GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

M.E. (GEOTECHNICAL ENGINEERING)

(Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

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M.E. GEOTECHNICAL ENGINEERING

Programme Educational Objectives (PEO's)

- Graduates will have an advanced conceptual understanding, in depth knowledge, smart skills and awareness of their responsibilities to the society so that, they emerge themselves as globally competent Geotechnical engineers.
- Graduates will emerge as specialist in handling investigations and testing devices to evaluate and analyze ground conditions for evolving solutions in challenging situations.
- Graduates will have an extensive knowledge of analytical and design soft wares that enable them to cope with the rapid development of the construction industry.
- Graduates will be able to recognize social needs and ethical responsibilities and become a successful entrepreneur and to apply the ideas and concepts to evaluate the problems more effectively through advanced testing and measurements in order to design Geotechnical structures.

M.E.GEOTECHNICAL ENGINEERING

Programme Outcomes (PO's)

1) To apply knowledge of mathematics and engineering knowledge in providing solutions for Geotechnical related problems.

2) To effectively communicate the knowledge gained to the fellow researchers and engineers.

3) Capability to use modern Geotechnical equipments and soft wares to analyse and design structures.

4) To gain cutting edge technology in carrying out research in challenging areas of Geotechnical engineering.

5) Spearheading Geotechnical principles and techniques in giving solutions focussing with enduring vision.

6) Dexterity to tackle complex Geotechnical problems by evolving new techniques.

7) Competence to organize and manage projects as individually and as a team with economical viability.

8) To practice ethics in professional and social responsibilities.

9) Resourcefulness in creating innovative design solutions in collaboration with the industries that include realistic constraints such as economic, ethical, safety and durability.

10) An ability to recognise the importance of Geotechnical engineering by continuing lifelong professional development and take-up rewarding careers in Geotechnical engineering.

11) Ability to understand the impact of engineering solutions meeting with social needs on environmental sustainability.

M.E.GEOTECHNICAL ENGINEERING

Program Specific Outcomes (PSO's)

PSO1: An ability to obtain global research opportunities and placements in R & D departments in the field of Geotechnical Engineering.

PSO2: An ability to analyse, design, develop and execute projects related to Geotechnical Engineering.

PSO3: An ability to become Consultant, Entrepreneur and Pioneers in the field of Geotechnical Engineering

PSO4: An ability of developing skills to face various competitive exams in order to take up challenging and rewarding careers

CURRICULUM FOR CANDIDATES ADMITTED DURING 2018-2019 AND ONWARDS

TWO YEAR M.E. PROGRAMME

GEOTECHNICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM-CURRICULUM

(Full Time Candidates admitted during 2018 – 2019and onwards)

FIRST SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18GEFCZ1	Research Methodology and IPR	FC	50	50	100	3	3	0	0	3
2	18GEPC01	Advanced Foundation Engineering	PC	50	50	100	3	3	0	0	3
3	18GEPC02	Strength and Deformation Characteristics of Soils	PC	50	50	100	3	3	0	0	3
4	18GEPEXX	Professional Elective I	PE	50	50	100	3	3	0	0	3
5	18GEPEXX	Professional Elective II	PE	50	50	100	3	3	0	0	3
6	18GEPEXX	Professional Elective III	PE	50	50	100	3	3	0	0	3
7	18GEACXX	Audit Course I	AC	50	50	100	2	2*	0	0	0
Practical											
8	18GEPC03	Soil Mechanics Laboratory	PC	50	50	100	3	0	0	3	1.5
Total				**400**	**400**	**800**	**23**	**20**	**0**	**3**	**19.5**

SECOND SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1.	18GEPC04	Soil Dynamics and Machine Foundations	PC	50	50	100	3	3	0	0	3
2.	18GEPC05	Site Exploration and Soil Investigation	PC	50	50	100	3	3	0	0	3
3	18GEPEXX	Professional Elective IV	PE	50	50	100	3	3	0	0	3
4	18GEPEXX	Professional Elective V	PE	50	50	100	3	3	0	0	3
5	18GEACXX	Audit Course II	AC	50	50	100	2	2*	0	0	0
Practical											
6	18GEEE01	Mini Project	EEC	50	50	100	4	0	0	4	2
7	18GEPC06	Subsoil Exploration Laboratory	PC	50	50	100	3	0	0	3	1.5
8	18GEPC07	Finite Element Analysis Laboratory	PC	50	50	100	3	0	0	3	1.5
Total				**400**	**400**	**800**	**24**	**14**	**0**	**10**	**17**

THIRD SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18GEPEXX	Professional Elective VI	PE	50	50	100	3	3	0	0	3
2	18$OEXX	Open Elective	OE	50	50	100	3	3	0	0	3
Practical											
3	18GEEE02	Project Phase I	EEC	100	100	200	20	0	0	20	10
Total				**200**	**200**	**400**	**26**	**6**	**0**	**20**	**16**

FOURTH SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18GEEE03	Project Phase II	EEC	200	200	400	32	0	0	32	16
Total				200	200	400	32	0	0	32	16

TOTAL CREDITS: 68.5

LIST OF PROFESSIONAL ELECTIVES FOR M.E.GEOTECHNICAL ENGINEERING											
S.No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
PROFESSIONAL ELECTIVE I											
1	18GEPE01	Analytical and Numerical Methods (Common with M.E. Structural Engg.)	PE	50	50	100	3	3	0	0	3
2	18GEPE02	Remote Sensing and its Applications In Geotechnical Engineering	PE	50	50	100	3	3	0	0	3
3	18GEPE03	Soil Properties and Behaviour	PE	50	50	100	3	3	0	0	3
4	18GEPE04	Reinforced Soil Structures	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE II											
5	18GEPE05	Finite Element Analysis	PE	50	50	100	3	3	0	0	3
6	18GEPE06	Foundation in Expansive Soils	PE	50	50	100	3	3	0	0	3
7	18GEPE07	Soil Structure Interaction (Common with M.E. Structural Engg.)	PE	50	50	100	3	3	0	0	3
8	18GEPE08	Environmental Engineering Structures (Common with M.E. Structural Engg. and M.E. Environmental Engg.)	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE III											
9	18GEPE09	Rock Mechanics in Engineering Practice	PE	50	50	100	3	3	0	0	3
10	18GEPE10	Geotechnical Earthquake Engineering (Common with M.E. Structural Engg.)	PE	50	50	100	3	3	0	0	3
11	18GEPE11	Design of Underground Excavations	PE	50	50	100	3	3	0	0	3
12	18GEPE12	Computational Geomechanics	PE	50	50	100	3	3	0	0	3

PROFESSIONAL ELECTIVE IV											
13	18GEPE13	Slope Stability and Landslides	PE	50	50	100	3	3	0	0	3
14	18GEPE14	Geology in Geotechnical Engineering	PE	50	50	100	3	3	0	0	3
15	18GEPE15	Structural Design of Foundations and Substructures	PE	50	50	100	3	3	0	0	3
16	18GEPE16	Land Reclamation	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE V											
17	18GEPE17	Environmental Geotechnology	PE	50	50	100	3	3	0	0	3
18	18GEPE18	Pavement Engineering	PE	50	50	100	3	3	0	0	3
19	18GEPE19	Theoretical Soil Mechanics	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE VI											
20	18GEPE20	Earth Retaining Structures	PE	50	50	100	3	3	0	0	3
21	18GEPE21	Professional Practices In Design of Geotechnical Structures	PE	50	50	100	3	3	0	0	3
22	18GEPE22	Ground Improvement Techniques	PE	50	50	100	3	3	0	0	3

LIST OF OPEN ELECTIVES FOR M.E.GEOTECHNICAL ENGINEERING

SL.No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contacts Periods	CREDITS			
								L	T	P	C
1	18SEOE01	Vastu Science For Building Construction	OE	50	50	100	3	3	0	0	3
2	18SEOE02	Planning of Smart Cities	OE	50	50	100	3	3	0	0	3
3	18SEOE03	Green Building	OE	50	50	100	3	3	0	0	3
4	18EEOE04	Environment, Health and Safety in Industries	OE	50	50	100	3	3	0	0	3
5	18EEOE05	Climate Change and Adaptation	OE	50	50	100	3	3	0	0	3
6	18EEOE06	Waste to Energy	OE	50	50	100	3	3	0	0	3
7	18GEOE07	Energy in built environment	OE	50	50	100	3	3	0	0	3
8	18GEOE08	Earth and its environment	OE	50	50	100	3	3	0	0	3
9	18GEOE09	Natural hazards and mitigation	OE	50	50	100	3	3	0	0	3
10	18EDOE10	Business Analytics	OE	50	50	100	3	3	0	0	3
11	18EDOE11	Cost Management of Engineering Projects	OE	50	50	100	3	3	0	0	3
12	18EDOE12	Introduction to Industrial Engineering	OE	50	50	100	3	3	0	0	3
13	18MFOE13	Industrial Safety	OE	50	50	100	3	3	0	0	3
14	18MFOE14	Operations Research	OE	50	50	100	3	3	0	0	3
15	18MFOE15	Composite Materials	OE	50	50	100	3	3	0	0	3
16	18TEOE16	Global Warming Science	OE	50	50	100	3	3	0	0	3
17	18TEOE17	Introduction to Nano Electronics	OE	50	50	100	3	3	0	0	3

18	18TEOE18	Green Supply Chain Management	OE	50	50	100	3	3	0	0	3
19	18PSOE19	Distribution Automation System	OE	50	50	100	3	3	0	0	3
20	18PSOE20	Power Quality Assessment And Mitigation	OE	50	50	100	3	3	0	0	3
21	18PSOE21	Modern Automotive Systems	OE	50	50	100	3	3	0	0	3
22	18PEOE22	Virtual Instrumentation	OE	50	50	100	3	3	0	0	3
23	18PEOE23	Energy Auditing	OE	50	50	100	3	3	0	0	3
24	18PEOE24	Advanced Energy Storage Technology	OE	50	50	100	3	3	0	0	3
25	18AEOE25	Design of Digital Systems	OE	50	50	100	3	3	0	0	3
26	18AEOE26	Advanced Processors	OE	50	50	100	3	3	0	0	3
27	18AEOE27	Pattern Recognition	OE	50	50	100	3	3	0	0	3
28	18VLOE28	VLSI Design	OE	50	50	100	3	3	0	0	3
29	18VLOE29	Analog & Mixed Mode VLSI Circuits	OE	50	50	100	3	3	0	0	3
30	18VLOE30	Hardware Description Languages	OE	50	50	100	3	3	0	0	3
31	18CSOE31	Artificial Intelligence and Machine Learning	OE	50	50	100	3	3	0	0	3
32	18CSOE32	Computer Network Engineering	OE	50	50	100	3	3	0	0	3
33	18CSOE33	Big Data Analytics	OE	50	50	100	3	3	0	0	3

LIST OF AUDIT COURSES

S. No.	Subject Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Contact Periods	Hours/Week			
								L	T	P	C
1	18GEACZ1	English For Research Paper Writing	AC	50	50	100	2	2	0	0	0
2	18GEACZ2	Disaster Management	AC	50	50	100	2	2	0	0	0
3	18GEACZ3	Value Education	AC	50	50	100	2	2	0	0	0
4	18GEACZ4	Constitution Of India	AC	50	50	100	2	2	0	0	0
5	18GEACZ5	Pedagogy Studies	AC	50	50	100	2	2	0	0	0
6	18GEACZ6	Stress Management By Yoga	AC	50	50	100	2	2	0	0	0
7	18GEACZ7	Personality Development Through Life Enlightenment Skills	AC	50	50	100	2	2	0	0	0
8	18GEACZ8	Sanskrit For Technical Knowledge	AC	50	50	100	2	2	0	0	0

CURRICULUM DESIGN

S.No	Course Work Subject Area	No of Credits					Percentage
		I	II	III	IV	Total	
1.	Foundation Course	3	0	0	0	3	4.38 %
2.	Professional Cores	7.5	9	0	0	16.5	24.09 %
3.	Professional Electives	9	6	3	0	18	26.28 %
4.	Employability Enhancement Courses	0	2	10	16	28	40.88 %
5.	Open Elective Courses	0	0	3	0	03	4.38 %
Total Credits		**19.5**	**17**	**16**	**16**	**68.5**	**100%**

18GEFCZ1 RESEARCH METHODOLOGY AND IPR

(Common to All Branches)

Category : FC

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Definition and objectives of Research
- Quantitative methods for problem solving
- Data description and report writing

UNIT I INTRODUCTION **L(9)**

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code

UNIT II QUANTITATIVE METHODS FOR PROBLEM SOLVING **L(9)**

Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.

UNIT III DATA DESCRIPTION AND REPORT WRITING **L(9)**

Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis, Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.

UNIT IV INTELLECTUAL PROPERTY **L(9)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V PATENT RIGHTS **L(9)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1 ***Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta Academic, 1996.***

2 ***Donald H.McBurney and Theresa White, "Research Methods", 9th Edition, CengageLearning, 2013.***

3 ***RanjitKumar, "Research Methodology: A Step by Step Guide for Beginners", 4th Edition, 2014.***

4 ***Dr. C. R. Kotharia and GauravGarg, "Research Methodology: Methods and Trends", New age international publishers, Third Edition, 2014.***

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

CO1: Develop research question**[Usage]**

CO2: Perform exhaustive literature survey**[Usage]**

CO3: Apply right problem solving methods**[Usage]**

CO4: Prepare data for analysis**[Usage]**

CO5: Write research report**[Usage]**

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*	*M*		*H*		*H*	*M*				
CO2		*L*	*H*		*H*	*H*		*L*			
CO3		*L*	*H*	*H*					*H*	*M*	
CO4	*H*					*H*		*L*			*H*
CO5	*H*		*M*				*M*	*H*		*H*	

L – Low, M – Moderate (Medium), H – High

18GEPC01 - ADVANCED FOUNDATION ENGINEERING

Category: PC

	L	T	P	C
PREREQUISITES: Nil	**3**	**0**	**0**	**3**

COURSE OBJECTIVE

To study the different exploration techniques and to estimate the capacity of shallow and deep foundations on soils.

UNIT I - PLANNING OF SOIL EXPLORATION (09)

Exploration methods for different projects - methods of borings-penetration tests-pressure meter test, field vane shear test-field permeability test-rock boring, preservation, shipment and storage of samples.

UNIT II - SHALLOW FOUNDATIONS (09)

Requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations
using field test data IS codes.

UNIT III - PILE FOUNDATIONS (09)

Methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behaviour of piles, proportioning of
pile foundations, lateral and uplift capacity of piles.

UNIT IV- WELL FOUNDATION (09)

Introduction- applications, different shapes, grip length, scour depth, forces acting on well foundation- Terzaghi's method of analysis (general case), design of individual components of wells-measures for rectification of tilts and shifts.

UNIT V - FOUNDATIONS ON PROBLEMATIC SOILS AND COFFERDAMS (09)

Foundations for collapsible and expansive soil. Cofferdams-various types, analysis and design - Foundations under uplifting loads.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Narayan V. Nayak, Foundation Design Manual for Practising Engineers and Civil Engineering Students, DhanpatRai Publications Pvt. Ltd., Fourth edition 1996 (Reprint 2001).***
2. ***Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th edition 1997.***

3. ***Das B.M., Shallow Foundations: Bearing capacity and Settlement, CRC Press, 1999.***
4. ***Tomlinson M.J., Pile design and Construction Practice, Chapman and Hall Publication, 1994.***
5. ***Poulos, H.G. AND Davis,F.H., "Pile Foundation Analysis and Design", Wilkey and Sons,1980.***
6. ***Dunnicliff., J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.***
7. ***Hanna T.H., Field Instrumentation in Geotechnical Engineering, Trans Tech., 1985.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Identify and select suitable exploration techniques for different projects.

CO2: Evaluate the bearing capacity and settlement of shallow foundations.

CO3: Estimate the pile capacity and settlement of piles.

CO4: Understand the various components and forces acting on well foundation.

CO5: Gain knowledge about different types of foundations in problematic soil.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*			*M*	*M*						
CO2			*H*			*M*			*H*		
CO3	*H*			*M*				*H*	*M*		
CO4		*H*	*H*				*M*				*H*
CO5		*H*	*H*					*M*			*H*

L – Low, M – Moderate (Medium), H – High

18GEPC02 - STRENGTH AND DEFORMATION CHARACTERISTICS OF SOILS

Category: PC

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To impart knowledge on stress-strain characteristics of soils and its behaviour in the form of stress path and concepts of yield and failure criteria.

UNIT I - SHEAR STRENGTH OF COHESIONLESS SOILS (09)

Shear strength of granular soils – Direct shear – Triaxial Testing – Drained and undrained – Stress-strain behaviour – Dilatation – Contraction and critical states – Liquefaction and Liquefaction potential. Factors influencing – Stress-strain – Volume change behaviour of soils.

UNIT II - SHEAR STRENGTH OF COHESIVE SOILS (09)

Shear strength of clays – Stress-strain behaviour – Vane shear – UCC – Triaxial testing and stress path plotting – Pore pressure parameter of Skempton and Henkel – Total stress and effective stress approach – Shear strength of partially saturated clay in terms of stress state variables – Drained and undrained – Factors influencing stress-strain and shear strength.

UNIT III - YIELD CRITERION (09)

Concepts of yield and failure in soils – Yield criteria of Von Mises, Tresca, KvikPatriak, Drucker and Prager and their extended form – their applicability to soils – Detailed discussion of Mohr – Coulomb failure criterion.

UNIT IV - STRESS PATH AND STRESS – STRAIN LAWS (09)

Lambe's stress path for different cases – Stress path tests – Stress-strain laws for soils – Hyperbolic law – Linear visco-elastic and Elasto – Plastic laws – Yield functions, hardening law, flow rules and plastic strain computation – Elastic module – Cyclic loading – Limitation of linearity elastic model – Hyperbolic stress-strain model.

UNIT V - CRITICAL STATE SOIL MECHANICS AND RHEOLOGICAL MODELS (09)

Introduction to critical state soil mechanics – Boundary Surface – Roscoe and Hvorslev's – Rheological models of Kelvin, Maxwell and Burger as applied to soils.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Lambe, T.W. and Whitman R.V., Soil Mechanics John Wiley, 1979.***
2. ***Hotlz, R.D. and Kovais, W.D., Introduction of Geotechnical Engineering, Prentice – Hall1981.***

3. ***Atkinson, J.H and Brandsby, P.L., Introduction to critical state soil mechanics, Cambridge University Press, New York, 1990***
4. ***Braja, M. Das, Fundamentals of Geotechnical Engineering, Brooks/Cole, Thomson Learning Academic Resource, Center, ISBN-O0534-37114-0.***
5. ***Keedwell, M.J., Rheology and Soil mechanics, Elsevier Applied Science Publishers Ltd. 1984, ISBN 0-85334-285-7.***
6. ***Braja, M. Das, Advanced soil mechanics, McGraw Hill, 1997.***
7. ***Wood. D.M., Soil behaviour and Critical State Soil Mechanics, Cambridge University Press New York, 1990.***
8. ***Bazant, Z.P., Mechanics of Geo-materials, Rocks, Concrete and Soil, John Willey and Sons, Chilchester, 1985.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Evaluate the shear strength parameters of cohesionlesssoil and to gain knowledge about liquefaction.

CO2: Ability to obtain shear strength parameters of cohesive soil under different drainage conditions.

CO3: Understand failure criteria of soils and apply models to study the time-deformation behaviour of soils.

CO4: Use the concepts of stress path for different conditions and characterize stress strain behaviour of soils.

CO5: Get exposure towards various rheological models.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*	*L*		*M*							
CO2	*H*	*L*		*M*	*M*						
CO3				*M*	*H*				*L*		
CO4	*H*	*L*		*M*					*L*		
CO5			*L*		*H*				*L*		

L – Low, M – Moderate (Medium), H – High

18GEPC03 - SOIL MECHANICS LABORATORY

Category: PC

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

COURSE OBJECTIVES

To gain practical knowledge about the type and strength of soil through laboratory tests.

LIST OF PRACTICALS:

1. Determination of Moisture Content and Specific gravity of soil
2. Grain Size Distribution Analysis and Hydrometer Analysis
3. Atterberg Limits (Liquid Limit, Plastic limit, Shrinkage limit)
4. Vibration test for relative density of sand
5. Standard and modified proctor compaction test
6. Constant head permeability test and Falling head permeability test
7. Consolidation test
8. Unconfined compression test
9. Direct shear test
10. Tri-axial compression test – UU, CU, CD tests
11. Laboratory vane shear test

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Shashi K Gulhati and Manoj Datta., Geotechnical Engineering, Tata McGraw Hill Company Limited, New Delhi, 2009

2. C.Venkatramaiah, Geotechnical Engineering, New Age International Publishers, 2009

3. GopalRanjan, A S R Rao, Basic and Applied Soil Mechanics, New Age International Publishers, 2004

4. Iqbal H Khan, Textbook of Geotechnical Engineering, PHI Learning Private limited, 2012

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Determine the physical characteristics of soils.

