professor, Department of Civil Engineering				

I. COURSE OVERVIEW:

This course covers the study of physical geology, structural geology and petrology also the importance of geology from civil engineering point of view. It deals weathering of common rocks like granite and with reference to dams and reservoirs. This course also covers study of minerals, properties, role of properties in their identification. This course also deals with study of rocks, classification and their identification, study of common geological structures like folds, faults and unconformities. This course also deals the methods of investigating subsurface features by geophysical methods such as gravity methods, electrical methods, seismic methods and geothermal methods. Finally this course addresses study and selection of site for dams and reservoirs, improvement of competence of the site by grouting, water tightness, and design considerations of constructing tunnels and lining of tunnels.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS009	II	Environmental Studies	3
UG	AHS005	I	Engineering Chemistry	3

III. MARKSDISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Engineering Geology	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each modules carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	Assignments / Exams
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignments / Exams
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	Seminars
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	1	Assignments / Exams

3 = High; 2 = Medium;1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Assignments/ Exams
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	1	Assignments/ Exams
PSO 3	**Self-learning and service:** Graduates will be motivated for continuous self-learning in engineering practice and/or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	-	-

3 = High; 2 = Medium;1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Discuss the process of formation of rocks, their classifications and properties of minerals.
II	Identify different geological structures encountered in nature.
III	Recognize different hazards such as earthquakes, landslides etc causes and their effects
IV	Explain the importance of geophysical and geological studies of sites for tunnels, dams and Reservoirs.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcomes
CO 1	Understand the role of geology in the design and construction process of underground openings in rock.	CLO 1	Know the importance of geology in civil engineering.
		CLO 2	Distinguish weathered rocks from fresh rocks
		CLO 3	Understand the effects of weathering on dams, Reservoirs and tunnels.
		CLO 4	Understand the case histories of failure of some Civil Engineering constructions due to Geological draw backs.
CO 2	Be able to apply geologic concepts and approaches on rock engineering projects.	CLO 5	Identify and classify rock using basic geologic classification systems
		CLO 6	Study the minerals by their physical properties, chemical composition, optical properties and X- ray properties.
		CLO 7	Study the rocks by their physical properties, chemical composition, optical properties and X- ray properties.
		CLO 8	Understand the geological classification of rocks into Igneous, Sedimentary and Metamorphic rocks, their identification based on structure and texture.
		CLO 9	Identify the major types of rock-forming minerals and rock under both field and laboratory conditions.
CO 3	Be able to identify and classify rock using basic geologic classification systems.	CLO 10	Understand the importance of various associated geological structures like folds, faults, joints and unconformities present at site for foundations.
		CLO 11	Identify subsurface information and groundwater potential sites through geophysical investigations.
		CLO 12	Understand to select a suitable site for dams and reservoirs to avoid seepage, silting and Tilting.
		CLO 13	Understand internal geological processes (e.g. faults, earthquakes, volcanoes) and how they affect engineering studies.
		CLO 14	Locate various subsurface mines and rock bodies by applying geophysical investigations such as Gravity methods, magnetic methods, Electrical methods, seismic methods, radio metric methods and geothermal methods.
CO 4	Be able to use the geologic literature to establish the geotechnical framework needed to properly design and construct heavy civil works rock projects.	CLO 15	Understand the structural and lithological considerations for tunnel construction to avoid leakage and falling of rock parts
		CLO 16	Understanding of impact of engineering solutions on the society and also will be aware of contemporary issues
		CLO 17	Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels.

		CLO 18	Possess the knowledge and skills for employability.
CO5	Have knowledge of design and construction procedures required to safely control rock behavior in underground openings.	CLO19	Understanding of impact of engineering solutions on the society and also will be aware of Contemporary issues.
		CLO20	Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels.
		CLO21	Posses the Knowledge and Skills for employability and to succeed in national and international level competitive examinations.
		CLO22	Determination of shear strength of soil using direct shear test and tri-axial test in various drainage conditions.
		CLO23	Recognize the behavior of soil in normal, over and under consolidated soil. Understand the concept of dilatancy in sandy soil.