CO2: Classify the given soils as per IS classification test.

CO3: Evaluate the strength of the soil.

CO4: Evaluate the compressibility characteristics of soils.

CO5: Familiarize with handling of laboratory equipments.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*	*L*	*H*	*M*							*H*
CO2	*M*				*H*			*M*			
CO3		*L*	*H*	*M*		*H*	*M*	*L*		*M*	
CO4			*H*						*H*		*H*
CO5			*H*			*H*					

L – Low, M – Moderate (Medium), H – High

18GEPC04 - SOIL DYNAMICS AND MACHINE FOUNDATIONS

Category: PC

	L	T	P	C
PREREQUISITES: Nil	**3**	**0**	**0**	**3**

COURSE OBJECTIVE

To design different types of machine foundations based on the dynamic properties of soils and to get an exposure on vibration isolation techniques.

UNIT I - THEORY OF VIBRATION (09)

Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems – Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.

UNIT II - DYNAMIC SOIL PROPERTIES (09)

Dynamic stress-strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing factors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.

UNIT III - MACHINE FOUNDATIONS (09)

Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half-Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures.

UNIT IV - DESIGN OF MACHINE FOUNDATION (09)

Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance – Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double-acting steam hammer – Codalre commendations. Emprical approach – Barken's method – Bulb of pressure concept – Pauw's analogy – Vibration table studies.

UNIT V - VIBRATION ISOLATION (09)

Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000.***
2. ***Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.***
3. ***Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985.***
4. ***Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 1995.***
5. ***Arya, S., O'Nelt; S., Design of Structures and Foundations for Vibrating Machines, Prentice Hall, 1981.***
6. ***Major, A., Vibration Analysis and Design of Foundations for Machines and Turbines, Vol. I. II and III Budapest, 1964.***
7. ***Barkan, D.D., Dynamics of Basis of Foundation, McGraw Hill, 1974.***
8. ***Swami Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd. New Delhi 2010.***
9. ***Das B.M., Principles of Soil Dynamics, McGraw Hill, 1992.***
10. ***Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International series, Pearson Education (Singapore) Pvt Ltd, 2004.***
11. ***KameswaraRao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Acquire knowledge to apply theories of vibration to solve dynamic soil problems.

CO2: Evaluate the dynamic properties of soil using laboratory and field tests.

CO3: Acquire basic knowledge about machine foundations and design various types of machine foundation

CO4: To know and capable of selecting the types of vibration isolation materials

CO5: To apply vibration isolation techniques for various field problems..

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*		*L*		*M*						
CO2			*H*	*M*							
CO3	*H*		*H*			*H*			*H*		
CO4	*L*		*M*			*H*			*M*		
CO5	*L*				*M*		*H*		*H*		

L – Low, M – Moderate (Medium), H – High

18GEPC05 - SITE EXPLORATION AND SOIL INVESTIGATION

Category: PC

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To impart knowledge on the preparation of soil exploration report based on laboratory, field exploration and testing techniques.

UNIT I - SCOPE AND OBJECTIVES OF SITE INVESTIGATION AND SUBSURFACE EXPLORATION (09)

Scope and objectives – Preliminary desk studies – Planning an exploration programme – Location – Spacing – Depth of borings – Stabilization of bore holes– Soil Profile – Bore logs – Data Presentation – Soil investigation and exploration reports.

UNIT II - EXPLORATION TECHNIQUES (09)

Methods of boring and drilling – Non-displacement and displacement methods – Drilling in difficult subsoil conditions – Geophysical exploration and interpretation – Seismic refraction and electrical resistivity methods.

UNIT III - SAMPLES AND SAMPLERS (09)

Type of samples – Disturbed and undisturbed – Sample disturbance – Design features affecting sample disturbance – Area and recovery ratio – RQD – Types of samplers – Methods for preventing loss of samples – Shallow penetration samplers – Advanced sampling techniques – Offshore sampling – Preservation and handling of samples.

UNIT IV - FIELD TESTING (09)

Field tests – Importance– Penetration testing – Standard Penetration Test – Static Cone Penetration Test – Dynamic cone penetration test – Plate load test – Field Vane shear test – Pressuremeter test – Data interpretation –Field Permeability test.

UNIT V - INSTRUMENTATION (09)

Instrumentation in soil Engineering – Pore pressure – Ground water table – Strain gauges – Resistance and induction type – Load cells – Earth pressure cells – Settlement and heave gauges – Piezometers and slope indications – Inclinometer.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Site Investigation by CRI clayton, N.E. Simon's and M.C.Mathews – Cranada, 1976.***
2. ***Surface exploration and sampling of soils for Civil Engineering – Purposes – M.JundHvorslev – Waterways Experiment Station, MISSISSIPPI, 1978.***
3. ***Hunt R.E. Geotechnical Engineering Investigation Manual, McGraw Hill, 1984.***

4. ***Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, Nostrand Reinhold 1994.***
5. ***Nair, R.J. and Wood, P.M., Pressuremeter Testing Methods and Interpretation, Butter worths, 1987.***
6. ***Dunnicliff., J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.***
7. ***Hanna T.H., Field Instrumentation in Geotechnical Engineering, Trans Tech., 1985.***
8. ***Bowles J.E., Foundation Analysis and Design, The McGraw Hill companies, inc., New York, 2001.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Plan for soil investigation and exploration in soil and rock.

CO2: Select appropriate equipment for the exploration work for different sub soil condition.

CO3: Gain the practice of recovering samples using advanced sampling techniques.

CO4: Understand the importance of field testing and handling of field.

CO5: Implement geotechnical instrumentation in the field and evolve solutions for different soil conditions.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*			*M*	*M*						
CO2			*H*			*M*			*H*		
CO3	*H*			*M*				*H*	*M*		
CO4		*H*	*H*				*M*				*H*
CO5		*H*	*H*					*M*			*H*

L – Low, M – Moderate (Medium), H – High

18GEPC06 - SUBSOIL EXPLORATION LABORATORY

Category: PC

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

COURSE OBJECTIVES

To impart practical exposure to subsurface exploration through different field and laboratory testing.

List of Practicals:

1. Auger boring
2. One dimensional Consolidation Test
3. Triaxial test
4. Standard Penetration test
5. Dynamic Cone Penetration test
6. Static cone penetration test
7. Light Weight Deflectometer test
8. Ring shear Apparatus
9. Electrical Resistivity meter test
10. Plate load test (Demo only)

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

REFERENCE BOOKS:

1. J.E. Bowles,Physical and Geotechnical Properties of Soils, 2nd Edition, Mc. Graw Hill, New York.

2. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin,1997

3. Al-Khataji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.

4. Alam Singh and Chowdary, G.R.,Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, NewDelhi,2006.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Attain adequate knowledge in assessing compressibility and shear strength characteristics of soils

CO2: Trained to gain knowledge in assessing the safe bearing capacity of soil through field tests.

CO3: Assessing the subgrade modulus of soil for design of pavement thickness.

CO4: Learn to conduct geophysical exploration test and interpret the results.

CO5: Ability to solve geotechnical problems in field.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*		*H*			*L*			*L*	*L*	
CO2	*L*		*H*			*L*			*L*	*L*	
CO3	*L*		*H*			*L*			*L*	*L*	
CO4	*L*		*H*			*L*			*L*	*L*	
CO5			*H*		*L*		*H*		*M*	*H*	*H*

L – Low, M – Moderate (Medium), H – High

18GEPC07 - FINITE ELEMENT ANALYSIS LABORATORY

Category: PC

	L	T	P	C
PREREQUISITES: Nil	**0**	**0**	**3**	**1.5**

COURSE OBJECTIVES

To acquire software applications for various field problems and for various conditions.

ANALYSIS OF THE FOLLOWING

1. Settlement analysis of footings on Cohesive and Cohesionless soil
2. Settlement analysis of piles
3. Analysis of Footings on stone columns
3. Analysis of an embankment
4. Analysis of Flow around a sheet pile wall
5. Settlement analysis of tunnel construction
6. Dynamic Analysis of a machine on an elastic foundation
7. Stability analysis of a dam under Rapid drawdown
8. Analysis of Raft foundation
9. Analysis of Piled Raft
10. Slope Stability Analysis

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Attain ample knowledge in analyzing the settlement of the substructure

CO2: Trained to gain data in assessing the flow around the sheet pile wall

CO3: Analyzing capability for various the slope stability problems

CO4: Gain knowledge in various dynamic analysis problems.

CO5: Analyzing various structures like Raft, piled raft, embankment etc.

SOFTWARES TO BE USED: Plaxis, Oaysis

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*			*H*							
CO2	*L*		*H*				*H*				
CO3	*H*	*M*							*M*		
CO4	*L*	*M*			*L*				*H*		
CO5	*H*	*M*			*M*				*M*		

L – Low, M – Moderate (Medium), H – High

18GEEE01 - MINI PROJECT

Category: EEC

L	T	P	C
0	0	4	2

COURSE OBJECTIVE

To get an idea on literature collection, problem identification and solution techniques in various geotechnical problems.

COURSE CONTENTS:

Mini Project has mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1. Identify geotechnical engineering problems reviewing available literature.

CO2. Study different techniques helpful analyze complex Geotechnical systems.

CO3. Work on the solutions given and present solution by using his/her technique applying engineering principles.

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*
CO1	*L*			*H*							
CO2	*L*		*H*				*H*				
CO3	*H*	*M*							*M*		

L–Low, M – Moderate (Medium), H-High

18GEEE02 - PROJECT PHASE I

Category: EEC

L	T	P	C
0	0	20	10

COURSE OBJECTIVE

To identify state of art problem, develop methodology for solutions using analytical and experimental work and prepare project report for reviews and viva-voce examination.

COURSE CONTENT

Project works are undertaken by the students in the different areas of Geotechnical Engineering like Ground Improvement, Slope stability analysis, Environmental Geotechnology, Earthquake Engineering, Soil Dynamics, Earth Reinforcement, Pavement Engineering, Bearing capacity – settlement studies by conducting model load test etc in the department so that the students are capable of giving solutions to various Geotechnical problems. Collection of literatures from indexed journals, thorough and detailed study of the collected literatures will help the students to identify and choose the right problem for the Phase I project. In addition to problem identification, review of literatures help the students to formulate new ideas, techniques, methodologies to evolve solutions for the selected topic of research work. Preliminary studies and few laboratory investigations are to be carried out in the Phase I project which will help the students to undertake a detailed study in Phase II

Lecture: 0 Periods Tutorial: 0 Periods Practical: 300 Periods Total: 300 Periods

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Know the state of art in the particular area and will be in a position to carry the phase I project in a systematic way.

CO2: Enhance the ability to work independently on the topic using different experimental and analytical approaches.

CO3: Acquire a formulated methodology in solving any problem and to present the solutions in a proper way.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1				*L*							
CO2			*M*								
CO3									*H*		

L–Low, M – Moderate (Medium), H-High

18GEEE03 - PROJECT PHASE II

Category: EEC

L	T	P	C
0	0	32	16

COURSE OBJECTIVE

To carry out intensive research on current topics preferably industry oriented, giving solutions to the identified problems and to publish technical papers in referred journals.

COURSE CONTENT

With the results obtained from experimental studies, analytical tools and softwares like PLAXIS, OASYS, GIS, GEO5, ABAQUS, the students are capable of giving innovative solutions to the selected topic of research. While doing detailed experimental analysis both in the laboratory and in the field, the students gain lot of practical knowledge in handling the equipment and in the interpretation of results. This will help the students in the documentation of the project work in a systematic way. The results of the research work are published in the form of paper presentation in National and International conferences, National and International journals and also leads to development of patents which will be ultimately useful to the society. The output of the project helps the students to face challenging problems in the field with confidence

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 480 Periods** **Total: 480 Periods**

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Go deeper into specific areas using scientific research method.

CO2: Analyze and solve real life geotechnical problems with the knowledge gained through the project work.

CO3: Acquire the capability of preparing report highlighting their research findings and the same can be submitted to research journals.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*			*M*							
CO2			*H*						*M*		
CO3							*L*			*L*	

L – Low, M – Moderate (Medium), H – High

18GEPE01 - ANALYTICAL AND NUMERICAL METHODS
(Common with M.E Structural Engineering)

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

- To familiarize with numerical solutions of equation with one variable and system of equations.
- To obtain the knowledge of numerical interpolation, numerical differentiation and numerical integration.
- To acquire knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques.
- To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods.

UNIT I - SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS (09)

Error Analysis, Solutions of nonlinear algebraic and transcendental equations: Fixed point iteration method, Newton Raphson method, Solutions of linear system of equations: Gauss Elimination, Gauss Jordan, Gauss Seidel method - Eigen value of Matrix by Power method and Jacobi method.

UNIT II-CURVE FITTING AND INTERPOLATION (09)

Curve fitting: Method of least squares – Fitting a straight line, parabola and curves reducible to linear form, Newton's divided difference formula - Lagrange's interpolation - Newton Forward and backward difference formula.

UNIT III - NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION (09)

Numerical approximation of derivatives using interpolation polynomials - Numerical integration by Trapezoidal, Simpson's one third and Simpson's three eighth rules - Two point and three point Gaussian quadrature formula - Double integration using Trapezoidal and Simpson one third rule.

UNIT-IV - NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS (09)

Taylor series method - Euler method - Modified Euler method - Fourth order RungeKutta method for solving first order equations - Predictor and corrector methods: Milne's and Adam Bashforth methods

UNIT-V - NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (09)

Finite difference solutions for the second order ordinary differential equations - Finite difference solutions for one dimensional Heat Equation (Both Explicit and Implicit Methods) – One dimensional wave equation - Laplace and Poisson equation.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1.Srimanthapal, Numerical Methods, Principles, Analyses and Algorithm, Oxford University Press, New Delhi, Ist Edition, 2009.

2. Kandasamy P, Thilagavathy K and Gunavathy K "Numerical Methods" for I year B.E/B.Tech" S.Chand& Co, Ramnagar, New Delhi, Reprint 2013.

3.Kandasamy P, Thilagavathy K and Gunavathy K "Numerical Methods" for I year B.E/B.Tech" S.Chand& Co, Ramnagar, New Delhi, Reprint 2013.

4.Veerarajan T and Ramachandran T "Numerical Methods with Programming in C" McGraw Hill Education Pvt Ltd, New Delhi, Ist Edition, Reprint,2016.

5.S.S.Sastry, Introduction to Methods of Numerical Analysis, Prentice Hall of India, Delhi, 5th Edition,2015.

6 .Dr. J.S Chitode "Numerical Methods" Technical Publications, Pune, 2010.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1: Understand the numerical solutions to algebraic, exponential, logarithmic, transcendental and linear system of simultaneous equations.

CO2: Acquire fluency in numerical interpolation techniques with equal and unequal intervals.

CO3: Understand the techniques of finite differences to apply for numerical differentiation, numerical quadrature and numerical cubature.

CO4: Understand numerical solution to first order ordinary differential equations by different methods like single step and multistep etc.

CO5: Understand numerical solution to second order partial differential equations by different methods using finite differences.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*	*M*	*L*		*L*						
CO2	*H*	*M*	*L*		*L*						
CO3	*H*	*M*	*L*		*L*						
CO4	*H*	*M*	*L*		*L*						
CO5	*H*	*M*	*L*		*L*						

L–Low, M – Moderate (Medium), H-High

18GEPE02 - REMOTE SENSING AND ITS APPLICATIONS IN GEOTECHNICAL ENGINEERING

Category: PE

PREREQUISITES: Nil	L	T	P	C
	3	0	0	3

COURSE OBJECTIVE

To introduce the elements of GIS applied to Geotechnical Engineering and to be familiar with the use of GIS and GPS.

UNIT I - INTRODUCTION (09)

Remote sensing Fundamentals: Definition – Scope –Types and historical development – Ideal and real remote sensing system. Comparison of conventional survey, aerial remote sensing and satellite remote sensing –Advantages and limitation of satellite remote sensing.

EMR and Remote Sensing: Energy sources –Electro Magnetic Radiation – Spectral regions– Energy Interaction in the atmosphere – Atmospheric windows – Energy Interaction with earth surface features – Spectral reflectance patterns for different region of EMR.

UNIT II - SENSORS AND PLATFORMS (09)

Land observation satellites and sesnors LANDSAT- Classification of sensors and platforms LANSAT, SPOT, IRS and IKONSsensors– scanning and orbiting mechanisms – Resolution: spatial, spectral, radiometric and temporal resolution of the satellites –Classification of platforms.

UNIT III - IMAGES INTERPRETATION AND DIGITAL IMAGE PROCESSING (09)

Interpretation procedure –Elements of Photo Interpretation–Strategies of Image Interpretation –Keys of Image Interpretation –Basic equipments for Image Interpretation –Digital Signal Processing Digital analysis – Image Rectification and Restoration – Geometric correction – Image Enhancement and Image transformation.

UNIT IV - GEOGRAPHICAL INFORMATION SYSTEM (GIS) (09)

Definition data input and output: Topology, Digital elevation data – Data management – Relational data model –Spatial data models – Raster and Vector data Models –GIS analysis – Classification, overlay operation.

UNIT V - APPLICATION OF RS AND GIS IN GEOTECHNICAL ENGINEERING (09)

Role of Remote Sensing and GIS in terrain investigation – Digital Terrain Modelling (DTM) –Triangulated Irregular Network (TIN) – Land use and Land cover mapping –Landslide studies and seismic hazard mapping.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. AM Chandra, SK Ghosh, Remote Sensing and Geographic information system, Narosa Publishing house.

2. Lillesand T.M. and Kiefer R.W., Remote Sensing and image interpretation, John Wiley and Sons, New York.

3. J.B. Campbell, Taylor & Francis, Introduction to remote sensing, London.

4. J.R. Jensen, Introductory digital image processing, Prentice Hall International Ltd., London.

5. Kennie, T.J.M. and Matthews M.C., Remote Sensing in Civil Engineering, Surrey University Press, Glasgow.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Study about the remote sensing system, analysis of data and the interpretation of data.

CO2: Obtain knowledge about remote sensing sensors and platforms.

CO3: Gain the knowledge about image interpretation and processing techniques.

CO4: Gain the knowledge about data collection and management of GIS.

CO5: Know the application of GIS in various fields.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*										
CO2				*L*							
CO3				*M*							
CO4		*M*		*H*		*H*			*H*		
CO5			***M***								***L***

L – Low, M – Moderate (Medium), H – High

18GEPE03 - SOIL PROPERTIES AND BEHAVIOUR

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To study about clay minerals, physical, physio-chemical, expansive and conduction behaviour of soils.

UNIT I - FORMATION OF SOILS AND CLAY MINERALS (09)

Introduction – Soil Formation – Types of soils – Geological and pedogical background – Various soil deposits and their engineering suitability – Composition and structure of clay minerals – Structure of allophone, kaolinite, hallosite, montmorillonite, illite, chlorite and vermiculite minerals, mixed layer minerals - Classification and identification of clay minerals – X- ray diffraction data – electron microscopic analysis – Differential thermal analysis – Anion and cation exchange capacity of clays – Specific surface area – Bonding in clays.

UNIT II - PHYSICAL AND PHYSIO-CHEMICAL BEHAVIOUR OF SOIL (09)

Physical and Physio-Chemical behaviour of Soils – Diffused double layer theory – Computation of double layer distance – Dielectric constant – Temperature on double layer – Ion Exchange – Cation exchange capacity – Causes of cation exchange effect – Fixation of cations – Determination of cation exchange capacity – Exchangeable cations.

UNIT III - EXPANSIVE AND SHRINKING SOIL (09)

Introduction – Swelling and shrinking behaviour of soils – Problems associated – Characteristics affecting shrinkage – Crack formation during shrinkage – Measurements of shrinkage for samples – Factors influencing swell – Shrink characteristics – Swelling pressure of soils – Swell pressure determination – Mechanism of swelling – Volume changes and Engineering problems in the field – Osmotic swell pressure – Soil fabric and measurement – Sensitivity, activity - thixotrophy - Stress history – Identification of expansive clays.

UNIT IV - COMPRESSIBILITY AND COLLAPSIBLE SOIL (09)

Introduction – Compressibility – Permeability behaviours of soils and clays – Mechanism involved – Factors governing compressibility – Soil water – Consumption of soil water – Capillary tube, capillary potential – Soil moisture – Methods of determination of soil moisture – Physical behaviour of soil water systems – Liquefaction – Liquefaction potential – Soil suction – Determination of suction potential – Collapsible soil – its identification – Effect on foundation.

UNIT V - CONDUCTION PHENOMENON AND PREDICTION OF SOIL BEHAVIOUR (09)

Conduction in soils – Coupled flows – Electrical, Chemical, Hydraulic and Thermal flows in soils – Consolidation by Electro-osmosis – Clay mineralogy in relation to physical and engineering properties of clay minerals – Prediction of engineering behaviour of soils – Empirical correlations and their applicability – Granular soil structure – Clay structure models.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Bowles J.E., Engineering properties of soils and their measurement, McGraw Hill 1970.***
2. ***Mitchell J.K., Fundamentals of Soil Behaviour, John Wiley, New York, 1993.***
3. ***Yong R.N. and Warkentin, B.P., Introduction of Soil Behaviour, Macmillan, Limited, London, 1979.***
4. ***Das B.M. Principles of Foundation Engineering, PWS Publishing Company, Boston, 1999.***
5. ***McCarthy D.F., Essentials of Soil Mechanics and Foundations, Prentice Hall, 2002.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Get knowledge about the structure and identification of clay minerals.

CO2: Use the concept of diffuse double layer theory and the cation exchange capacity to .determine the chemical behaviour of soils.

CO3: Understand the mechanism and effects of swelling, shrinkage in clay soils.

CO4: Understand the behaviour of collapsible soil.

CO5: Use the clay models in conduction phenomenon to predict the engineering behaviour . of soils.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*		*H*	*M*	*H*	*H*					
CO2	*M*				*L*						
CO3				*H*					*L*	*M*	*H*
CO4						*H*					
CO5	*H*	*M*				*H*					

L – Low, M – Moderate (Medium), H – High

18GEPE04 - REINFORCED SOIL STRUCTURES

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To impart knowledge on geosynthetics, design principles and mechanism of reinforced soil, soil nailing and its applications in dams, embankments, pavements and foundation structures.

UNIT I - PRINCIPLES AND MECHANISMS (09)

Historical background – Initial and recent developments – Principles – Concepts and mechanisms of reinforced soil – Factors affecting behaviour and performance of soil – Reinforcement interactions.

UNIT II - MATERIALS AND MATERIAL PROPERTIES (09)

Materials used in reinforced soil structures – Fill materials, reinforcing materials, metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites, Geojutes, Geofoam, natural fibres, coir Geotextiles – Bamboo – Timber – Facing elements – Properties – Methods of testing – Advantages and disadvantages – Preservation methods.

UNIT III - DESIGN PRINCIPLES AND APPLICATIONS (09)

Design aspects of reinforced soil – Soil reinforcement function – Separator, Filtration, Drainage, Barrier function – Design and applications of reinforced soil of various structures – Retaining walls – Foundations – Embankments and slopes.

UNIT IV - GEOSYNTHETICS AND APPLICATIONS (09)

Introduction – Historical background – Applications – Design criteria – Geosynthetics in roads – Design – Giroud and Noiray approach – Geosynthetics in landfills – Geosynthetic clay liner – Design of landfills – Barrier walls.

UNIT V - SOIL NAILING AND CASE HISTORIES (09)

Soil nailing – Introduction – Overview – Soil-Nail interaction – Behaviour – Design procedure – Behaviour in seismic conditions.

Performance studies of reinforced dams, embankments, Pavements, Railroads, Foundations– Case studies.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.***
2. ***John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.***
3. ***Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.***
4. ***Koerner, R.M., Designing with Geosynthetics, (Third Edition), Prentice Hall, 1997.***
5. ***Proc. Conference on polymer and Reinforcement, Thomas Telford Co., London, 1984.***

6. ***Gray, D.H., and Sotir, R.B., Biotechnical and Soil Engineering Slope Stabilization. A Practical Guide for Erosion Control, John Wiley & Son Inc., New York, 1996.***
7. ***Ramanatha Ayyar, T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., Comprehensive reference book on Coir Geotextile, Centre for Development for Coir Technology, 2002.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the soil reinforcement interaction mechanism.

CO2: Enrich their knowledge on properties, testing methods of geosynthetics in earth reinforcement.

CO3: Detailed knowledge on soil reinforcement functions and the ability to select suitable reinforcing material to suit the functional requirement

CO4: Understand the design criteria for use of geosynthetics in landfills, pavement, liners

CO5: Design various soil reinforcements, soil nailing in major projects.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*M*				*M*						
CO2			*H*	*H*	*M*				*M*		
CO3			*L*			*H*			*H*		
CO4					*H*	*M*			*M*		
CO5	*M*				*M*				*H*		*H*

L – Low, M – Moderate (Medium), H – High

18GEPE05 - FINITE ELEMENT ANALYSIS

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To develop skills in the matrix operations to obtain solution for 1D and 2D problems and axisymmetric and non-linear analysis.

UNIT I - INTRODUCTION TO ELASTICITY (09)

Principles of Elasticity – Stress equations – Strain-Displacement relationships in matrix form – Plane stress – Plane strain and axisymmetric bodies of revolution with axisymmetric loading.

UNIT II - FINITE ELEMENT PROCESS (09)

Principles of discretization, element stiffness and mass formulation based on direct, variational and weighted residual techniques and displacements approach, Shape functions andnumerical integrations, convergence.

UNIT III - ELEMENT PROPERTIES AND ISOPARAMETRIC FORMULATIONS (09)

Concept of an element – Various element shapes– Displacement models – Generalized coordinates – Shape functions – Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements – Serendipity elements.

UNIT IV - SOIL APPLICATIONS (09)

Settlement Analysis, 2-D elastic solutions for homogeneous, isotropic medium, Steady Seepage Analysis: Finite element solutions of Laplace's equation, Consolidation Analysis: Terzaghi consolidation problem, Choice of Soil Properties for Finite Element Analysis

UNIT V - SOFTWARE APPLICATIONS (09)

Introduction to PLAXIS software – Applications of PLAXIS 2D on tunnel construction – Consolidation analysis of embankments – Soil displacement around excavation pit – Pore pressure distribution – Flow around a sheet pile wall – Pile driving –Flow through an embankment – Settlement of a footing on sand and clay – Construction of a road embankment.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Krishnamurthy, Finite Element Analysis – Theory and programming, Second edition, Tata McGraw Hill Publishing Co., 1994.***
2. ***Desai C.S., Elementary Finite Element Method, Prentice Hall, IINC, 1979.***

3. ***Rajasekaran S., Finite Element Analysis in Engineering Design, Wheeler publishing 1993.***
4. ***ChandrapatlaTirupathi, R and Belegundu Ashok, D., Introduction to Finite Elements in Engineering, Second edition, Prentice Hall of India, 1997***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the various stress-strain-displacement relations.

CO2: Know the concept of stiffness matrix and understand choosing boundary conditions.

CO3: Do the discretization of elements to solve the problems of plane stresses and plane strain, types of non linearity and their solutions.

CO4: Exposure towards various concepts in geotechnical finite element analysis

CO5: Software applications of various geotechnical field problems

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*M*		*M*		*H*						
CO2	*H*				*M*						
CO3	*H*		*H*			*H*					
CO4	*M*				*M*		*H*		*M*		
CO5	*L*				*M*		*H*		*H*		

L – Low, M – Moderate (Medium), H – High

18GEPE06 - FOUNDATION IN EXPANSIVE SOILS

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To get exposure on the properties of expansive soils and to study about the substructures placed on expansive soils.

UNIT I - GENERAL PRINCIPLES (09)

Origin of expansive soils – Physical properties of expansive soils –Mineralogical composition – Identification of expansive soils – Field conditions that favour swelling – Consequences of swelling.

UNIT II - SWELLING CHARACTERISTICS (09)

Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

UNIT III - TECHNIQUES FOR CONTROLLING SWELLING (09)

Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Prewetting – Soil replacement – Sand cushion techniques – CNS layer technique.

UNIT IV – FOUNDATIONS ON EXPANSIVE SOILS (09)

Belled piers – Bearing capacity and skin friction –Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

UNIT V - MODIFICATION OF SWELLING CHARACTERISTICS (09)

Lime stabilization – Mechainsms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Fu Hua Chen, Foundations on Expansive Soils, Elsevier ScientificPublishing Company, New York.

2. GopalRanjan and A.S.RRao, Basic and Applied Soil Mechanics,NewAge International Publishers – New Delhi.

3. Hand Book on Underreamed and Bored Compaction Pile Foundation,CBRI, Roorkee.

4. IS : 2720 (Part XLI) – 1977 – Measurement of Swelling Pressure of Soils.

5. R.K.Katti, Search for Solutions in Expansive Soils.

6. Alam Singh, Modern Geotechnical Engineering, Geo-EnvironAcademia, Jodhapur.

7. Swami Saran, Analysis and Design of Substructures.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Assess the occurrence and distribution of expansive soils.

CO2: Study the properties of expansive soils and the controlling techniques.

CO3: Understand various methods of stabilization of expansive soils and foundations used in expansive soils.

CO4: Design foundations on expansive soil.

CO5: Select suitable techniques and understand the mechanism of treatment of swelling Soils.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*								*L*		
CO2	*L*		*H*	*M*	*H*			*M*			
CO3	*H*				*H*	*M*			*M*		*M*
CO4	*H*				*H*	*H*		*H*			*H*
CO5	*M*				*H*	*H*		*M*			

L – Low, M – Moderate (Medium), H – High

18GEPE07 - SOIL STRUCTURE INTERACTION
(Common with M.E Structural Engineering)

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To get an idea on soil structure interaction, soil foundation models, finite difference and finite element analysis and elastic analysis of piles and piled raft.

UNIT I - SOIL - FOUNDATION INTERACTION (09)

Introduction to soil – Foundation interaction problems – Soil behaviour – Foundation behaviour – Interface behaviour – Scope of soil-foundation interaction analysis – Soil response models – Winkler, Elastic continuum, Two parameter elastic models, Elastic – Plastic behaviour – Time dependent behaviour.

UNIT II - BEAMS ON ELASTIC FOUNDATION - SOIL MODELS (09)

Infinite beam – Two parameters – Isotropic elastic half space – Analysis of beams of finite length – Classification of finite beams in relation to their stiffness – Analysis through application packages.

UNIT III - PLATE ON ELASTIC MEDIUM (09)

Infinite plate – Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates – Analysis of finite plates – Rectangular and circular plates – Numerical analysis of finite plates – Simple solutions – Analysis of braced cuts – Application packages.

UNIT IV - ELASTIC ANALYSIS OF PILE (09)

Elastic analysis of single pile – Theoretical solutions for settlement and load distribution – Analysis of pile group – Interaction analysis – Load distribution in groups with rigid cap – Pile raft – Application packages.

UNIT V - LATERALLY LOADED PILE (09)

Load deflection prediction for laterally loaded piles – Subgrade reaction and elastic analysis – Interaction analysis – Pile raft system – Solutions through influence charts –Application packages.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Saran, S., Analysis and design of substructures, Taylor & Francis Publishers, 2006.***
2. ***Hemsley, J.A., Elastic Analysis of Raft Foundations, Thomas Telford, 1998.***
3. ***Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 2008.***
4. ***Murthy, V.N.S., Advanced Foundation Engineering, CBS Publishers, New Delhi, 2007.***

5. ***McCarthy, R.N., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.***
6. ***Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.***
7. ***Scott, R.F., Foundation Analysis, Prentice Hall, 1981.***
8. ***Structure Soil Interaction – State of Art Report, Institution of structural Engineers, 1978.***
9. ***ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Delhi, 1988.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand various soil response models applicable to soil-foundation interaction analysis.

CO2: Come up with elastic solutions for problems of pile, pile-raft system.

CO3: Use software packages to analyze soil-foundation system including laterally loaded piles.

CO4: Acquire knowledge on elastic analysis of pile and pile group

CO5: Acquire knowledge on analysis of laterally loaded piles

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*M*			*H*	*H*						
CO2	*H*				*H*						
CO3	*H*		*H*	*M*		*M*					
CO5	*L*				*M*		*H*		*H*		
CO5	*L*				*M*		*H*		*H*		

L – Low, M – Moderate (Medium), H – High

18GEPE08 - ENVIRONMENTAL ENGINEERING STRUCTURES
(Common with M.E Structural Engineering and M.E Environmental Engineering)

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

To acquire knowledge about design of pipes, concrete roofing, design of water tank and special structures.

UNIT I - DESIGN OF PIPES **(09)**

Structural design of Concrete, Prestressed Concrete, Steel and Cast iron pipes - piping mains – joints – Leak detection - sewerage tank design – anchorage for pipes – massive outfalls – structural design - laying – Testing - hydrodynamic considerations - Advances in the manufacture of pipes.

UNIT II - DESIGN OF CONCRETE ROOFING SYSTEMS **(09)**

Design of concrete roofing systems – Cylindrical, Spherical and Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete – Design of pumping stations – Drainage plan of a building.

UNIT III - ANALYSIS AND DESIGN OF WATER TANKS **(09)**

IS Codes for the design of water retaining structures.

Design of circular, rectangular, spherical and Intze type of tanks using concrete. Design of prestressed concrete cylindrical tanks – Economic analysis – introduction to computer aided design and packages.

UNIT IV - DESIGN OF SPECIAL PURPOSE STRUCTURES **(09)**

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clari-flocculators, aeration tanks, etc.,- effect of earth pressure and uplift considerations – selection of materials of construction.

UNIT V - REPAIR AND REHABILITATION OF STRUCTURES **(09)**

Diagnosing the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures. Exposure on Steel, Lattice Structures used in water and sewerage works.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Prestressed Concrete by KrishnaRaju, Tata McGraw Hill Publishing Co. 2nd edition, 1988.***
2. ***Reinforced Concrete by N. C. Sinha& S .K. Roy -S. Chand and Co.1985.***
3. ***Hulse R. and Mosley W. H., Reinforced Concrete Design by Computer, Macmillan Education Ltd., 1986.***
4. ***Ramaswamy G. S., Design and Construction of Concrete shell roofs, CBS Publishers, India, 1986***
5. ***Green J. K. and Perkins P. H., Concrete liquid retaining structures, Applied Science Publishers, 1981***

COURSE OUTCOMES

At the end of the course students will be able to

CO1: Design concrete roofing systems, pipelines and pumping stations.
CO2: Analyze and Design water tanks and special purpose structures
CO3: Get knowledge about serviceability and durability of structures.
CO4: Acquire knowledge about design of pipes and concrete roofing
CO5: Able to do design of water tank and special structures

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1		*M*	*H*		*M*						
CO2	*M*	*L*	*H*			*M*					
CO3		*H*			*H*						
CO4			*M*		*H*				*H*		
CO5					*H*	*M*				*M*	*M*

L – Low, M – Moderate (Medium), H – High

18GEPE09 - ROCK MECHANICS IN ENGINEERING PRACTICE

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To make the students understand the properties of rock, pattern of failure, evaluation of stresses and stability considerations of rock masses.

UNIT I - CLASSIFICATION OF ROCKS (09)

Rocks of peninsular India and the Himalayas – Index properties and classification of rock masses, competent and incompetent rock – Value of RMR and ratings in field estimations.

UNIT II - STRENGTH CRITERIA OF ROCKS (09)

Behaviour of rock under hydrostatic compression and deviatoric loading – Modes of rock failure – Planes of weakness and joint characteristics – Joint testing, Mohr – Coulomb failure criterion and tension cut-off, Hoek and Brown Strength criteria for rocks with discontinuity sets.Value of RQD rating in field estimations.

UNIT III - DESIGN ASPECTS IN ROCKS (09)

Insitu stresses and their measurements, flat jack – Over and under coring methods – stress around underground excavations – Design aspects of openings in rocks – Case studies.

UNIT IV - SLOPE STABILITY OF ROCKS (09)

Rock slopes – Role of discontinuities in slope failure, slope analysis and factor of safety – Remedial measures for critical slopes – Case studies.

UNIT V - REINFORCEMENT OF ROCKS (09)

Reinforcement of fractured and jointed rocks – Shotcreting – Bolting – Anchoring – Installation methods – Case studies.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Goodman, R.E., Introduction to Rock Mechanics, John Wiley and Sons, 1989.***
2. ***Hool, E and Bray, J., Rock Slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.***
3. ***Hoek, E and Brown, E.T., Underground Excavations in Rock, Institute of Mining and Metallurgy, U.K. 1981.***
4. ***Obvert, L. and Duvall, W., Rock Mechanics and the Design of Structures in Rock, John Wiley, 1967.***
5. ***Bazant, Z.P., Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester, 1985.***
6. ***Wittke, W., Rock Mechanics:Theroy and Applications with Case Histories, Springerverlag, Berlin, 1990.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Know the formation and classification of rocks in India.

CO2: Understand the strength of the rocks in field assessment

CO3: Understand the in-situ stresses developed and methods of measurement.

CO4: Evaluate the strength parameters of rocks and adopt appropriate remedial measures for stability of critical slopes of rocks.

CO5: Give suitable remedial measures in fractured rocks.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*										
CO2		*M*		*M*	*M*						
CO3											
CO4						*H*	*L*	*L*			
C05	*H*					*H*					*H*

L – Low, M – Moderate (Medium), H – High

18GEPE10 - GEOTECHNICAL EARTHQUAKE ENGINEERING
(Common with M.E Structural Engineering)

Category: PE

	L	T	P	C
PREREQUISITES: Nil	**3**	**0**	**0**	**3**

COURSE OBJECTIVE

To understand the mechanism of earthquake, wave propagation analysis, ground motion, earthquake hazards, their mitigation and design of earthquake resistant foundations.

UNIT I - EARTHQUAKE SEISMOLOGY (09)

Causes of earthquake – Plate tectonics –Earthquake Fault sources – Elastic Rebound theory – Seismic waves– Elastic Rebound theory – Locating an earthquake – Quantification of earthquakes – Intensity and magnitudes – Locating an earthquake –Case studies.

UNIT II - GROUND MOTION AND GROUND RESPONSE ANALYSIS (09)

Characteristics of ground motion – Factors influencing ground motion – Evaluation of shear wave velocity – Lab tests – Need for Ground Response Analysis – Methods of Ground Response analysis.

UNIT III - LIQUEFACTION AND LATERAL SPREADING (09)

Liquefaction related phenomena – Liquefaction susceptibility – Evaluation of liquefaction by Cyclic Stress and Cyclic Strain approaches – Lateral deformation and spreading – Criteria for mapping liquefaction hazard zones – Liquefaction computation from Lab and Field tests.

UNIT IV - SEISMIC DESIGN OF FOUNDATIONS, RETAINING WALLS AND SLOPES (09)

Seismic design requirements of foundation – Seismic design of pile foundations – Seismic design of retaining walls – Behaviour of reinforced slope under seismic condition – Recommendations of seismic codes related to geotechnical engineering.

UNIT V - SEISMIC HAZARD ANALYSIS (09)

Seismic hazard analysis – DSHA – PSHA – Seismic microzonation – Soil Improvement for remediation of seismic hazards.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheller Publishing – New Delhi, 2000.***
2. ***Krammer S.L., Geotecnical Earthquake Engineering, Prentice hall, International series Pearson Education (Singapore) Pvt. Ltd., 2004.***
3. ***KameswaraRao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.***

4. ***McGuire, R.K., Seismic Hazard and Risk Analysis, Earthquake Engineering Research Institute. MNo – 10, ISBN 0-943198-01-1, 2004.***
5. ***Mahanti, N.C., Samal, S.K., Datta, P., Nag N.K., Disaster Management, Narosa Publishing House, New Delhi, India ISBN : 81-7319-727X-2006.***
6. ***Bharat Bhushan Prasad, Fundamentals of Soil Dynamics and Earthquake Engineering, PHI Learning Pvt.Ltd.,NewDelhi, 2009.***
7. ***Bharat Bhushan Prasad, Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt.Ltd.,NewDelhi, 2011.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Acquire knowledge about the earthquake ground motion, making familiar with code and software packages to study the ground motion.

CO2: Analyze the liquefaction susceptibility of the site using laboratory and field tests.

CO3: Design earthquake resistant geotechnical structures and the methods to improve the ground for hazard resistance.

CO4: Acquire knowledge about Seismic related codes in geotechnical engineering

CO5: Acquire knowledge about soil improvement for remediation of seismic hazards

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*		*H*			*M*					
CO2	*M*		*H*		*M*						
CO3			*H*		*H*				*H*		*H*
CO4	*H*		*H*			*M*					
CO5	*L*		*H*			*M*					

L – Low, M – Moderate (Medium), H – High

18GEPE11 - DESIGN OF UNDERGROUND EXCAVATIONS

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

To get exposure to analysis, design of underground support system and to learn about the various field tests conducted during and after construction of underground structures.

UNIT I - PLANNING AND EXPLORATION (09)

Introduction, planning and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

UNIT II -ANALYSIS AND DESIGN OF UNDER GROUND STRUCTURES (09)

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory.

UNIT III - TUNNELLING METHODS (09)

Application of rock mass classification systems, ground conditions in tunnelling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / platejacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunnelling Method (NATM), Norwegian Tunnelling Method (NTM),construction dewatering.