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACEB05.01	CLO 1	Know the importance of geology in civil engineering.	PO1, PO 6	1
ACEB05.02	CLO 2	Distinguish weathered rocks from fresh rocks	PO 3, PO 6, PO 7	2
ACEB05.03	CLO 3	Understand the effects of weathering on dams, reservoirs and tunnels.	PO 3, PO 6, PO 7	2
ACEB05.04	CLO 4	Understand the case histories of failure of some Civil Engineering constructions due to Geological draw backs.	PO 3, PO 6, PO 7	1
ACEB05.05	CLO 5	Identify and classify rock using basic geologic classification systems	PO 1, PO 6	1
ACEB05.06	CLO 6	Study the minerals by their physical properties, chemical composition, optical properties and X- ray properties.	PO 3	1
ACEB05.07	CLO 7	Study the rocks by their physical properties, chemical composition, optical properties and X- ray properties.	PO 3	1
ACEB05.08	CLO 8	Understand the geological classification of rocks into Igneous, Sedimentary and Metamorphic rocks, their identification based on structure and texture.	PO 6	1
ACEB05.09	CLO 9	Identify the major types of rock-forming minerals and rock under both field and laboratory conditions.	PO 3, PO 6	1
ACEB05.10	CLO 10	Understand the importance of various associated geological structures like folds, faults, joints and unconformities present at site for foundations.	PO 3, PO 6, PO 7	1
ACEB05.11	CLO 11	Identify subsurface information and groundwater potential sites through geophysical investigations.	PO 3, PO 6	1
ACEB05.12	CLO 12	Understand to select a suitable site for dams and reservoirs to avoid seepage, silting and Tilting.	PO 3, PO 6, PO 7	2
ACEB05.13	CLO 13	Understand internal geological processes (e.g. faults, earthquakes, volcanoes) and how they affect engineering studies.	PO 1, PO 3, PO 6, PO 7	1
ACEB05.14	CLO 14	Locate various subsurface mines and rock bodies by applying geophysical investigations such as Gravity methods, magnetic methods, Electrical methods, seismic methods, radio metric methods and geothermal methods.	PO 1, PO 3, PO 6	1
CLO Code	**CLO's**	**At the end of the course, the student will have the ability to:**	**PO's Mapped**	**Strength of Mapping**

ACEB05.15	CLO 15	Understand the structural and lithological considerations for tunnel construction to avoid leakage and falling of rock parts	PO 3, PO 6, PO 7	2
ACEB05.16	CLO 16	Understanding of impact of engineering solutions on the society and also will be aware of contemporary issues	PO 1, PO 6	1
ACEB05.17	CLO 17	Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels.	PO 3, PO 6, PO 7	1
ACEB05.18	CLO 18	Possess the knowledge and skills for employability.	PO 1	2
ACEB05.19	CLO 19	Understanding of impact of engineering solutions on the society and also will be aware of Contemporary issues.	PO 3, PO 6, PO 7	1
ACEB05.20	CLO 20	Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels.	PO 3, PO 6	2
ACEB05.21	CLO 21	Possess the Knowledge and Skills for employability and to succeed in national and international level competitive examinations.	PO 3, PO 6, PO 7	2
ACEB05.22	CLO 22	Determination of shear strength of soil using direct shear test and tri-axial test in various drainage conditions.	PO 1, PO 3, PO 6, PO 7	1
ACEB05.23	CLO 23	Recognize the behavior of soil in normal, over and under consolidated soil. Understand the concept of dilatancy in sandy soil.	PO 1, PO 3, PO 6	2

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes (PSOs)	
	PO 1	PO 3	PO 6	PO 7	PSO1	PSO2
CO 1	2	2	2	2	2	2
CO 2	2	1	2	2	2	1
CO 3	2	2	2	2	1	2
CO 4	2	2	2	2	2	2
CO 5	2	2	2	2	1	1

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	1					1							1		
CLO 2			2			3	2								
Course	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		

Learning Outcomes (CLOs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 3			2			2	2							1	
CLO 4			1			2	1								
CLO 5	1					1							1	1	
CLO 6			1												
CLO 7			1												
CLO 8						1								1	
CLO 9			2			1									
CLO 10			2			2	1							2	
CLO 11			1			2								1	
CLO 12			2			2	1							1	
CLO 13	1		1			2	1						1	1	
CLO 14	1		2			1							1		
CLO 15			3			1	2							1	
CLO 16	1					2							1	2	
CLO 17			2			1	1							1	
CLO 18	2												1		
CLO 19			1			1	1						1		
CLO 20			2			2								1	
CLO 21			2			2	2							1	
CLO 22	1		1			1	1						1		
CLO 23	2		2			2							1		