UNIT IV - ROCK MASS (09)

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi'selasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts.

UNIT V - INSTRUMENTATION (09)

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc. Instrumentation and monitoring of underground excavations, during and after construction, various case studies.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Hoek, E and and Brown, E. T., Underground Excavations in Rocks, Institute of Mining Engineering.***
2. ***Obert, L. and Duvall, W.I.,Rock Mechanics and Design of Structures in Rocks, John Wiley.***
3. ***Singh, B. and Goel, R.K.,Rock Mass Classification- A Practical Engineering Approach, Elsevier.***
4. ***Singh, B. and Goel, R.K., "Tunnelling in Weak Rocks", Elsevier***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the use of elastic and plastic analysis in the design of underground support system.

CO2: Have idea about the field tests generally conducted during and after construction of underground structures

CO3: Critically analyse the behaviour of underground structures.

CO4: Understand the different methods of tunnelling suited to different ground conditions.

CO5: Gain knowledge about instrumentation during and after construction of underground construction

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*		*H*	*M*		*L*					
CO2			*H*	*M*	*M*	*L*					
CO3	*M*		*M*	*M*	*L*	*H*					
CO4				*H*	*M*				*M*	*M*	*L*
CO5			*L*		*H*				*M*		*L*

L – Low, M – Moderate (Medium), H – High

18GEPE12 - COMPUTATIONAL GEOMECHANICS

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To understand and gain knowledge on the mathematical solutions for geotechnical related problems.

UNIT I - SOLUTION OF LINEAR AND NON-LINEAR EQUATIONS (09)

Bisection - False position - Newton-Raphson - successive approximation method - Iterative method. Solution of Linear Equation by Jacobi's method - Gauss Seidal method - Successive over relaxation method.

UNIT II - FINITE DIFFERENCE METHOD AND FINITE ELEMENT METHOD (09)

Two point Boundary value problems– Disichlet conditions - Neumann conditions; ordinary and partial differential equation.

UNIT III - FINITE ELEMENT METHOD (09)

Fundamentals - constitutive finite element models for soils. Correlation-Scatter diagram - Karl Pearson - coefficient of correlation - Limits of correlation coefficient; Regression-Lines of regression - Regression curves - Regression coefficient - Differences between correlation and regression analysis

UNIT IV - ONE DIMENSIONAL CONSOLIDATION AND FLOW THROUGH POROUS MEDIA (09)

Theory of consolidation - Analytical procedures - Finite difference solution procedure for multi-layered systems - Finite element formulation. Geotechnical aspects - Numerical methods - Applications and Design analysis - Flow in jointed media.

UNIT V- RISK ASSESSMENT IN GEOTECHNICAL ENGINEERING (09)

Probabilistic site characterisation and design of foundation.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***S.Chandrakant Desai and John T.Christian,"Numerical Methods in Geotechnical Engineering",Mc.Graw Hill Book Company,1977.***
2. ***M.K.Jain,S.R.K.Iyengar and R.K. Jain,"Numerical Methods for Scientific and Engineering Computation",Third edition ,New Age International(P)Ltd.Publishers,New Delhi-1996***
3. ***D.J.Naylor and G.N.Pande,"Finite Elements in Geotechnical Engineering",Pineridge press Ltd.,UK-1981***
4. ***Sam Helwany,"Applied Soil mechanics",John Wiley&sons,Inc-2007***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand different numerical and statistical tools for analysing various geotechnical engineering problems.

CO2: Apply probabilistic approach for selection of design parameters and compute their impact on risk assessment.

CO3: Understand the fundamentals constitutive models for soil.

CO4: Evaluate finite element solutions to consolidation and flow through porous media.

CO5: Compute risk assessment both in characterisation of soil and in the design.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*					*H*					
CO2	*H*			*M*	*M*	*H*			*M*		
CO3	*H*		*H*						*L*		
CO4			*H*						*L*		*H*
CO5											

L – Low, M – Moderate (Medium), H – High

18GEPE13 - SLOPE STABILITY AND LANDSLIDES

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVE

To impart knowledge on investigation, analysis, design and stabilization of slopes.

UNIT I - STABILITY OF SLOPES (09)

Introduction – Importance – General characteristics – Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.

UNIT II - STABILITY ANALYSIS (09)

Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations – Evaluation of pore water pressure.

UNIT III - IRREGULAR SLOPES (09)

Non-uniform soils – Janbu's analysis – Taylor's analysis – Bishop's analysis – Total stress and effective stress approaches – Composite surfaces of sliding – Block sliding.

UNIT IV - LAND SLIDES (09)

General Characteristics – Sources–Stability of Hill side slopes – Open cuts – Engineering problems involving the stability of slopes – Cuts in sand – Cuts in loess – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows – Clays containing pockets and sand masses – Slides in stiff clay slopes on shale – Slopes on weathered rock; talus slopes, slopes on over consolidated clays – Slides along coastal areas and tropically weathered residual soils – Long term stability of clay slopes.

UNIT V - FIELD OBSERVATIONS AND SLOPE STABILIZATION (09)

Field instrumentation – Observation studies during construction – Post construction, piezometers – Settlement plates – Inclinometer – Case histories. Compaction of new embankments – Compaction of natural masses of soil and existing fills – Compaction of deep deposits of sand – Vibroflotation – Compaction of compressible soils – Drainage as a means of stabilization – Use of Geotextiles – Soil nailing.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.***
2. ***Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994.***

3. ***Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow 1986.***
4. ***Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Gain knowledge about the purpose of computing slope stability.

CO2: Analyse stability of slopes in cohesive and cohesionless soils.

CO3: Familiarize on the analysis of irregular slopes with different approaches

CO4: Reasoning about causes of landslides in different soil conditions

CO5: Understand the use of instrumentation in the slope stability and execute suitable ground improvement techniques in the field.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*		*L*	*M*							
CO2			*H*	*M*							
CO3						*H*			*M*		
CO4	*M*			*M*						*M*	*H*
CO5				*L*					*H*		*M*

L–Low, M – Moderate (Medium), H-High

18GEPE14 - GEOLOGY IN GEOTECHNICAL ENGINEERING

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To understand microscopic study of rocks, geophysical exploration for ground water and structural geology and also causes and preventing measures of landslides.

UNIT I - INTRODUCTION **(09)**

Soil formation – Soil types of India – Texture formation and structure of igneous, sedimentary and metamorphic rocks. Microscopic study – Microscopic study of rocks with particular reference to texture – microscopic study of unconsolidated sediments with reference to their grain size and mineral content.

UNIT II - GEOPHYSICAL INVESTIGATION **(09)**

Geotechnical Investigation – Geophysical methods of subsurface investigations – Electrical, Magnetic, gravitational, seismic, radioactive and geochemical methods – Influence of structure and texture of rocks, Engineering properties, foundation problems in igneous, sedimentary and metamorphic rocks including recent sediments – Case studies. Investigations for foundation of dams and reservoirs – Problem encountered and treatment, case studies – Investigation of canals and deep cuts – Case studies.

UNIT III - LAND SLIDES **(09)**

Land Slides – Causes – Preventive and control measures – Engineering problems related to earthquakes, case studies- seismic zones in India-causes and features of earthquake

UNIT IV - GROUND WATER **(09)**

Ground Water problems – Location of water tables, composition of ground water – Ground water surveys – Conservation of ground water – Scope of ground water investigation in Civil Engineering.

UNIT V - STRUCTURAL GEOLOGY **(09)**

Altitude of beds – Dip and Strike, Characteristics, Types, Causes and mechanism of folding, Classification, Causes and mechanism of faults – Field evidences and Recognition of faults. Joint systems – Classification and its types, Difference between faults and joints. Definition, importance and field recognition of unconformity.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***ParbinSingh, Engineering and General Geology, Katson Publication House, 1987.***
2. ***Blyth, Geology for Engineering, ELBS 1995.***
3. ***Legget, Geology and Engineering, McGraw Hill Book Company, 1998.***
4. ***Krynine and Judd, Principles of Engineering Geology and Geo techniques, 1998.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Identify the soil types and its historical background of formation.

CO2: Identify mineral content, texture and structural behaviour of rocks using microscopic study.

CO3: Carryout investigation for foundations of massive structures, handle situations of earthquake and landslide.

CO4: Do ground water survey and understand ground water investigation studies.

CO5: Gain knowledge about structural problems and recognition of field and give the suitable remedial measures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1		*L*									
CO2				*M*							
CO3						*H*		*H*			
CO4	*M*				*L*		*L*		*L*		
CO5				*M*							*M*

L–Low, M – Moderate (Medium), H-High

18GEPE15 - STRUCTURAL DESIGN OF FOUNDATIONS AND SUBSTRUCTURES

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES

To give exposure to students the structural design of shallow, deep and special foundations.

UNIT I – DESIGN OF FOOTINGS (09)

Introduction to Limit State Design of reinforced concrete in foundations; Soil pressure for structural design, Conventional structural design of continuous footings, individual footings – rectangular and circular, combined footings – rectangular, trapezoidal and strap.

UNIT II – DESIGN OF RAFTS (09)

Raft Foundations – Structural Design of rectangular and circular rafts and mats using conventional method of analysis, Analysis and design of rafts and mats incorporating soil structure interaction using any FEM software.

UNIT III – DESIGN OF PILES AND PIERS (09)

Structural design of piles including pile caps, under-reamed piles, Structural Design of pier

UNIT IV – DESIGN OF FOUNDATION AND COFFER DAM (09)

Types of well foundation – components – structural design of well foundation – types of coffer dam – design – lateral pressure stability

UNIT V – DESIGN OF RETAINING WALLS (09)

Structural design of retaining walls-Reinforced Concrete Cantilever retaining wall, Counterfort retaining wall, Flexible retaining Structures –Sheet Pile Wall, Anchored Bulk Heads.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Nainan P. Kurian "Design of Foundation Systems: Principles and Practices",Narosa publish House, New Delhi.

2. Swami Saran, "Analysis and Design of Substructures", Oxford & IBH Publishing Co.

3. Tomlinson M.J., "Foundation Design and Construction", Prentice Hall.27

4. ShamsherPrakash, Hari D., Sharma "Pile Foundations in Engineering Practice", Wiley- IEEE.

5. Nainan P. Kurian "Shell foundations: Geometry, Analysis, Design and Construction", Alpha Science International Ltd.
6. Tomlinson M.J., John Woodward "Pile Design and Construction Practice",Routledge.
7. Som N. N., and Das S.C., "Theory and Practice of Foundation Design Prentice Hall of India.
8. Sharat Chandra Gupta, "Raft Foundations – Design and Analysis with Practical Approach", New Age International Pvt.Ltd , New Delhi.

COURSE OUTCOMES

At the end of this course, students will be able to

CO1: Design the isolated and combined footing.
CO2: Carry out analysis and design of rafts.
CO3: Get familiarised with design of piles and pier.
CO4: Carryout structural design of well foundation and coffer dam.
CO5: Do design of retaining walls.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*			*M*		*M*	*L*		*H*		
CO2	*H*	*L*	*H*		*M*	*M*		*M*	*H*		*M*
CO3	*H*				*M*	*H*	*L*				
CO4	*H*	*M*		*H*				*M*	*H*	*H*	*H*
CO5	*H*			*H*		*H*			*H*	*H*	*H*

L–Low, M – Moderate (Medium), H-High

18GEPE16 - LAND RECLAMATION

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES

To get an idea of characteristic of waste, processes and remediation techniques.

UNIT I - INTRODUCTION (09)

Soil around us, Soil Water Characteristics, Soil Erosion, Soil and Pollution, Water resources, Irrigation and Wetlands, Soil Pollution Management, Nuclear Waste Management, Solid Waste Management.

UNIT II – TRANSPORTATION OF WASTES (09)

Handling and segregation of wastes at source- storage and collection of municipal solid wastes- Analysis of collection systems- Need for transfer and transport- Transfer stations Optimizing Waste allocation- compactability, storage, labelling and handling of hazardous wastes- hazardous waste manifests and transport.

UNIT III - TREATMENT OF WASTES (09)

Objectives of waste processing- material separation and processing technologies- biological and chemical conversion technologies-method and controls of composting- thermal conversion technologies and energy recovery- incineration- solidification and stabilization of hazardous wastes- treatment of biomedical wastes.

UNIT IV - LANDFILLS (09)

Waste disposal options- Disposal in landfills- Landfill Classification, types and methods- site selection- design and operation of sanitary landfills, secure landfills and landfill bioreactors- leachate and landfill gas management- landfill closure and environmental monitoring- closure of landfills- landfill remediation.

UNIT V - WASTE MANAGEMENT AND BIOREMEDIATION (09)

Types and Sources of solid and hazardous wastes-Need for solid and hazardous waste management- Elements of integrated waste management and roles of stakeholders- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes-Bioremediation- techniques-field applications.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***GeorgeTchobanoglous, Hilary Theisen and Samuel A, Vigil "Integrated Solid Waste Management, McGraw- Hill International edition, New York, 1993.***

2. CPHEEO "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.

3.Micheael D. Lagrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, McGraw- Hill International edition, New york, 2001.

4.Vesilind P.A., Worrell W and Reinhart, Solid Waste Engineering, Thomson Learning Inc., Singapore, 2002.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the fundamentals of solid and hazardous wastes and also the types, need and sources of solid and hazardous wastes.

CO2: Understand the methods of waste characterization and source reduction and to study the various methods of generation of wastes.

CO3: Understand in detail about the storage, collection handling, segregation and transport of wastes.

CO4: Gain the knowledge on the waste processing techniques which includes incineration, solidification and stabilization of hazardous wastes

CO5: Know about the basics of various waste disposal methods.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*M*			*H*	*H*						
CO2	*H*				*H*						
CO3	*H*		*H*	*M*		*M*					
CO5	*L*				*M*		*H*		*H*		
CO5	*L*				*M*		*H*		*H*		

L–Low, M – Moderate (Medium), H-High

18GEPE17 - ENVIRONMENTAL GEOTECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVE

To acquire knowledge on the geotechnical engineering problems associated with soil contamination, safe disposal of waste, stabilization of waste, transportation of contaminant and site remediation techniques.

UNIT I - SOIL POLLUTANT INTERACTION (09)

Introduction to Geoenvironmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil – Pollutant interaction – Failures of foundations due to pollutants – Case studies.

UNIT II - SITE SELECTION AND SAFE DISPOSAL OF WASTE (09)

Safe disposal of waste – Site selection for landfills – Characterization of landfill sites– Risk assessment – Stability of landfills – Current practice of waste disposal – Design of landfill - Monitoring facilities – Passive containment system – Leachate contamination - Hydrological consideration in landfill design – Application of geosynthetics in solid waste management – Rigid and flexible liners – Design.

UNIT III - TRANSPORT OF CONTAMINANTS (09)

Contaminant transport in sub surface – Advection – Diffusion – Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation –Ground water pollution – Bearing capacity of compacted fills – Foundation for waste fill ground – Pollution of aquifers by mixing of liquid waste – Protection of aquifers.

UNIT IV - WASTE STABILIZATION AND DISPOSAL (09)

Hazardous waste control and storage system – Stabilization/Solidification of wastes – Micro and Macro encapsulation – Absorption, adsorption, precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement – Case studies.

UNIT V - REMEDIATION OF CONTAMINATED SOILS (09)

Rational approach to evaluate and remediate contaminated sites – Monitored natural attenuation – Ex-situ and in-situ remediation – Solidification, Bio-remediation, incineration, soil washing, electro kinetics, soil heating, vitrification, bio-venting – Ground water remediation – Pump and treat, air sparging, reactive well –Case studies.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.***
2. ***Daniel, D.E., Geotechnical Practice for waste disposal, Chapman and Hall, London, 1993.***
3. ***Proceedings of the International symposium of Environmental Geotechnology (Vol. I and II), Environmental Publishing Company, 1986 and 1989.***
4. ***Ott, W.R., Environmental Indices, Theory and Practice, Ann. Arbor, 1978.***
5. ***Fried, J.J., Ground Water Pollution, Elsevier, 1975.***
6. ***ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.***
7. ***Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.***
8. ***Lagrega, M.D., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.***
9. ***Zheng C "Applied Contaminant Transport Modelling" John Wiley and Sons.***
10. ***Oweis I.S and Khera R.P, "Geotechnology of waste management, PWS publishing company, Boston***
11. ***Fang H.Y "Introduction to Environmental Geotechnology "CRC press , Boca Raton.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Assess the causes of soil pollution and identify the factors governing soil pollutant interaction.

CO2: Design landfill for safe disposal of waste.

CO3: Understand the mechanism of transport of contaminants in subsoil.

CO4: Select suitable technique for the stabilization of solid waste.

CO5: Select appropriate technique for the remediation of contaminated site.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*			*M*							*H*
CO2	*M*		*H*		*L*				*H*		*H*
CO3							*M*	*H*	*L*		
CO4	*H*					*M*					*H*
CO5	*H*					*M*				*M*	*H*

L–Low, M – Moderate (Medium), H-High

18GEPE18 - PAVEMENT ENGINEERING

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To gain knowledge on assessing stresses, design of flexible and rigid pavements and pavement rehabilitation techniques.

UNIT I - BASIC CONCEPTS (09)

Pavement – types – Historical developments – Approaches to pavement design – Vehicle and traffic considerations – Behaviour of road materials under repeated loading – Stresses and deflections in layered systems.

UNIT II - FLEXIBLE PAVEMENT (09)

Factors affecting flexible pavements–Material characterization for analytical pavement design – CBR and stabilometer tests – Resilient modulus – Fatigue subsystem – Failure criteria for bituminous pavements – IRC design guidelines.

UNIT III - RIGID PAVEMENT (09)

Factors affecting rigid pavements – Design procedures for rigid pavement – IRC guidelines – Design of joints, reinforcements, tie bars, dowel bars - Airfield pavements – CRC pavements.

UNIT IV - PAVEMENT EVALUATION AND REHABILITATION (09)

Pavement evaluation and rehabilitation, condition and evaluation surveys – Causes and types of distress in flexible and rigid pavements – PSI models – Serviceability index of rural roads – Overlay design - pavements maintenance management and construction.

UNIT V- STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS (09)

The need for a stabilized soil – Design criteria and choice of stabilizers – Testing and field control – Stabilisation for rural roads – Use of geofabrics in road construction – Case studies.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Wright, P.H., Highway Engineers, Johwiley& Sons, Inc. New York, 2009.***
2. ***Yoder, R.J and Witchak, M.W., Principles of Pavment Design, John wiley, 2000.***
3. ***Khanna, S.K and Justo C.E.G., Highway Engineering, New Chand and Brothers, Roorkee, 1998.***
4. ***Design and specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.***
5. ***Guidelines for the Design of Flexible Pavements, IRC : 37 – 2012, The Indian Roads Congress, New Delhi.***

6. ***Guidelines for the Design of Rigid Pavements, IRC : 58 – 2012, The Indian Roads Congress, New Delhi.***
7. ***O' Flaherty, C.A., Highway Engineering (Vol. 2), Edward Arnold Cp. 1978.***
8. ***Kadiyali, L.R., Transport planning & Traffic Engineering, Khanna Publishers, 2008.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Learn loading conditions and corresponding stresses and deformation developed.

CO2: Carry out material characterization and the design of flexible pavement.

CO3: Design of rigid pavement as per IRC guidelines.

CO4: Evaluate pavement and to select appropriate rehabilitation technique.

CO5: Select suitable stabilizers and their applicability in pavements.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*	*L*		*H*							
CO2	*H*		*M*		*H*	*M*			*H*		
CO3	*H*								*L*		
CO4	*M*		*H*	*H*			*M*			*M*	
CO5	*L*		*H*							*M*	*H*

L–Low, M – Moderate (Medium), H-High

18GEPE19 - THEORETICAL SOIL MECHANICS

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To learn elastic solutions by understanding stress-strain behaviour using theory of elasticity in anisotropic and non-homogeneous soil.

UNIT I - THEORY OF ELASTICITY (09)

Introduction – Material behaviour – Idealistic behaviour – Elastic, viscous and plastic – Elasticity and stability problems, concept of stress and strain – Plane stress, plane strain and axisymmetric problems – Equation of equilibrium and compatibility – Stress functions.

UNIT II - STRESSES AND DISPLACEMENTS (ELASTIC SOLUTIONS) (09)

Stresses in elastic half-space medium by external loads – Fundamental solutions – Boussinesq, Flamant, Kelvin and Mindlin solution – Applications of fundamental solutions – Anisotropic and non-homogeneous linear continuum – Influence charts – Elastic displacement.

UNIT III - LIMIT EQUILIBRIUM ANALYSIS (09)

Limit equilibrium analysis – Perfectly plastic material – Stress-strain relationship – Stress and displacement field calculations – Slip line solutions for undrained and drained loading – Dimensional similitude.

UNIT IV - LIMIT ANALYSIS (09)

Limit analysis – Principles of virtual work – Theorems of plastic collapse – Mechanism for plane plastic collapse – Simple solutions for drained and undrained loading – Stability of slopes, cuts and retaining structures. Centrifuge model – Principles and scale effects, practical considerations.

UNIT V - FLOW THROUGH POROUS MEDIA (09)

Flow through porous media – Darcy's law – General equation of flow – Steady state condition – Solution by flow net – Fully saturated conditions – Flownetin anisotropic soils – construction of flownet for different cases.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Aysen, A., Soil Mechanics: Basic concepts and Engineering Application, A.A.Balkema Publishers, 2002.***
2. ***Ulrich Smoltc, YK, Geotechnical Engineering Handbook (Vol. 1) Ernot&Sohn, 2002.***
3. ***Aysen, A., Problem Solving inSoil Mechanics, A.A.Balkema Publisher, 2003.***

4. ***Davis, R.O., and Selvadurai, A.P.S., Elasticity and Geomechanics, Cambridge University Press, 1996.***
5. ***Taylor, R.N., Geotechnical Centrifuge Technology, Blackie Academic and Professional 1995.***
6. ***Wai-Fah Chen, and Liu, X.L., Limit Analysis in Soil Mechanics, Elsevier Science Ltd., 1991.***
7. ***Muni Budhu, Soil Mechanics and Foundations, John Wiley and Sons, Inc, Network, 2000.***
8. ***Atkinson, J.H., Foundations and Slopes, McGraw Hill, 1981.***
9. ***Harr, M.E., Foundations of Theoretical Soil Mechanics, McGraw Hill, 1966.***
10. ***Cedergren, H.R., Seepage Drainage and Flownets, John Wiley, 1997.***
11. ***Winterkorn, H.F., and Fang, H.Y., Foundation Engineering Handbook Galgottia, Booksource, 2000.***
12. ***Karl Terzaghi,Theoritical Soil Mechanics, John Wiley & Sons Publications.***

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Apply theories of elasticity and plasticity to characterize the stress-strain behaviour of soil

CO2: Imparting knowledge required for calculating stress and settlement at any depth in semi-infinite elastic soil medium, anisotropic and layered medium due to external loads

CO3: Acquire knowledge on slip line solutions on drained and undrained condition.

CO4: Arrive at solutions for drained and undrained loading conditions for analysis of slopes, cuts and retaining structures for their stability using theorem of plastic collapse.

CO5: Understand the concept of flow through soil media and to construct flow nets for different cases.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*		*L*	*M*							
CO2	*L*			*H*		*H*					
CO3					*M*				*L*		
CO4	*L*				*M*				*L*		
CO5	*M*		*M*		*M*	*H*					

L–Low, M – Moderate (Medium), H-High

18GEPE20 - EARTH RETAINING STRUCTURES

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To impart knowledge on earth pressure theories, design of retaining walls, sheet pile walls with and without geosynthetic reinforcements.

UNIT I - EARTH PRESSURE THEORIES (09)

Introduction – State of stress in retained soil mass – Classical earth pressure theories – Active and Passive earth pressures – Earth pressure at rest – Earth pressure due to external loads – Empirical methods – Wall movements and complex geometry – Graphical method of computing earth pressure – Rehbann's and Culmann's approach.

UNIT II - RETAINING WALLS (09)

Retaining walls – Uses and types – Forces on retaining walls – Design of retaining walls by limit state method – General principles – Design and construction details – Design of solid gravity walls, Semi – gravity walls, cantilever walls, counterfort walls – Stability of retaining walls – Drainage arrangements and its influence.

UNIT III - SHEET PILE WALLS (09)

Earth retaining structures – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls – Deadman and continuous anchor – Diaphragm and bored pile walls – Design requirements.

UNIT IV - BRACED EXCAVATION (09)

Braced cuts in sand and clay – Lateral pressure on sheeting in Braced excavation – Stability against piping and bottom heaving – Procedure for computation of lateral earth pressure for braced cuts and Flexible Bulk heads – Soil anchors – Soil nailing – Soil pinning – Methods of design.

UNIT V - REINFORCED EARTH RETAINING WALL (09)

Reinforced earth retaining wall – General principles, Concepts and Mechanism of reinforced earth – Design consideration of reinforced earth – Geotextile, geogrids, metal strips and facing elements – Construction – Selection of type of retaining structures – Construction practice – Field observations.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Winterkorn H.F. and Fang H.Y., Foundation Engineering Hand book, Galgotia Book-source, 2000.***

2. ***Rowe R.K., Geotechnical and Geo environmental Engineering Hand Book, Kluwer Academic Publishers, 2001.***
3. ***Militisky .J and Woods R., Earth and earth retaining structures, Routledge, 1992.***
4. ***Das B.M., Principles of Geotechnical Engineering (Fourth edition). The PWS series in Civil Engineering, 1998.***
5. ***Clayton C.R.I. Militisky, J and Woods R., Earth pressure and earth retaining structures (second edition) Survey University Press, 1993.***
6. ***McCarthy D.F., Essentials of soil Mechanics and foundations; Basic Geotechnics (sixth Edition) Prentice Hall, 2002***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand earth pressure theories and computation of earth pressure

CO2: Capability to calculate the forces on retaining walls and design the retaining walls

CO3: Carry out analysis and design of sheet pile walls

CO4: Design excavations, soil nailing, pinning, and anchoring on stability considerations.

CO5: Apply concepts of reinforcement in earth retaining structures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*		*H*	*M*							
CO2			*H*		*M*				*H*		
CO3	*H*				*L*						
CO4	*M*		*M*		*H*				*M*		
CO5	*M*		*M*	*L*	*H*				*H*		

L–Low, M – Moderate (Medium), H-High

18GEPE21 - PROFESSIONAL PRACTICES IN DESIGN OF GEOTECHNICAL STRUCTURES

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To gain exposure on practical aspects of design relating to substructure elements using software, Geotechnical construction practices, and field execution of the works.

UNIT I- CONSTRUCTION TECHNIQUES (09)

Project planning – Geotechnical engineering practices – Soil profile – Bore log – Report review and preparation – Geotechnical Plant and Machinery – Safety aspects at site– Construction management – Quality control – Quality management – Geosynthetics – Geomembrane.

UNIT II- RETAINING STRUCTURES (09)

Design of retaining wall – Design of culvert – Design of deep excavations – Sheet pile – diaphragm walls – Shoring system – Design of Caisson.

UNIT III- SUBSTRUCTURES (09)

Design of Tower Foundation – Design of Floating foundation– Design of Pile and Pile group – Design of underreamed pile – Design of abutment – Design of Pier – Design of mat foundation – Design of piled raft foundation.

UNIT IV- DYNAMIC RESPONSE OF FOUNDATIONS (09)

Soil behaviour – Dynamic properties of soil– Seismic performance analysis – Calculation of seismic loads in foundation – Design procedure for earthquake resistant foundation – Soil structure interaction – Retrofitting.

UNIT V-FINITE ELEMENT ANALYSES AND SOFTWARE APPLICATION (09)

Finite Element Analysis applied to Geotechnical Engineering – ANSYS – Modelling – Applications – Oasys – PLAXIS.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Helmsley, Design Applications of Raft Foundations.***
2. ***Michael John Tomlinson,R.Boorman,Foundation Design & Construction, Prentice Hall PTR,2001.***
3. ***George paaswell, Retaining Walls:Design& Construction,Bibliobazaar,2009.***
4. ***Design & Construction of bridge approaches,Transportation Research Board,1990.***
5. ***M.J. Tomlinson,Taylor and Francis ltd., Pile design and construction practice, 1994.***

6. ***Davies and Poulos, Analysis and design of pile foundation, John Wiley and Sons, 1980***
7. ***J.E. Bowles, Foundation Analysis and Design, McGraw-Hill, 1997***
8. ***V.N.S. Murthy, Advanced Foundation Engineering, CBS Publishers & Distributors, 2007***
9. ***Swami Saran, Soil Dynamics and Machine Foundations, Galgotia Publications, New Delhi.***
10. ***Potts and Zdravkovic, Finite Element Analyses Applied to Geotechnical Engineering, Vol.1 (Theory) and Vol. 2 Applications.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Know the field practises in investigations, safety, and quality on substructure components.

CO2: Design foundations for special structures using softwares.

CO3: Evaluate dynamic properties of soils and design Earthquake resistant foundations.

CO4: Know about various substructure retrofitting techniques

CO5: Acquire knowledge about the use of finite element based softwares to analyse geotechnical engineering structures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*		*H*						*M*		
CO2			*H*						*H*		
CO3			*H*	*M*		*H*					
CO4	*L*		*H*						*M*		
CO5	*L*		*H*			*M*					

L–Low, M – Moderate (Medium), H-High

18GEPE22 - GROUND IMPROVEMENT TECHNIQUES

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE

To identify weak soils, suggest suitable improvements methods and to be familiar with the equipments used for improvement.

UNIT I - DEWATERING **(09)**

Introduction – Scope and necessity of ground improvement – New Technologies – Basic concepts – Drainage methods – Ground water lowering by well points – Deep well, Vacuum and Electro – Osmosis methods.

UNIT II - COMPACTION AND SAND DRAINS **(09)**

In-situ compaction of cohesionless and cohesive soils – Shallow and deep compaction – Vibration methods – Vibro-compaction, Blasting, Vibrating probe, Vibratory rollers, Vibro-displacement compaction, Vibroflotation – Concept, Factors influencing compaction – Heavy Tamping – Vertical drains – Preloading with sand drains, Fabric drains, Wick drains – Design of sand drains – Relative merits of different methods – Limitations.

UNIT III - STONE COLUMN AND CONSOLIDATION **(09)**

Precompression and consolidation – Dynamic consolidation – Electro-osmotic consolidation – Stone column – Functions – Methods of installation – Design estimation of load carrying capacity of stone column – Settlement of stone column – Lime piles – Earth reinforcement – Soil Nailing – Types of reinforcement material – Applications.

UNIT IV - STABILIZATION **(09)**

Introduction – Stabilization methods – Mechanical, Cement, Lime, Bitumen, Chemical stabilization – Electrical stabilization – Stabilization by Thermal and Freezing techniques – Ground improvement by excavating and replacing – Stabilization of expansive clays – Prewetting.

UNIT V - GROUTING **(09)**

Introduction – Applications – Functions – Characteristics of grouts – Types of grout – Suspension and solution grouts – Basic requirements of grout – Displacement – Compaction grouting, displacement – Soil fracture grouting, Jet – Displacement grouting, Permeation grouting – Grouting equipment – Injection methods – Grout monitoring.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Purushothama Raj, P., Ground Improvement Techniques, Laxmi Publications (P) Ltd., New Delhi, 2005.***
2. ***Moseley M.D., Ground Treatment, Blackie Academic and Professional, 1998.***
3. ***Shroff, A.V., Grouting Technology, in Tunneling and Dam, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.***
4. ***Koerner, R.M., Designing with Geosynthetics (fourth edition), Prentice Hall, New Jersey, 1999.***

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Understand the parameters of weak soil and the techniques used for treating such soils.

CO2: Know the various compaction techniques

CO3: Design store column and the consolidation processes.

CO4: Know various types of stabilizers and stabilizing techniques.

CO5: Acquire knowledge for application of grouting methods in the field

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*M*				*H*	*H*					
CO2	*L*				*M*		*H*		*H*		
CO3							*M*			*H*	*H*
CO4	*L*				*M*		*H*		*H*		
CO5	*L*				*M*		*H*		*H*		

L–Low, M – Moderate (Medium), H-High

18SEOE01- VASTU SCIENCE FOR BUILDING CONSTRUCTION
(Common to All Branches)

Category: OE

PRE-REQUISITES: NIL	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE:

To impart basic knowledge of vastu science and its impact on human well being.

UNIT I - INTRODUCTION **(9)**

Traditional definition - Meaning of Vastu and Vaastu -its classification -Relationship to earth - concept of existence and manifestation – planatory influence on earth.

UNIT II - SPACE THEORY IN VASTU **(9)**

Features of good building site -good building shapes -macro, micro, enclosed and material spaces - relationship between built space, living organism and universe -impact of built space on human psyche. Flow of energy within built space and outside -
zoning of functional areas -fitting of components in the building -significance of water bodies and energy -The cube as the basic structure.

UNIT III - COSMOGRAM & SETTLEMENT CONCEPTS **(9)**

Orientation of building, site, layout and settlement -positive and negative energies - importance of cardinal and ordinal directions -The celestial grid or-mandala and its type.The Vaastu Purusha Mandala and its significance in creation of patterns, and lay-outs, extension of this to aural and visual fields -Types of Lay-Outs

UNIT IV - INTERFACE OF TIME, VIBRATION AND RHYTHM **(9)**

Theory of vibration and energy transfer – equation of time and space – manifestation in living organism – human beings – measurement of the energy– Kirlian energy of various forms-documentation of objects – filaments and streamers.

UNIT V - MEASUREMENTS & MATERIALS **(9)**

Units of measurement -Mana shastra -Ayadi techniques -Tala system and Hasta system of measures -Musical measurements compared to space measurements -resultant ambience in built space. Use of wood, stone, metal, brick and time- making technology, corbelling technology, jointing technology -foundations for heavy and light structures -Landscaping in and around buildings -Aesthetic in Indian Architecture.

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. Dr.Prasanna Kumar Acharya-"Manasara" -Oxford1 University Press1927 -(English version)

2. K.S.Subramanya Sastri –"Maya Matam" -Thanjavur Maharaja Sarjoji saraswathil Mahal Library -Thanjavur-1966.
3. Stella Kramresh –"The Hindu Temple" Vol.1 & II Motital Banarsidass Publishers Pvt. Ltd., Delhi -1994.
4. Bruno Dagens –"Mayamatam", Vol.1 & IIIGNCA and Motilal Bamarsidars, .Publishers Pvt. Ltd-s Delhi -1994.
5. George Birdsall –"Feng Shui: The Key Concepts" -January 2011

COURSE OUTCOMES:

The students are able to

CO 1: Obtain exposure on various concepts of vastu

CO 2: Understand the theories in Vastu.

CO 3: familiarize with the Cosmogram and settlement concepts of vastu

CO 4: Understand the role of vasthu in energy flow manifestation in living beings.

CO 5: Plan a structure considering various vastu techniques.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*										
CO2	*H*										
CO3	*H*										
CO4	*H*								*M*		
CO5	*M*				*M*						

L–Low, M – Moderate (Medium), H-High

18SEOE02 - PLANNING OF SMART CITIES
(Common to All Branches)

Category: OE

PRE-REQUISITES: NIL	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVE:

To have an exposure on development of smart cities considering various fields related and their challenges.

UNIT I – SMART CITIES DEVELOPMENT POTENTIALS AND CHALLENGES(09)

Perspectives of Smart Cities: Introduction and Overview - Implementation Challenges - Methodological issues - Spatial distribution of start up cities – Re imagining post industrial cities - Implementation Challenges for Establishing Smart Urban Information and Knowledge Management System

UNIT II – ROLE OF ICT, REMOTE SENSING, AND GEOGRAPHICAL INFORMATION SYSTEM (09)

Optimising Green Spaces for Sustainable Urban Planning - 3D City Models for Extracting Urban Environmental Quality Indicators - Assessing the Rainwater Harvesting Potential - The Strategic Role of Green Spaces - Monitoring Urban Expansion

UNIT III – ENVIRONMENT, ENERGY, DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT (09)

Alternatives for Energy Stressed Cities - Social Acceptability of Energy-Efficient Lighting - Energy Management - Urban Dynamics and Resource Consumption - Issues and Challenges of Sustainable Tourism - Green Buildings: Eco-friendly Technique for Modern Cities

UNIT IV– MULTIFARIOUS MANAGEMENT FOR SMART CITIES (09)

An Assessment of Domestic Water Use Practices - An Issue of Governance in Urban Water Supply - Assessment of Water Consumption at Urban Household Level - Water Sustainability - Socio-economic Determinants and Reproductive Healthcare System - Problems and Development of Slums.

UNIT V – INTELLIGENT TRANSPORT SYSTEM (09)

Introduction to Intelligent Transportation Systems (ITS)- The Range of ITS Applications - Network Optimization-Sensing Traffic using Virtual Detectors- In-Vehicle Routing, and Personal route information-The Smart Car-Commercial Routing and Delivery-Electronic Toll Collection-The Smart Card-Dynamic Assignment- Traffic Enforcement. Urban Mobility and Economic Development

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. ***Poonam Sharma, Swati Rajput, "Sustainable Smart Cities in India_ Challenges and Future Perspectives Springer 2017 Co.(P) Ltd. 2013***
2. ***Ivan Nunes Da Silva, Rogerio Andrade Flauzino-Smart Cities Technologies-ExLi4EvA (2016)***
3. ***Stan McClellan, Jesus A. Jimenez, George Koutitas (eds.)-Smart Cities_ Applications, Technologies, Standards, and Driving Factors-Springer International Publishing (2018)***
4. ***Stan Geertman, Joseph Ferreira, Jr., Robert Goodspeed, John Stillwell, "Planning Support Systems and Smart Cities" , Springer, 2015***

COURSE OUTCOME:

CO 1: Identify the potential and challenges in smart city development.
CO 2: Apply the different tools for sustainable urban planning.
CO 3: Understand the concepts of environment, energy and disaster management.
CO 4: Identify the proper methods for water and waste water management.
CO 5: Familiarize with the intelligent transport systems.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1											
CO2											
CO3									*M*	*M*	
CO4						*M*					
CO5	*L*	*H*				*L*					

L–Low, M – Moderate (Medium), H-High

18SEOE03 - GREEN BUILDING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project.

UNIT I - INTRODUCTION (09)

Life Cycle impacts of materials and products – sustainable design concepts – strategies of Design for the Environment -The sun-earth relationship and the energy balance on the earth's surface, climate, wind – Solar radiation and solar temperature – Sun shading and solar radiation on surfaces – Energy impact on the shape and orientation of buildings – Thermal properties of building materials.

UNIT II - ENERGY EFFICIENT BUILDINGS (09)

Passive cooling and day lighting – Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency – Energy audit and energy targeting- Technological options for energy management.

UNIT III - INDOOR ENVIRONMENTAL QUALITY MANAGEMENT (09)

Psychrometry- Comfort conditions- Thermal comfort- Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination requirement- Auditory requirement- Energy management options- -Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines- Heat rejection equipment- Energy efficient motors- Insulation.

UNIT IV - GREEN BUILDING CONCEPTS (09)

Green building concept- Green building rating tools- Leeds and IGBC codes. – Material selection Embodied energy- Operating energy- Façade systems- Ventilation systems- Transportation- Water treatment systems- Water efficiency- Building economics

UNIT V - GREEN BUILDING DESIGN CASE STUDY (09)

Students to work through a controlled process of analysis and design to produce drawings and models of their own personal green building project. Topics include building form, orientation and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget-Case Study on green construction and design.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Kibert, C. "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2005***
2. ***Edward G Pita, "An Energy Approach- Air-conditioning Principles and Systems", Pearson Education, 2003.***
3. ***Colin Porteous, "The New Eco-Architecture", Spon Press, 2002.***
4. ***Energy Conservation Building Codes: www.bee-india.nic.in***
5. ***Lever More G J, "Building Energy Management Systems", E and FN Spon, London, 2000.***
6. ***Ganesan T P, "Energy Conservation in Buildings", ISTE Professional Center, Chennai, 1999.***
7. ***John Littler and Randall Thomas, "Design with Energy: The Conservation and Use of Energy in Buildings", Cambridge University Press, 1984.***

COURSE OUTCOMES:

The students are able to

CO 1: Describe the concepts of sustainable design

CO 2: Familiarize with green building techniques including energy efficiency management.

CO 3: Understand the indoor environmental quality management in green building.

CO 4: Perform the green building rating using various tools.

CO 5: Create drawings and models of their own personal green building project.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*										
CO2					*M*	*M*					
CO3						*M*					
CO4						*M*					
CO5	*M*								*L*	*M*	*M*

L–Low, M – Moderate (Medium), H-High

18EEOE04 - ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES

(Common to All Branches)

Category: OE

PREREQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

On completion of this course the students are able to:

1. Get knowledge about occupational health hazard and safety measures at work place
2. Learn about accident prevention and safety management
3. Learn about general safety measures in industries

UNIT I OCCUPATIONAL HEALTH AND HAZARDS (8)

Occupation, Health and Hazards - Safety Health and Management: Occupational Health Hazards - Ergonomics - Importance of Industrial Safety Radiation and Industrial Hazards : Types and effects - Vibration - Industrial Hygiene - Different air pollutants in industries and their effects Electrical, fire and Other Hazards - General causes, Machine Guards and its types, Automation.