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XIII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO3, PO6, PO7, PSO1,PSO2	SEE Exams	PO 1, PO3, PO6, PO7, PSO1,PSO2	Assignments	PO 1, PO3, PO6,PO7, PSO1,PSO2	Seminars	PO 6
Laboratory Practices	PO 6	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XIV. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feed Back
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

MODULE-I	WEATHERING OF ROCKS
Introduction: Importance of geology from civil engineering point of view. Brief study of case histories of failures of some civil engineering constructions due to geological draw backs. Importance of physical geology, petrology and structural geology. Weathering of rocks: Its effect over the properties of rocks importance of weathering with reference to dams, reservoirs and tunnels weathering of common rock like granite.	
MODULE - II	**MINERALOGY AND PETROLOGY**
Mineralogy: Definition of mineral, importance of study of minerals, different methods of study of minerals. Advantages of study of minerals by physical properties. Role of study of physical properties of minerals in the identification of minerals. Study of physical properties of following common rock forming minerals: Feldsper, Quartz, Flint, Jasper, Olivine, Augite, Hornblende, Muscovite, Biotite, Asbestos, Chlorite, Kyanite, Garnet, Talc, Calcite. Study of other common economics minerals such as Pyrite, Hematite, Magnetite, Chrorite, Galena, Pyrolusite, Graphite, Magnesite, and Bauxite. Petrology: Definition of rock, geological classification of rocks into igneous, sedimentary and metamorphic. Dykes and Sills, common structures and textures of igneous, sedimentary and metamorphic rocks. Megascopic study of Granite, Dolerite, Basalt, Pegmatite, Laterite, Conglomerate, Sand Stone, Shale, Limestone, Gneiss, Schist, Quartzite, Marble and Slate. Rock excavation, stone aggregates.	
MODULE- III	**STRUCTURAL GEOLOGY**
Indian stratigraphy, palaeontology and geological time scale, out crop, strike and dip study of common geological structures associating with the rocks such as fold, faults unconformities, and joint types. Ground water: Water table, common types of ground water movement, ground water exploration. Earth quakes, their causes and effects, shield hazards, water in landslides their causes and effects, measures to be taken to prevent their occurrence. Importance of study of ground water, earthquake and landslides.	
MODULE- IV	**GEOLOGY OF DAMS AND RESERVOIRS**
Types of dams and bearing of Geology of site in their selection, Geological Considerations in the selection of a dam site. Factors contributing to the success of a reservoir,Geological factors influencing water tightness and life of reservoirs, Geo hazards, ground subsidence. Geophysicalstudies: Importance of geophysical studies Principles of geophysical study by Gravity methods, Magnetic methods, Electrical methods, Seismic methods, Radio metric methods and geothermal method. Special importance of Electrical resistivity methods and seismic refraction methods. Improvement of competence of sites by grouting etc. Fundamental aspects of Rock mechanics and Environmental Geology.	
MODULE- V	**TUNNELS**
Purpose of tunneling, Effects of Tunneling on the ground, Role of Geological Considerations (ie. Litho logical, structural and ground water) in tunneling over break and lining in tunnels, Tunnels in rock, subsidence over old mines, mining substances.	
Text Books	
1.N. Chennkesavulu, “Engineering Geology”, Mc Milan India Private Limited, New Delhi, India, 2.Venkat Reddy, “Engineering Geology”, Vikas Publications, New Delhi, India, 2nd Edition, 2011. 3.VasudevKanithi, “Engineering Geology”, University Press, 1st Edition, 2013. 4. Gokhale, “Principles of Engineering Geology”, BS Publications, 2009.	
Reference Books	
1. F.G. Bell, “Fundamentals of Engineering Geology”, Butterworth’s Publications, 3rd Edition, New Delhi, 1992. 2. K. V. G. K. Gokhale, “Principles of Engineering Geology”, BS Publications, New Delhi, India, 5th Edition, 5th Edition, 2008.	

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Introduce the subject and importance.	CLO 1	T2:24.6 T2:24.8
2	To know the importance of geology.	CLO 1	T1:12.14
3	To know various case histories of failures of some major constructions due to geological drawbacks.	CLO 1	T2:3.10 T2:24.7
4-5	Able to understand various branches of geology.	CLO 2	T2:3.11 T2:3.12
6-7	To know the process of weathering.	CLO 2	T2:3.11 T2:3.12
8-9	To avoid failures due to weathering.	CLO 2	T1:16.6.2
10-11	To avoid reservoir failures due to weathering.	CLO 3	T2:26.9
12-13	To know how the granite respond to weathering.	CLO 3	T2:26.11
14	To understand the importance of minerals and study.	CLO 2	T1:16.7
15-16	To understand the different methods of study of minerals.	CLO 3	T2:26
17-18	Ability to identify the mineral based on their physical properties.	CLO 4	T2:20.4
19	Ability to study on different physical properties of minerals such as feldspar, quartz, flint minerals.	CLO 4	T2:23.4
20	Ability to identify jasper, olivine, hornblende and augiteminerals.	CLO 4	T2:20.9
21-22	Ability to identify muscovite, biotite, asbestos, chlorite and kyanite minerals.	CLO 5	T2:5.13
23-24	Ability to identify Garnet, Talc	CLO 5	T2:5.13
25-26	Ability to study on common Economic minerals such as Pyrite, Hematite, Magnetite, Chrorite, Galina	CLO 6	T2:21.12
27	Ability to study on common Economic minerals such as Pyrolusite, Graphite, magnesite, Bauxite.	CLO 6	T1:6.5
28-30	To know about petrology ,definition of rock, classification of rock	CLO 7	T1:21.3 T1:21.4 T2:21.5
31-33	Ability to study about distinguishing features of sand stone, shale, limestone, gneiss, schist	CLO 7	T3:27.2
34-36	Ability to understand the importance of Richter scale , precautions to be taken for building construction in seismic areas	CLO 7	T3:27.9
37-39	Ability to understand the importance of landslides, hazards, water in landslides their causes and effects and measures to be taken to prevent their occurrence	CLO 8	T1:12.6.2
40-42	Ability to understand the importance of ground water , earth quakes and land slides	CLO 8	T1:12.7.2
43-44	Ability to understand the importance of geology of dams and reservoirs and types of dams	CLO 9	T1:12.8.2
45-46	Ability to understand the importance bearing capacity of geology of site in their selection	CLO 9	T1:12.8.6
47-49	Ability to understand the importance of geological considerations in the selection of a dam site and the analysis dam failure in the past	CLO 9	T1:7.2.5
50-51	Ability to understand the importance of factors contributing to the success of a reservoir.	CLO 11	T1:10.7
52-53	Ability to understand the importance of geological factors influencing water tightness and life of reservoirs, geo hazards and ground subsidence.	CLO 11	T1:8.4.2 R1:1.3.4
Lecture No	**Topics to be covered**	**Course Learning Outcomes (CLOs)**	**Reference**

54	Ability to understand the importance of geophysical studies, principles of geophysical study in gravity methods, magnetic and electric methods.	CLO 12	T1:8.8
55	Ability to understand the importance of seismic, radiometric and geothermal methods.	CLO 13	T1:8.12.2
56	Ability to understand the importance of electrical resistivity methods, seismic refraction methods.	CLO 14	T5:23.22
57	Ability to understand the importance of improvement of competence of sites by grouting etc…, fundamental aspects of rock mechanics and environmental geology.	CLO 20	T5:25.15 R2:4.7
58	Ability to understand the importance of tunnels , purposes of tunneling, effects of tunneling on geological considerations (litho logical, structural and ground water) in tunneling.	CLO 21	T5:32.17
59	Ability to understand the importance of over break and Lining in tunnels.	CLO 22	T1:10.7
60	Ability to understand the importance of tunnels in rock, subsidence over old mines, mining substances.	CLO 23	T1:8.4.2 R1:2.4

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S.No.	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Explore and identify the rock and suggest the suitability of rock for construction.	Seminars	PO 1	PSO 1
2	Importance of earthquake, groundwater and environment on the properties of rock.	Seminars / NPTEL	PO 2	PSO 1
3	Explore the rock profile using various geophysical studies which aids in calculating the load carrying capacity of a rock at a site.	NPTEL	PO 3	PSO 1

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