UNIT II SAFETY A WORKPLACE (10)

Safety at Workplace - Safe use of Machines and Tools: Safety in use of different types of unit operations - Ergonomics of Machine guarding - working in different workplaces - Operation, Inspection and maintenance Plant Design and Housekeeping, Industrial lighting, Vibration and Noise.

UNIT III ACCIDENT PREVENTION (9)

Accident Prevention Techniques - Principles of accident prevention - Definitions, Theories, Principles - Hazard identification and analysis, Event tree analysis, Hazop studies, Job safety analysis - Theories and Principles of Accident causation - First Aid : Body structure and functions - Fracture and Dislocation, Injuries to various body parts.

UNIT IV SAFETY MANAGEMENT (9)

Safety Management System and Law - Legislative measures in Industrial Safety: Various acts involved in Detail- Occupational safety, Health and Environment Management : Bureau of Indian Standards on Health and Safety, 14489, 15001 - OSHA, Process safety management (PSM) and its principles - EPA standards- Safety Management : Organisational& Safety Committee - its structure and functions.

UNIT V GENERAL SAFETY MEASURES (9)

Plant Layout for Safety -design and location, distance between hazardous units, lighting, colour coding, pilot plant studies, Housekeeping - Accidents Related with Maintenance of Machines - Work Permit System: Significance of Documentation Directing Safety: Definition, Process, Principles **and** Techniques Leadership: Role, function and attribution of a leader Case studies - involving implementation of health and safety measures in Industries.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***R.K. Jain and Sunil S. Rao, Industrial safety, Health and Environment Management, Khanna publishers, New Delhi (2006).***
2. ***Frank P. Lees - Loss of Prevention in Process Industries, Vol 1 and 2, Butterworth - Heinamann Ltd., London (1991)***
3. ***Industrial Safety - National Council of India***
4. ***Factories Act with Amendments 1987, Govt. of India Publications DGFASLI, Mumbai***

COURSE OUTCOMES:

At the end of the course student will be able to:

CO1: Gain the knowledge about occupational health hazard and safety measures at work place

CO2: be Able to learn about accident prevention and safety management

CO3: Understand occupational health hazards and general safety measures in industries

CO4: Got to know various laws, standards and legislations.

CO5: Able to learn about safety and proper management of industries

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	L	M		H			L		H	H	L
CO2	H	H	M	H			L		M	H	H
CO3	H	H		M			L		L	M	M
CO4							L		L	L	L
CO5							L		L	L	L

L-Low, M-Moderate(Medium), H-High

18EEOE05 - CLIMATE CHANGE AND ADAPTATION

(Common to All Branches)

Category: OE

PREREQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

On completion of this course the students are able to:

1. Able get knowledge about Climate system and its changes and causes
2. Able to learn about impacts, adaptation and mitigation of climate change
3. Able to learn about clean technology and clean energy

UNIT I EARTH'S CLIMATE SYSTEM (09)

Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II OBSERVED CHANGES AND ITS CAUSES (09)

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT III IMPACTS OF CLIMATE CHANGE (09)

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES (09)

Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT V CLEAN TECHNOLOGY AND ENERGY (09)

Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press, 2003.***
2. ***IPCC fourth assessment report - The AR4 synthesis report, 2007***
3. ***IPCC fourth assessment report –Working Group I Report, " The physical Science Basis", 2007***
4. ***IPCC fourth assessment report - Working Group II Report, " Impacts, Adaptation and Vulnerability", 2007***
5. ***IPCC fourth assessment report – Working Group III Report" Mitigation of Climate change", 2007***
6. ***Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 'Climate Change and Water'. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.***
7. ***Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.***

COURSE OUTCOMES:

At the end of the course the student will be able:

CO1: To understand the climatic system and the factors influencing the climatic changes

CO2: To assess the uncertainty and impact of climatic changes

CO3: To develop strategies for adaptation and mitigation of climatic changes

CO4: To identify clean technologies for sustainable growth

CO5: To identify clean technologies for sustainable growth

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*
CO1	M			M			H		L	M	M
CO2	M			M			M		L	L	M
CO3	M			M			H		L	M	M
CO4	M	M	M	H	M	M	L	M	M	L	M
CO5	M			M			M		L	L	L

L-Low, M-Moderate(Medium), H-High

18EEOE06 - WASTE TO ENERGY

(Common to All Branches)

Category: OE

PREREQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

On completion of this course the students are able to:

Able to get knowledge about the utilization of waste and its purpose.

UNIT I INTRODUCTION **(09)**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS **(09)**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION **(09)**

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION **(09)**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIOGAS **(09)**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.***
2. ***Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.***
3. ***Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.***
4. ***Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.***

COURSE OUTCOMES:

At the end of the course the student will be able:

CO1: Understand solid waste management techniques
CO2: Know what is biomass
CO3: Study Methods and factors considered for biomass gasification
CO4: Know equipment meant for biomass combustion
CO5: Understand about biogas and its development in India

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	M			M			H		L	L	L
CO2	M			M			H		L	L	L
CO3	M			M			H		L	L	L
CO4	M		M	M			H		L	L	L
CO5	M			M			H		L	L	L

L-Low, M-Moderate (Medium), H-High

18EEOE07 - ENERGY IN BUILT ENVIRONMENT
(Common to All Branches)

Category: OE

PREREQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

On completion of this course students are able to:

1. About energy use and its management
2. Understand constructional requirements of buildings
3. Know relationship of energy and environment

UNIT I INTRODUCTION (09)

Indoor activities and environmental control - Internal and external factors on energy use - Characteristics of energy use and its management -Macro aspect of energy use in dwellings and its implications - Thermal comfort - Ventilation and air quality - Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement

UNIT II LIGHTING REQUIREMENTS IN BUILDING (09)

The sun-earth relationship - Climate, wind, solar radiation and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings – Lighting and daylighting: Characteristics and estimation, methods of day-lighting – Architectural considerations for day-lighting

UNIT III ENERGY REQUIREMENTS IN BUILDING (09)

Steady and unsteady heat transfer through wall and glazed window - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer - Thermal gain and net heat gain - End-use energy requirements - Status of energy use in buildings - Estimation of energy use in a building

UNIT IV ENERGY AUDIT (09)

Energy audit and energy targeting - Technological options for energy management - Natural and forced ventilation – Indoor environment and air quality - Airflow and air pressure on buildings - Flow due to stack effect

UNIT V COOLING IN BUILT ENVIRONMENT (09)

Passive building architecture – Radiative cooling - Solar cooling techniques - Solar desiccant dehumidification for ventilation - Natural and active cooling with adaptive comfort –Evaporative cooling – Zero energy building concept.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***J. Krieder and A. Rabl (2000), Heating and Cooling of Buildings: Design for Efficiency, McGraw-Hill.***
2. ***S. M. Guinnes and Reynolds (1989), Mechanical and Electrical Equipment for Buildings, Wiley.***
3. ***A. Shaw (1991), Energy Design for Architects, AEE Energy Books.***
4. ***ASHRAE (2001), Handbook of Fundamentals, ASHRAE, Atlanta, GA.***
5. ***Reference Manuals of DOE-2 (1990), Orlando Lawrence-Berkeley Laboratory, University of California, and Blast, University of Illinois, USA.***

COURSE OUTCOMES:

At the end of the course the student will be able:

CO1: Understand energy and its usage
CO2: To know lighting to be given to a building
CO3: To study energy requirements in a building
CO4: Understand energy audit
CO5: To study architectural specifications of a building.

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*
CO1	M			M			M		L	L	L
CO2	M			M			M		L	L	L
CO3	M			M			M		L	L	L
CO4	M			M		M	M		L	L	L
CO5	M			M			M		L	L	L

L-Low, M-Moderate (Medium), H-High

18GEOE08 - EARTH AND ITS ENVIRONMENT
(Common to All Branches)

Category: OE

PREREQUISITES: NIL	L	T	P	C
	3	0	0	3

COURSE OBJECTIVE

To know about the planet earth, the geosystems and the resources like ground water and air and to learn about the Environmental Assessment and sustainability.

UNIT I-EVOLUTION OF EARTH (09)

Evolution of earth as habitable planet - Evolution of continents - oceans and landforms - evolution of life through geological times - Exploring the earth's interior - thermal and chemical structure - origin of gravitational and magnetic fields.

UNIT II-GEOSYSTEMS (09)

Plate tectonics - working and shaping the earth - Internal Geosystems – earthquakes – volcanoes - climatic excursions through time - Basic Geological processes - igneous, sedimentation - metamorphic processes.

UNIT III-GROUND WATER GEOLOGY (09)

Geology of groundwater occurrence - recharge process - Groundwater movement - Groundwater discharge and catchment hydrology - Groundwater as a resource - Natural groundwater quality and contamination - Modeling and managing groundwater systems.

UNIT IV- ENVIRONMENTAL ASSESMENT AND SUSTAINABILITY (09)

Engineering and sustainable development - population and urbanization - toxic chemicals and finite resources - water scarcity and conflict - Environmental risk - risk assessment and characterization - hazard assessment - exposure assessment.

UNIT V-AIR AND SOLIDWASTE

Air resources engineering - introduction to atmospheric composition – behaviour - atmospheric photochemistry - Solid waste management – characterization - management concepts.

Lecture: 45 periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***John Grotzinger and Thomas H. Jordan, Understanding Earth, Sixth Edition, W. H.Freeman, 2010.***
2. ***Younger, P. L., Groundwater in the Environment: An introduction, Blackwell Publishing, 2007.***
3. ***Mihelcic, J. R., Zimmerman, J. B., Environmental Engineering: Fundamentals, Sustainability and Design, Wiley, NJ, 2010.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Know about evolution of earth and the structure of the earth.

CO2: Understand the internal Geosystems like earthquakes and volcanoes and the various geological processes.

CO3: Understand the geological process of occurrence and movement of groundwater and the modeling systems.

CO4: Assess the Environmental risks and the sustainability developments.

CO5: Learn about the photochemistry of atmosphere and the solid waste management concepts.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*L*			*M*	*M*			*H*	*H*		
CO2	*H*		*H*	*H*		*H*					
CO3	*M*						*H*			*M*	
CO4		*M*			*L*		*H*	*H*	*H*		*H*
CO5	*M*	*M*		*L*				*H*			

L-Low, M-Moderate (Medium), H-High

18GEOE09 - NATURAL HAZARDS AND MITIGATION
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE

To get idea about the various natural hazards like Earthquakes, slope stability, floods, droughts and Tsunami and the mitigation measures.

UNIT I- EARTHQUAKES **(09)**

Definitions and basic concepts - different kinds of hazards – causes - Geologic Hazards – Earthquakes - causes of earthquakes – effects - plate tectonics - seismic waves - measures of size of earthquakes - earthquake resistant design concepts.

UNIT II- SLOPE STABILITY **(09)**

Slope stability and landslides - causes of landslides - principles of stability analysis - remedial and corrective measures for slope stabilization.

UNIT III- FLOODS **(09)**

Climatic Hazards – Floods - causes of flooding - regional flood frequency analysis - flood control measures - flood routing - flood forecasting - warning systems.

UNIT IV-DROUGHTS **(09)**

Droughts – causes - types of droughts - effects of drought - hazard assessment - decision making - Use of GIS in natural hazard assessment – mitigation - management.

UNIT V-TSUNAMI **(09)**

Tsunami – causes – effects – undersea earthquakes – landslides – volcanic eruptions – impact of sea meteorite – remedial measures – precautions – case studies.

Lecture: 45 periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, Natural Hazards and Disasters, Brooks/Cole Cengage Learning, 2008.

2. Edward Bryant, Natural Hazards, Cambridge University Press, 2005.

3. J Michael Duncan and Stephan G Wright, Soil Strength and Slope Stability, John Wiley & Sons, Inc, 2005.

4. Amr S Elnashai and Luigi Di Sarno, Fundamentals of Earthquake Engineering, John Wiley & Sons, Inc, 2008

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the basic concepts of earthquakes and the design concepts of earthquake resistant buildings.

CO2: Acquire knowledge about the causes and remedial measures of slope stabilization.

CO3: Gain knowledge about the causes and control measures of flood.

CO4: Understand the types, causes and mitigation of droughts.

CO5: Know the causes, effects and precautionary measures of Tsunami.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	*H*	*M*	*H*			*H*		*M*		*H*	*M*
CO2	*H*			*H*	*H*		*L*		*M*	*H*	*M*
CO3	*H*		*H*				*M*			*H*	*M*
CO4	*H*		*M*		*L*					*H*	*M*
CO5	*H*				*L*		*M*			*H*	*M*

L-Low, M-Moderate (Medium), H-High

18EDOE10 - BUSINESS ANALYTICS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE:

- Understand the role of business analytics within an organization.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

BUSINESS ANALYTICS AND PROCESS (09)

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

REGRESSION ANALYSIS (09)

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

STRUCTURE OF BUSINESS ANALYTICS (09)

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

FORECASTING TECHNIQUES (09)

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

DECISION ANALYSIS AND RECENT TRENDS IN BUSINESS ANALYTICS (09)

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey"Business analytics Principles, Concepts, and Applications", Pearson FT Press.

2. PurbaHalady Rao,2013"Business Analytics: An application focus", PHI Learning Pvt.Ltd..

3.R.N.Prasad, Seema Acharya,2011"Fundamentals of Business Analytics ", Persons Education.

4.James Evans"Business Analytics", Persons Education.

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Students will demonstrate knowledge of data analytics.

CO2: Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.

CO3: Students will demonstrate the ability to use technical skills in predicative and Prescriptive modeling to support business decision-making.

COURSE ARTICULATION MATRIX

	PO 1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	L	L	L	L	M	L	-	L	M	-	L
CO2	-	H	L	L	L	L	-	-	L	-	-
CO3	L	L	-	-	L	-	L	M	L	-	L

L-Low, M-Moderate (Medium), H-High

18EDOE11-COST MANAGEMENT OF ENGINEERING PROJECTS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

- To be familiar with cost management and project planning.
- To acquire knowledge of decision making, price strategies and total quality management tools.

INTRODUCTION TO COST MANAGEMENT (09)

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

PROJECT PLANNING ACTIVITIES (09)

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

COST ANALYSIS (09)

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

PRICING STRATEGIES AND BUDGETORY CONTROL (09)

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

TQM AND OPERATIONS REASEARCH TOOLS (09)

Total Quality Management and Theory of constraints, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCE BOOKS:

1. Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi.

2. Charles T. Horngren and George Foster, Advanced Management Accounting.

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting.

4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher.

5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understanding methods concepts of cost management.

CO2: Developing the skills for project planning.

CO3: Evaluating the cost behavior and profit.

COURSE ARTICULATION MATRIX

	PO 1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	-	-	L	L	L	L	M	L	L	-	L
CO2	-	L	L	M	L	L	M	L	L	-	L
CO3	L	-	L	-	-	-	H	-	L	L	L

L-Low, M-Moderate (Medium), H-High

18EDOE12-INTRODUCTION TO INDUSTRIAL ENGINEERING

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES: Nil

COURSE OBJECTIVE :

The objective of this course is to provide foundation in Industrial Engineering in order to enable the students to make significant contributions for improvements in different organisations.

INTRODUCTION (09)

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Operations Management – Production System – Input Output Model –Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

PLANT LOCATION AND LAYOUT (09)

Factors affecting Plant location – Objectives of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.

WORK SYSTEM DESIGN (09)

Need – Objectives – Method Study procedure – Principles of Motion Economy – Work Measurement procedures – Work Measurement techniques.

STATISTICAL QUALITY CONTROL (09)

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts for attributes – Sampling Inspection – Sampling Plans – Sampling Plans.

PRODUCTION PLANNING AND CONTROL (09)

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Process planning – Economic Batch Quantity – Tool control – Loading – Scheduling and control of production – Dispatching–Progress control.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCE BOOKS:

1.O.P.Khanna, 2010, Industrial Engineering and Management, Dhanpat Rai Publications.

2.Ravi Shankar, 2009, Industrial Engineering and Management, Galgotia Publications & Private Limited.

3. Martand Telsang,2006, Industrial Engineering and Production Management, S. Chand and Company.

4. M.I. Khan,2004, Industrial Engineering and Production Management, New Age International..

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understanding the functioning of various kinds of Industries.

CO2: Developing the knowledge in plant location layout and work system design.

CO3: Evaluating the cost optimization in industries.

COURSE ARTICULATION MATRIX

	PO 1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	-	-	-	-	L	L	L	L	L	L	M
CO2	L	L	L	L	L	L	-	-	L	H	M
CO3	L	L	-	-	-	-	H	-	-	L	-

L-Low, M-Moderate (Medium), H-High

18MFOE13 INDUSTRIAL SAFETY
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVES:

- To be familiar with industrial safety equipments and techniques.
- To acquire practical knowledge of maintenance techniques available in industry.

UNIT –I INDUSTRIAL SAFETY (9)

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT –II FUNDAMENTALS OF MAINTENANCE ENGINEERING (9)

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT –III WEAR AND CORROSION (9)

.Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT –IV FAULT TRACING (9)

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT –V PERIODIC AND PREVENTIVE MAINTENANCE (9)

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Higgins & Morrow "Maintenance Engineering Handbook", Da Information Services, 2008

2. H.P.Garg "Maintenance Engineering", S. Chand and Company, 2010.

3. Audels "Pump-hydraulic Compressors", Mcgrew Hill Publication, 1943.

4. Winterkorn, Hans "Foundation Engineering Handbook", Chapman & Hall London, 1975.

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: Understand types of industrial safety equipments and techniques available.

CO2: Acquire practical knowledge of maintenance techniques available in industry.

CO3: Acquire knowledge on fault tracing techniques in industrial safety.

COURSE ARTICULATION MATRIX

CO/ PO	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	M	L	L	L	-	L	L	-	M	M	L
CO 2	M	H	M	L	L	L	L	-	L	H	M
CO 3	H	H	H	L	-	L	M	-	M	L	-

L – Low, M – Moderate (Medium), H – High

18MFOE14 OPERATIONS RESEARCH
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

- To familiarize students with the basic concepts, models and statements of the operations research theory.

UNIT- I INTRODUCTION **(9)**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT- II LINEAR PROGRAMMING PROBLEM **(9)**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

(9)

UNIT-III NON LINEAR PROGRAMMING PROBLEM

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

(9)

UNIT -IV SEQUENCING AND INVENTORY MODEL

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT -V GAME THEORY **(9)**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. H.A. Taha "Operations Research, An Introduction", PHI, 2008

2. H.M. Wagner "Principles of Operations Research", PHI, Delhi, 1982.

3. J.C. Pant "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008

4. Hitler Libermann "Operations Research", McGraw Hill Pub. 2009

5. Pannerselvam "Operations Research", Prentice Hall of India 2010

6. Harvey M Wagner "Principles of Operations Research" Prentice Hall of India 2010

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: Apply basic theoretical principles in optimization and formulate the optimization models.

CO2: Develop mathematical skills to analyse and solve integer programming, network models arising from a wide range of industrial applications.

CO3: Implement optimization techniques in engineering problems.

COURSE ARTICULATION MATRIX

CO/ PO	***PO 1***	***PO 2***	***PO 3***	***PO 4***	***PO 5***	***PO 6***	***PO 7***	***PO 8***	***PO 9***	***PO 10***	***PO 11***
CO 1	H	H	H	L	H	L	M	-	-	L	L
CO 2	H	H	H	L	-	L	L	-	-	L	-
CO 3	L	M	H	L	L	L	-	-	-	L	M

L – Low, M – Moderate (Medium), H – High

18MFOE15 COMPOSITE MATERIALS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES: NIL

COURSE OBJECTIVES :

- To be familiar with composite materials and their advantages, applications.
- To acquire knowledge of reinforcement, manufacturing and strength analysis of composites.

UNIT- I INTRODUCTION **(9)**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT- II REINFORCEMENT **(9)**

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT- III MANUFACTURING OF METAL MATRIX COMPOSITES **(9)**

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV MANUFACTURING OF POLYMER MATRIX COMPOSITE **(9)**

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT-V STRENGTH ANALYSIS OF COMPOSITES **(9)**

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. Lubin, George, "Hand Book of Composite Materials", Springer, 1982.

2. K.K.Chawla, "Composite Materials", Springer, 2011

3. Deborah D.L. Chung , "Composite Materials Science and Applications" , Springer, 2010.

4. Danial Gay, Suong V. Hoa, and Stephen W.Tasi, "Composite Materials Design and Applications", CRC Press,2002.

5. R.W.Cahn, "Material Science and Technology – Vol 13– Composites", VCH, West Germany, 1996.

6. WD Callister, Jr., Adapted by R. Balasubramaniam, "Materials Science and Engineering, An introduction", John Wiley & Sons, NY, Indian edition, 2007.

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the nature of composite materials and composite reinforcements.

CO2: Develop the skills for manufacturing of composites.

CO3: Evaluate the strength of composite materials.

COURSE ARTICULATION MATRIX

CO/ PO	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	H	L	L	M	L	L	-	-	L	-	L
CO 2	L	M	H	L	L	L	-	-	L	L	L
CO 3	M	L	H	M	L	L	-	-	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE16 – GLOBAL WARMING SCIENCE
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make the students to learn about the material consequences of climate change, sea level change due to increase in the emission of greenhouse gases and to examine the science behind mitigation and adaptation proposals.

INTRODUCTION **(9)**

Terminology relating to atmospheric particles – Aerosols-types, characteristics, measurements – Particle mass spectrometry. Anthropogenic-sources, effects on humans.

CLIMATE MODELS **(9)**

General climate modeling- Atmospheric general circulation model, Oceanic general circulation model, Sea ice model, Land modelconcept, Paleo-climate, Weather prediction by Numerical process. Impacts of climate change, Climate Sensitivity, Forcings and feedbacks.

EARTH CARBON CYCLE AND FORECAST **(9)**

Carbon cycle-process, importance, advantages. Carbon on Earth, Global carbon reservoirs, Interactions between human activities and Carbon cycle. Geologic time scales, Fossil fuels and energy, Perturbed Carbon cycle.

GREEN HOUSE GASES **(9)**

Blackbody Radiation, Layer model, Earth’s atmospheric composition and Green house gases effects on weather and climate. Radiative equilibrium. Earth’s energy balance.

GEO ENGINEERING **(9)**

Solar mitigation, Strategies – Carbon dioxide removal, solar radiation management, Recent observed trends in global warming for sea level rise, drought, glacier extent.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1 ***Archer, David. GlobalWarming: Understanding the Forecast, Wiley, 2011***

2 ***Budyko, Climate Changes, American Geophysical Society, Washington, D.C.,244 pp.***

3 ***Bodansky, May we engineer the climate?Clim. Change 33, 309-321.***

4 ***Dickinson, Climate Engineering-A review of aerosol approaches to changing the global energy balance, Clim. Change 33, 279-290.***

5 ***Climate Change 2007-The Physical Science Basis: Working Group I Contribution to the Fourth Assessment Report of the IPCC. Cambridge University Press,2007.***

COURSE OUTCOMES:

On completion of this course, the students will be able to:

CO1: Understand the current warming in relation to climate changes throughout the Earth.

CO2: Assess the best predictions of current climate models.

CO3: Able to know about current issues, including impact from society, environment, economy as well as ecology related to greenhouse gases.

COURSE ARTICULATION MATRIX

CO/PO	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	M	L	L	L	L	M	H	M	L	M	L
CO 2	L	L	L	L	L	M	H	M	L	M	L
CO 3	L	L	L	L	L	H	M	M	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE17 – INTRODUCTION TO NANO ELECTRONICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

- To make the students to provide strong, essential, important methods and foundations of quantum mechanics and apply quantum mechanics on engineering fields.

INTRODUCTION **(9)**

Particles and Waves, Operators in quantum mechanics, The Postulates of Quantum Mechanics, The Schrodinger Equation Values and Wave Packet Solutions, Ehrenfest's Theorem.

ELECTRONIC STRUCTURE AND MOTION **(9)**

Atoms- The Hydrogen Atom, Many-Electron Atoms, Many-Electron Atoms.Pseudopotentials, Nuclear Structure, Molecules, Crystals. Translational motion – Penetration through barriers – Particle in a box. Two Terminal Quantum Dot Devices, Two Terminal Quantum Wire Devices.

SCATTERING THEORY **(9)**

The formulation of scattering events- scattering cross section, stationary scattering state. Partial wave stationary scattering events, Multi-channel scattering, Solution for Schrodinger Equation- radial and wave equation, Greens' function.

CLASSICAL STATISTICS **(9)**

Probabilities and microscopic behaviors, Kinetic theory and transport processes in gases, Magnetic properties of materials, The partition function.

QUANTUM STATISTICS **(9)**

Statistical mechanics- Basic Concepts, Statistical models applied to metals and semiconductors. The thermal properties of solids- The electrical properties of materials. Black body radiation, Low temperatures and degenerate systems.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1 ***Peter L. Hagelstein, Stephen D. Senturia, and Terry P. Orlando, Introductory Applilied Quantum Statistical Mechanics, Wiley (2004).***

2 ***A. F. J. Levi, Applied Quantum Mechanics (2nd Edition), Cambridge (2006).***

3 ***Walter A Harrison, Applied Quantum Mechanics, Stanfor University (2008).***

4 ***Richard Liboff, Introductory Quantum Mechanics, 4th edition, Addison Wesley (2003).***

5 ***P.W. Atkins and R.S. Friedman, Molecular Quantum Mechanics Oxford University Press, 3rd edition 1997.***

COURSE OUTCOMES:

On completion of this course, students will be able to:

CO1: The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, hetero structures.

CO2: The student should be able to set up and solve the Scfrödinger equation for different types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.

CO3: Potentially be able to join a research group in nanoscience / nanotechnology as a student researcher.

COURSE ARTICULATION MATRIX:

	PO 1	***PO 2***	***PO 3***	***PO 4***	***PO 5***	***PO 6***	***PO 7***	***PO 8***	***PO 9***	***PO 10***	***PO 11***
CO 1	M	M	L	M	L	M	L	L	L	L	L
CO 2	M	M	L	M	L	M	L	L	L	L	L
CO 3	M	M	L	M	L	H	L	L	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE18 – GREEN SUPPLY CHAIN MANAGEMENT
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

- To make the students to learn and focus on the fundamental strategies, tools and techniques required to analyze and design environmentally sustainable supply chain systems.

INTRODUCTION **(9)**

Logistics – aim, activities, importance, progress, current trends. Integrating logistics with an organization.

ESSENTIALS OF SUPPLY CHAIN MANAGEMENT **(9)**

Basic concepts of supply chain management, Supply chain operations – Planning and sourcing, Making and delivering. Supply chain coordination and use of Technology. Developing supply chain systems.

PLANNING THE SUPPLY CHAIN **(9)**

Types of decisions – strategic, tactical, operational. Logistics strategies, implementing the strategy. Planning resources – types, capacity, schedule, controlling material flow, measuring and improving performance.

ACTIVITIES IN THE SUPPLY CHAIN **(9)**

Procurement – cycle, types of purchase. Inventory management – EOQ, uncertain demand and safety stock, stock control. Material handling – purpose of warehouse and ownership, layout, packaging. Transport – mode, ownership, routing vehicles.

SUPPLY CHAIN MANAGEMENT STRATEGIES **(9)**

Five key configuration components, Four criteria of a good supply chain strategies, Next generation strategies- New roles for end to end supply chain management. Evolution of supply chain organization.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1 ***Rogers, Dale, and Ronald Tibben-Lembke."An Examination of Reverse Logistics Practices." Journal of Business Logistics 22, no. 2 (2001) : 129-48.***

2 ***Guide, V., Kumar Neeraj, et al. "cellular Telephone Reuse: The ReCellular Inc. Case." Managing Closed-Loop Supply Chains. Case: Part 6, (2005): 151-156.***

3 ***Mark, K. "Whirlpool Corrporation: Reverse Logistics." Richard Ivey School of Business. Case: 9B11D001, August 8, 2011.***

4 ***Porter, Michael E., and Mark R. Kramer. "Strategy and Society: The Link between Competitive Advantage and Corporate Social Responsibility." Harvard Business Revies 84, no. 12 (2006): 78-92.***

5 ***Shoshnah Cohen, Josep Roussel, "Strategic Supply Chain Management", the five disciplines for top performance, McGraw-Hill, (2005.)***

COURSE OUTCOMES:

On completion of this course, students will be able to:

CO1: Evaluate complex qualitative and quantitative data to support strategic and operational decisions.

CO2: Develop self-leadership strategies to enhance personal and professional effectiveness.

CO3: The importance of the design and redesign of a supply chain as key components of an organization's strategic plan.

COURSE ARTICULATION MATRIX

CO/ PO	***PO 1***	***PO 2***	***PO 3***	***PO 4***	***PO 5***	***PO 6***	***PO 7***	***PO 8***	***PO 9***	***PO 10***	***PO 11***
CO 1	M	L	L	L	L	H	L	M	L	L	L
CO 2	M	L	L	L	L	H	L	M	L	L	L
CO 3	M	L	L	L	L	H	L	M	L	L	L

L – Low, M – Moderate (Medium), H – High

18PSOE19 - DISTRIBUTION AUTOMATION SYSTEM
(Common to all Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To study about the distributed automation and economic evaluation schemes of power network

UNIT-I INTRODUCTION (09)

Introduction to Distribution Automation (DA) - Control system interfaces- Control and data requirements- Centralized (vs) decentralized control- DA system-DA hardware-DAS software.

UNIT-II DISTRIBUTION AUTOMATION FUNCTIONS (09)

DA capabilities - Automation system computer facilities- Management processes- Information management- System reliability management- System efficiency management- Voltage management- Load management.

UNIT-III COMMUNICATION SYSTEMS (09)

Communication requirements - reliability- Cost effectiveness- Data requirements- Two way capability- Communication during outages and faults - Ease of operation and maintenance-Conforming to the architecture of flow.Distribution line carrier- Ripple control-Zero crossing technique- Telephone, cableTV,radio, AM broadcast, FM SCA,VHF radio, microwave satellite, fiber optics-Hybrid communication systems used in field tests.

UNIT-IV ECONOMIC EVALUATION METHODS (09)

Development and evaluation of alternate plans- select study area – Select study period- Project load growth-Develop alternatives- Calculate operating and maintenance costs-Evaluate alternatives.

UNIT-V ECONOMIC COMPARISON (09)

Economic comparison of alternate plans-Classification of expenses - capital expenditures-Comparison of revenue requirements of alternative plans-Book life and continuing plant analysis- Year by year revenue requirement analysis, Short term analysis- End of study adjustment-Break even analysis, sensitivity analysis - Computational aids.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. ***IEEE Tutorial course "Distribution Automation",IEEE Working Group on Distribution Automation, IEEE Power Engineering Society. Power Engineering Education Committee, IEEE Power Engineering Society. Transmission and Distribution Committee, Institute of Electrical and Electronics Engineers, 1988***
2. ***Maurizio Di Paolo Emilio, "Data Acquisition Systems: From Fundamentals to Applied Design", Springer Science & Business Media, 21-Mar-2013***
3. ***Taub, "Principles Of Communication Systems", Tata McGraw-Hill Education, 07-Sep-2008***
4. ***M.K. Khedkar, G.M. Dhole, "A Textbook of Electric Power Distribution Automation", Laxmi Publications, Ltd., 2010.***

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Analyse the requirements of distributed automation
CO2: Know the functions of distributed automation
CO3: Perform detailed analysis of communication systems for distributed automation.
CO4: Study the economic evaluation method
CO5: Understand the comparison of alternate plans

COURSE ARTICULATION MATRIX:

CO/PO	*PO1*	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*
CO1	H	M	M	M	L	M	L	L	L	L	L
CO2	H	H	L	L	L	L	L	L	L	L	L
CO3	M	L	M	L	L	L	L	L	L	L	L
CO4	M	M	M	L	L	L	L	L	L	L	L
CO5	M	M	M	L	L	L	M	M	L	L	L

L – Low, M – Moderate (Medium), H- High

18PSOE20 - POWER QUALITY ASSESSMENT AND MITIGATION
(Common to all Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES S: NIL

COURSE OBJECTIVE:

To identify, analyze and create solutions for the power quality problems in power system networks.

UNIT-I : INTRODUCTION (09)

Importance of power quality - Terms and definitions as per IEEE std.1159 for transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers - Symptoms of poor power quality- Definitions and terminology of grounding- Purpose of groundings- Good grounding practices - problems due to poor grounding.

UNIT-II : FLICKERS AND TRANSIENT VOLTAGES (09)

RMS voltage variations in power system, complex power, voltage regulation and per unit system - Basic power flow and voltage drop - Devices for voltage regulation and impact of reactive power management - Causes and effects of voltage flicker - Short term and long term flickers -Methods to reduce flickers- Transient over voltages, impulsive transients, switching transients - Effect of surge impedance and line termination - control of transient voltages.

UNIT-III : VOLTAGE INTERRUPTIONS (09)

Definitions -Voltage sags versus interruptions - Economic impact, Major causes and consequences -characteristics, assessment, Influence of fault location and fault level on voltage sag - Areas of vulnerability, Assessment of equipment sensitivity, Voltage sag limits for computer equipment- CBEMA, ITIC, SEMI F 42curves, Report of voltage sag analysis, Voltage sag indices, Mitigation measures for voltage sag- DSTATCOM, UPQC,UPS, DVR, SMEs, CVT, utility solutions and end user solutions.

UNIT-IV : WAVEFORM DISTORTION (09)

Definition of harmonics, inter-harmonics, sub-harmonics- Causes and effects - Voltage versus current distortion, Fourier analysis, Harmonic indices, A.C. quantities under non-sinusoidal conditions, Triplet harmonics, characteristic and non characteristic harmonics- Series and Parallel resonances- Consequence - Principles for controlling and Reducing harmonic currents in loads, K-rated transformer -Computer tools for harmonic analysis- Locating sources of harmonics, Harmonic filtering- Passive and active filters - Modifying the system frequency response- IEEE Harmonic standard 519-1992.

UNIT-V : ANALYSIS AND CONVENTIONAL MITIGATION METHODS (09)

Analysis of power outages, Analysis of unbalance condition: Symmetrical components inphasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers - Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. M. H. J. Bollen, "Understanding Power Quality Problems, Voltage Sag and Interruptions", IEEE Press, series on Power Engineering, 2000.

2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., "Electrical Power SystemQuality", Second Edition, McGraw Hill Publication Co., 2008.

3. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition).

4. Enrique Acha, Manuel Madrigal, "Power System Harmonics: Computer Modeling and Analysis", John Wiley and Sons, 2001.

5. Arrillaga J. and Watson N."Power System Harmonics"2nd edition on; John Willey&sons, 2003

6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

COURSE OUTCOMES:

CO1: Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.

CO2: Recognize the practical issues in the power system

CO3: Analyze the impact of power electronic devices and techniques in power system

CO4: Develop trouble shooting skills and innovative remedies for various power quality problems in power system

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

L – Low, M – Moderate (Medium), H- High

18PSOE21 MODERN AUTOMOTIVE SYSTEMS **Category : OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To expose the students with theory and applications of Automotive Electrical and Electronic Systems.

UNIT-I : INTRODUCTION TO MODERN AUTOMOTIVE ELECTRONICS **(08)**

Introduction to modern automotive systems and need for electronics in automobiles- Role of electronics and microcontrollers- Sensors and actuators- Possibilities and challenges in automotive industry- Enabling technologies and industry trends.

UNIT-II : SENSORS AND ACTUATORS **(09)**

Introduction- basic sensor arrangement- Types of sensors- Oxygen sensor, engine crankshaft angular position sensor – Engine cooling water temperature sensor- Engine oil pressure sensor- Fuel metering- vehicle speed sensor and detonation sensor- Pressure Sensor- Linear and angle sensors- Flow sensor- Temperature and humidity sensors- Gas sensor- Speed and Acceleration sensors- Knock sensor- Torque sensor- Yaw rate sensor- Tyre Pressure sensor- Actuators - Stepper motors – Relays.

UNIT-III : POWER TRAIN CONTROL SYSTEMS IN AUTOMOBILE **(09)**

Electronic Transmission Control - Digital engine control system: Open loop and close loop control systems- Engine cooling and warm up control- Acceleration- Detonation and idle speed control - Exhaust emission control engineering- Onboard diagnostics- Future automotive power train systems.

UNIT-IV : SAFETY, COMFORT AND CONVENIENCE SYSTEMS **(10)**

Cruise Control- Anti-lock Braking Control- Traction and Stability control- Airbag control system- Suspension control- Steering control- HVAC Control.

UNIT-V : ELECTRONIC CONTROL UNITS (ECU) **(09)**

Need for ECUs- Advances in ECUs for automotives - Design complexities of ECUs- V-Model for Automotive ECU‘s- Architecture of an advanced microcontroller (XC166 Family, 32-bit Tricore) used in the design of automobile ECUs- On chip peripherals, protocol interfaces, analog and digital interfaces.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. M. H. J. Bollen, "Understanding Power Quality Problems, Voltage Sag and Interruptions", IEEE Press, series on Power Engineering, 2000.

2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., "Electrical Power SystemQuality", Second Edition, McGraw Hill Publication Co., 2008.

3. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition).

4. Enrique Acha, Manuel Madrigal, "Power System Harmonics: Computer Modeling and Analysis", John Wiley and Sons, 2001.

5. Arrillaga J. and Watson N."Power System Harmonics"2nd edition on; John Willey&sons, 2003

COURSE OUTCOMES:

CO1: Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.

CO2: Recognize the practical issues in the power system

CO3: Analyze the impact of power electronic devices and techniques in power system

CO4: Develop trouble shooting skills and innovative remedies for various power quality problems in power system

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

L – Low, M – Moderate (Medium), H- High

18PEOE22 - VIRTUAL INSTRUMENTATION
(Common to All Branches)

Category:OE

PREREQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

To comprehend the Virtual instrument action programming concepts towards measurements and control

UNIT-I : INTRODUCTION (07)

Introduction - advantages - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - Data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT-II : GRAPHICAL PROGRAMMING AND LabVIEW (09)

Concepts of graphical programming - LabVIEW software - Concept of VIs and sub VI - Display types - Digital - Analog - Chart and Graphs. Loops - structures - Arrays – Clusters- Local and global variables – String - Timers and dialog controls.

UNIT-III : MANAGING FILES & DESIGN PATTERNS (11)

High-level and low-level file I/O functions available in LabVIEW – Implementing File I/O functions to read and write data to files – Binary Files – TDMS – sequential programming – State machine programming – Communication between parallel loops –Race conditions – Notifiers & Queues – Producer Consumer design patterns

UNIT-IV : PC BASED DATA ACQUISITION (09)

Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT-V : DATA AQUISTION AND SIGNAL CONDITIONING (09)

Components of a DAQ system, Bus, Signal and accuracy consideration when choosing DAQ hardware – Measurement of analog signal with Finite and continuous buffered acquisition- analog output generation – Signal conditioning systems – Synchronizing measurements in single & multiple devices – Power quality analysis using Electrical Power Measurement tool kit.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Jeffrey Travis, Jim Kring, 'LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition), Prentice Hall, 2006.

2. Sanjeev Gupta, 'Virtual Instrumentation using LabVIEW' TMH, 2004

3. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001

4. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.

5. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000

COURSE OUTCOMES:

CO1: Gain Knowledge of graphical programming techniques using LabVIEW software.
CO2: Explore the basics of programming and interfacing using related hardware.
CO3: Outline the aspects and utilization of PC based data acquisition and Instrument interfaces.
CO4: Create programs and Select proper instrument interface for a specific application.

COURSE ARTICULATION MATRIX

CO/PO	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	H	M	-	M	H	-	-	-	-	-	-
CO2	H	H	-	M	H	-	M	-	-	-	L
CO3			H	M	H						L
CO4	H	H	H	M	H	-	-	-	M	-	L

L – Low, M – Moderate (Medium), H- High

18PEOE23 - ENERGY AUDITING **Category: OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To Comprehend energy management schemes and perform economic analysis and load management in electrical systems.

UNIT-I : BASICS OF ENERGY MANAGEMENT (09)

Energy Scenario – Energy Sector Reforms – Impact on environment – Strategy for future and conservation – Basics of Energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and Methodology - Audit Report – Energy Cost, Benchmarking and Energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, Material and energy balance diagrams.

UNIT-II : ACTION PLANNING AND MONITORING (09)

Energy Management System – Performance assessment – Goal setting by Manager – Action plan implementation – Financial Management: Investment - Financial analysis techniques, ROI, Risk and sensitivity analysis, role of Energy Service Companies. Project management: Steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.

UNIT-III : STUDY OF THERMAL UTILITIES (09)

Combustion of Oil, Coal and Gas – Performance Evaluation of Boilers – Boiler blow down – Boiler water treatment – Energy Conservation Opportunity – Cogeneration: Principal – Options - Classification – Influencing Factors and technical parameters. Waste heat recovery: Classification – application – benefits - Different heat recovery devices.

UNIT-IV : STUDY OF ELECTRICAL UTILITIES (09)

Electricity Billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – recommended luminance levels – Lighting system energy efficiency study – Energy Efficient Technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, Light controllers and Electronic ballasts.

UNIT-V : ENERGY ASSESSMENT IN UTILITY SYSTEMS (09)

Performing Financial analysis: Fixed and variable costs – Payback period – methods – factors affecting analysis – Waste Minimization Techniques: Classification – Methodology. Performance assessment of HVAC Systems: Measurements, Procedure – Evaluation. Assessment of Pumps: Measurements, Procedure – Evaluation.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Murphy W.R. and G.Mckay Butter worth , "Energy Management", Heinemann Publications.

2. Paul o' Callaghan, "Energy Management",Mc-Graw Hill Book Company – 1st edition; 1998.

3. John.C.Andreas, "Energy Efficient Electric Motors", Marcel Dekker Inc Ltd – 2nd edition; 1995.

4. W.C.Turner, "Energy Management Handbook", John Wiley and Sons, Fifth edition, 2009.

5. "Energy Management and Good Lighting Practice: fuel efficiency" – booklet 12 – EEO.

6. www.em-ea.org/gbook1.asp

COURSE OUTCOMES:

CO1: Possess knowledge on energy management.

CO2: Analyze the feature of energy audit methodology and documentation of report.

CO3: Able to plan energy management action and develop the understanding of implementation.

CO4: Familiarize with thermal utilities.

CO5: Familiarize with electrical utilities.

CO6: Perform assessment of different systems.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	M	L	L	-	M	M	L	-	M
CO2	-	-	M	L	L	-	M	M	L	-	M
CO3	-	-	M	L	-	-	M	M	L	-	M
CO4	-	-	M	-	-	-	M	-	L	-	M
CO5	-	-	M	-	-	-	M	-	L	-	M
CO6	-	-	M	-	-	-	M	-	L	-	M

L – Low, M – Moderate (Medium), H- High

18PEOE24 - ADVANCED ENERGY STORAGE TECHNOLOGY
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To explore the fundamentals, technologies and applications of energy storage.

UNIT-I : ENERGY STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES (09)

Storage Needs- Variations in Energy Demand- Variations in Energy Supply- Interruptions in Energy Supply- Transmission Congestion - Demand for Portable Energy-Demand and scale requirements - Environmental and sustainability issues.

UNIT-II : TECHNICAL METHODS OF STORAGE (09)

Introduction: Energy and Energy Transformations, Potential energy (pumped hydro, compressed air, springs)- Kinetic energy (mechanical flywheels)- Thermal energy without phase change passive (adobe) and active (water)-Thermal energy with phase change (ice, molten salts, steam)- Chemical energy (hydrogen, methane, gasoline, coal, oil)- Electrochemical energy (batteries, fuel cells)- Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets)- Different Types of Energy Storage Systems.

UNIT-III PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS (09)

Energy capture rate and efficiency- Discharge rate and efficiency- Dispatch ability and load flowing characteristics, scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity- Ease of materials, recycling and recovery- Environmental consideration and recycling , Merits and demerits of different types of Storage.

UNIT-IV : APPLICATION CONSIDERATION (09)

Comparing Storage Technologies- Technology options- Performance factors and metrics- Efficiency of Energy Systems- Energy Recovery - Battery Storage System: Introduction with focus on Lead Acid and Lithium- Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance, Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

UNIT-V : HYDROGEN FUEL CELLS AND FLOW BATTERIES (09)

Hydrogen Economy and Generation Techniques, Storage of Hydrogen, Energy generation - Super capacitors: properties, power calculations – Operation and Design methods - Hybrid Energy Storage: Managing peak and Continuous power needs, options - Level 1: (Hybrid Power generation) Bacitor “Battery + Capacitor” Combinations: need, operation and Merits; Level 2: (Hybrid Power Generation) Bacitor + Fuel Cell or Flow Battery operation-Applications: Storage for Hybrid Electric Vehicles, Regenerative Power, capturing methods.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. DetlefStolten, "Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications", Wiley, 2010.

2. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion", John Wiley and Sons, 2012.

3. Francois Beguin and ElzbietaFrackowiak,"Super capacitors", Wiley, 2013.

4. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The Electrochemical Society, New Jersy, 2010.

COURSE OUTCOMES:

CO1: Recollect the historical perspective and technical methods of energy storage.

CO2: Learn the basics of different storage methods.

CO3: Determine the performance factors of energy storage systems.

CO4: Identify applications for renewable energy systems.

CO5: Understand the basics of Hydrogen cell and flow batteries.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	-	-	-	-	-	-	L	-	-
CO2	L	M	M	-	-	-	-	-	L	-	-
CO3	-	-	M	L	-	M	-	-	L	-	-
CO4	L	L	M	L	-	-	-	-	L	-	-
CO5	L	M	L	L	-	-	-	-	L	-	-

L – Low, M – Moderate (Medium), H- High

18AEOE25 - DESIGN OF DIGITAL SYSTEMS
(Common to all Branches)

Category: OE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

***COURSE OBJECTIVES*:**

- Design synchronous and asynchronous sequential circuits
- Develop VHDL code for digital circuits
- Implementation in PLDs
- Fault diagnosis

SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN **(9)**

Analysis of Clocked Synchronous Sequential Circuits - Modeling, state table reduction, state assignment, Design of Synchronous Sequential Networks, Design of iterative circuits - ASM chart - ASM realization.

ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN **(9)**

Analysis of Asynchronous Sequential Circuits - Races in ASC – Primitive Flow Table - Flow Table Reduction Techniques, State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers.

SYSTEM DESIGN USING PLDS **(9)**

Basic concepts – Programming Technologies - Programmable Logic Element (PLE) - Programmable Array Logic (PLA) - Programmable Array Logic (PAL) –Design of combinational and sequential circuits using PLDs – Complex PLDs (CPLDs)

INTRODUCTION TO VHDL **(9)**

Design flow - Software tools – VHDL: Data Objects - Data types - Operators – Entities and Architectures – Components and Configurations – Signal Assignment –Concurrent and Sequential statements — Behavioral, Data flow and Structural modeling – Transport and Inertial delays – Delta delays - Attributes – Generics – Packages and Libraries

LOGIC CIRCUIT TESTING AND TESTABLE DESIGN **(9)**

Digital logic circuit testing - Fault models - Combinational logic circuit testing - Sequential logic circuit testing-Design for Testability - Built-in Self-test, Board and System Level Boundary Scan. Case Study: Traffic Light Controller

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45periods

REFERENCE BOOKS:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill, 2002.
2. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "Digital Logic Circuit Analysis and Design", Prentice Hall International, Inc., New Jersey, 1995

3. Volnei A. Pedroni, "Circuit Design with VHDL", PHI Learning, 2011.
4. Parag K Lala, "Digital Circuit Testing and Testability", Academic Press, 1997
5. Charles H Roth, "Digital Systems Design Using VHDL," Cencage 2nd Edition 2012.
6. Nripendra N Biswas "Logic Design Theory" Prentice Hall of India,2001

***COURSE OUTCOMES*:**

Upon completion of the course the students will be able to:

CO1: Design synchronous and asynchronous sequential circuits based on specifications
CO2: Develop algorithm and VHDL code for design of digital circuits
CO3: Illustrate digital design implementation on PLDs .

***COURSE ARTICULATION MATRIX*:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	-	H	-	-	-	-	-	-	-
CO2	-	-	M	M	-	-	-	-	-	-	-
CO3	L	M	-	-	H	-	-	-	-	-	-

L – Low, M – Moderate (Medium), H- High

18AEOE26 ADVANCED PROCESSORS
(Common to all Branches)

Category: OE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

***COURSE OBJECTIVES*:**

- To introduce the basics of CISC and RISC
- Describe the architectural features of Pentium processors
- Describe ARM and Special processors

MICROPROCESSOR ARCHITECTURE **(9)**

Instruction set – Data formats – Instruction formats – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – The instruction pipeline – pipeline hazards – Instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation.

HIGH PERFORMANCE CISC ARCHITECTURE –PENTIUM **(9)**

The software model – functional description – CPU pin descriptions – Addressing modes – Processor flags – Instruction set – Bus operations – Super scalar architecture – Pipe lining – Branch prediction – The instruction and caches – Floating point unit– Programming the Pentium processor.

HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM INTERFACE **(9)**

Protected mode operation – Segmentation – paging – Protection – multitasking – Exception and interrupts - Input /Output – Virtual 8086 model – Interrupt processing.

HIGH PERFORMANCE RISC ARCHITECTURE: ARM **(9)**

ARM architecture – ARM assembly language program – ARM organization and implementation – ARM instruction set - Thumb instruction set.

SPECIAL PURPOSE PROCESSORS **(9)**

Altera Cyclone Processor – Audio codec – Video codec design – Platforms – General purpose processor – Digital signal processor – Embedded processor – Media Processor – Video signal Processor – Custom Hardware – Co-Processor.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45periods

REFERENCE BOOKS:

1. ***Daniel Tabak, "Advanced Microprocessors", McGraw Hill. Inc., 2011.***

2. James L. Antonakos, "The Pentium Microprocessor", Pearson Education, 1997.
3. Steve Furber, "ARM System –On –Chip architecture",Addison Wesley, 2009.
4. Gene .H. Miller, "Micro Computer Engineering", Pearson Education, 2003.

5. Barry. B. Brey, "The Intel Microprocessors Architecture, Programming and Interfacing", PHI, 2008.
6. Valvano, "Embedded Microcomputer Systems" Cencage Learing India Pvt Ltd, 2011.
7. Iain E.G.Richardson, "Video codec design", John Wiley & sons Ltd, U.K, 2002.

***COURSE OUTCOMES*:**

Upon completion of the course the students will be able to:

CO1: Distinguish between RISC and CISC generic architectures.
CO2: Describe the architectural features of Pentium processors
CO3: Develop simple applications using ARM processors

***COURSE ARTICULATION MATRIX*:**

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*
CO1	M	H	-	-	M	-	-	-	-	-	-
CO2	H	-	M	-	-	-	-	-	-	-	-
CO3	-	M	H	M	-	-	-	-	-	-	-

L – Low, M – Moderate (Medium), H- High

18AEOE27 PATTERN RECOGNITION
(Common to all Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

***COURSE OBJECTIVES*:**

- To get knowledge in pattern recognition in computer vision techniques
- To get knowledge in structural pattern methods
- To get knowledge on neural networks and fuzzy systems.

PATTERN CLASSIFIER **(9)**

Overview of pattern recognition -Discriminant functions-Supervised learning –Parametric estimation- Maximum likelihood estimation –Bayesian parameter estimation- Perceptron algorithm-LMSE algorithm – Problems with Bayes approach –Pattern classification by distance functions-Minimum distance pattern classifier.

UNSUPERVISED CLASSIFICATION **(9)**

Clustering for unsupervised learning and classification - Clustering concept-C-means algorithm-Hierarchical clustering procedures- Graph theoretic approach to pattern clustering - Validity of clustering solutions.

STRUCTURAL PATTERN RECOGNITION **(9)**

Elements of formal grammars-String generation as pattern description - recognition of syntactic description- Parsing-Stochastic grammars and applications - Graph based structural representation.

FEATURE EXTRACTION AND SELECTION **(9)**

Entropy minimization – Karhunen - Loeve transformation-feature selection through functions approximation- Binary feature selection.

NEURAL NETWORKS **(9)**

Neural network structures for Pattern Recognition –Neural network based Pattern associators-Unsupervised learning in neural Pattern Recognition-Self organizing networks-Fuzzy logic-Fuzzy classifiers-Pattern classification using Genetic Algorithms.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45periods

REFERENCE BOOKS:

1. R. O Duda, P.E Hart and Stork, "Pattern Classification", Wiley, 2012.

2. Robert J. Sehalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", JohnWiley & Sons Inc., 2007.

3. Tou & Gonzales, "Pattern Recognition Principles", Wesley Publication Company, 2000.

4. Morton Nadier and P. Eric Smith, "Pattern Recognition Engineering", John Wiley & Sons, 2000.

***COURSE OUTCOMES*:**

Upon completion of the course, the students will have:

CO1: Apply parametric estimation and supervised learning techniques for pattern classification

CO2: Describe the structural pattern recognition methods

CO3: Apply neural networks, fuzzy systems and Genetic algorithms to pattern recognition and classification.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	M	-	L	-	-	-	M	-	-
CO2	H	L	M	-	L	-	-	-	M	-	-
CO3	H	L	M	-	L	-	-	-	M	-	-

L – Low, M – Moderate (Medium), H- High

18VLOE28 VLSI DESIGN
(Common to All Branches)

Category : OE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To gain knowledge on MOS and CMOS Circuits with its characterization
- To design CMOS logic and sub-system
- To understand low power CMOS VLSI Design

INTRODUCTION TO MOS CIRCUITS (9)

MOS Transistor Theory -Introduction MOS Device Design Equations -MOS Transistor as a Switches - Pass Transistor - CMOS Transmission Gate -Complementary CMOS Inverter - Static Load MOS Inverters - Inverters with NMOS loads - Differential Inverter - Tri State Inverter - BiCMOS Inverter.

CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION (9)

Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margin and Reliability.

CMOS CIRCUIT AND LOGIC DESIGN (9)

CMOS Logic Gate Design, Physical Design of CMOS Gate, Designing with Transmission Gates, CMOS Logic Structures, Clocking Strategies, I/O Structures.

CMOS SUB SYSTEM DESIGN (9)

Data Path Operations - Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.

LOW POWER CMOS VLSI DESIGN (9)

Introduction to Low Power Design, Power Dissipation in FET Devices, Power Dissipation in CMOS, Low-Power Design through Voltage Scaling – VTCMOS Circuits, MTCMOS Circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches, Low Power Basics CMOS Gate and Adder Design.

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. ***Sung Ms Kang, Yusuf Lablebici, "CMOS Digital Integrated Circuits: Analysis & Design", Tata Mc-Graw Hill, 2011.***
2. ***N. Weste and K. Eshranghian, "Principles of CMOS VLSI Design", Addison Wesley, 1998.***
3. ***Neil H.E. Weste, David Harris, Ayan Banerjee,"CMOS VLSI Design:A Circuits and Systems Perspective ", 2013, Pearson Education***
4. ***Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems" – McGraw-Hill Professional, 2004.***
5. ***Gary K. Yeap,"Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002.***
6. ***Jan M. Rabaey,"Digital Integrated Circuits: A Design Perspective",Pearson Education, 2003.***

***COURSE OUTCOMES*:**

After completing this course, the students will have:

- **CO1**: knowledge on MOS and CMOS Circuits with its characterization
- **CO2**: an ability to design CMOS logic and sub-system
- **CO3**: an understanding of low power CMOS VLSI Design

***COURSE ARTICULATION MATRIX*:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	-	M	-	-	-	-	-	-	-
CO2	-	-	H	-	-	-	-	-	-	-	-
CO3	M	L	-	M	M	-	-	-	-	-	-

L – Low, M – Moderate (Medium), H- High

18VLOE29 ANALOG & MIXED MODE VLSI CIRCUITS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES:Nil
***COURSE OBJECTIVES*:**

- To acquire knowledge on MOS circuit configuration and CMOS amplifier
- To analyze and design Operational amplifier
- To understand mixed signal circuits

MOS CIRCUIT CONFIGURATION (9)

Basic CMOS Circuits - Basic Gain Stage - Gain Boosting Techniques - Super MOS Transistor - Primitive Analog Cells, Current Source, Sinks and References MOS Diode/Active resistor, Simple current sinks and mirror, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.

CMOS AMPLIFIER (9)

CMOS Amplifier Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier.

CMOS DIFFERENTIAL AMPLIFIER (9)

CMOS Differential Amplifier Differential signalling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load, Differential to single ended conversion. Linear Voltage - Current Converters - CMOS, Bipolar and Low – Voltage BiCMOS Op - Amp Design - Instrumentation Amplifier Design.

BICMOS CIRCUIT TECHNIQUES AND CURRENT-MODE SIGNAL PROCESSING (9)

Basic BiCMOS Circuit Techniques, Current - Mode Signal Processing: Continuous - Time Signal Processing – Sampled - Data Signal Processing – Switched - Current Data Converters.

ANALOG FILTERS AND A/D CONVERTERS (9)

Sampled - Data Analog Filters, Over Sampled A/D Converters and Analog Integrated Sensors: First - order and Second SC Circuits - Bilinear Transformation – Cascade Design – Switched - Capacitor Ladder Filter

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCE BOOKS:

1. ***Behzad Razavi, Design of Analog CMOS Integrated circuits, Tata McGraw Hill Education, 2002.***
2. ***Mohammed Ismail, Terri Fiez, Analog VLSI signal and Information Processing, McGraw- Hill International Editons, 1994.***
3. ***R. Jacob Baker, Harry W. Li, and David E. Boyce, CMOS: Circuit Design , Layout and Simulation, Prentice Hall of India, 1997.***
4. ***David A. Johns and Ken Martin, Analog Integrated circuit Design, John Wiley & Son, 2013***

5. Greogorian and Tames, Analog Integrated Circuit for Switched Capacitor Circuits,

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO1: Knowledge on MOS circuit configuration and CMOS amplifier

CO2: To analyze and design Operational amplifier

CO3: An understanding on mixed signal circuits

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	L	-	-	-	-	-	M	L	-
CO2	H	-	L	-	-	-	-	-	M	L	-
CO3	H	-	L	-	-	-	-	-	M	L	-

L – Low, M – Moderate (Medium), H- High

18VLOE30 HARDWARE DESCRIPTION LANGUAGES
(Common to All Branches)

Category : OE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To gain knowledge on HDLs and Modeling styles
- To understand the VHDL and Verilog HDL.
- To design sub-systems USING VHDL/VERILOG

BASIC CONCEPTS OF HARDWARE DESCRIPTION LANGUAGES (9)

VLSI Design flow, Features of VHDL, Capabilities, Hierarchy, Syntax and Semantics of VHDL; Basic Language Elements - Data objects - Variable signal, and constant, Data types, Operators and signal assignments, Design Suits - Entities, architecture declaration, configurations, Packages.

MODELING STYLES (VHDL) (9)

Behavioral Modeling - Process statement, Sequential assignment statements, Loops, wait statement, assertion statement, Delay Model – Inertial delay Model, Transport delay model; Gate Level Modeling – Component instantiation statements; Data flow Modeling - Concurrent assignment statement, Conditional assignment statements, Procedures, functions, Generics, attributes, Model simulation - Writing a test bench, Logic Synthesis.

INTRODUCTION TO VERILOG HARDWARE DESCRIPTION LANGUAGE (9)

Key features, Capabilities, Language Constructs and Conventions in Verilog, Syntax and Semantics of Verilog; Basic Language Elements: Operators, nets, registers, vectors, arrays, parameters, system tasks, complier directives, Module, port connection rules.

MODELING STYLES (VERILOG) (9)

Gate Level Modeling - Gate types, Gate delays; Dataflow Modeling – continuous assignment, Behavioral Modeling - Initial & Always Construct, Assignments with Delays, wait construct, Multiple always blocks, If and if - else, assign, Loop Construct, Sequential and Parallel blocks, Switch level modeling - MOS switches, CMOS switches.

DESIGN SUB-SYSTEMS USING VHDL/VERILOG (9)

Combinational logics – Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter; Flip flop, state machines – Mealy type FSM, Moore type FSM, Counters and Shift register. Synthesis of digital logic circuits.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCE BOOKS:

1. ***J. Bhaskar, "A VHDL Primer, 3rd Edition, Pearson Education, 2015.***
2. ***Douglas Perry, "VHDL", McGraw Hill International, New York, 1998.***
3. ***S. Brown & Z. Vransesic, "Fundamental of digital Logic with Verilog design", Tata McGraw Hill, 2002.***
4. ***S. Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall (NJ, USA), 2003.***
5. ***Frank Vahid, "Digital Design", Wiley, 2006.***
6. ***Peter J Ashenden, "The Designer's Guide to VHDL", Morgan Kaufmann Publishers, 2008.***
7. ***Navabi, "VHDL Analysis & Modeling of digital systems", McGraw Hill, 1998.***

***COURSE OUTCOMES*:**

After completing this course, the students will have:

CO1: knowledge on HDLs and Modeling styles

CO2: to write the VHDL and Verilog HDL codes

CO3: to design sub-systems USING VHDL/VERILOG

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	H	L	H	L	M	-	-	-	M	-	-
CO2	H	L	H	-	M	-	-	-	M	-	-
CO3	H	L	H	-	M	-	-	-	M	-	-

L – Low, M – Moderate (Medium), H- High

18CSOE31 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- Artificial Intelligence and intelligent agents, history of Artificial Intelligence
- Building intelligent agents (search, games, constraint satisfaction problems)
- Machine Learning algorithms
- Applications of AI (Natural Language Processing, Robotics/Vision)
- Solving real AI problems through programming with Python, Tensor Flow and Keras library.

UNIT I FOUNDATIONS OF AI **L(9)**

Introduction - History of Artificial Intelligence - Intelligent Agents - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Adversarial Search - Constraint Satisfaction Problems.

UNIT II SUPERVISED AND UNSUPERVISED LEARNING **L(9)**

Maximum likelihood estimation -Regression -Linear, Multiple, Logistic - bias-variance, Bayes rule, maximum a posteriori inference- Classification techniques - k-NN, naïve Bayes - Decision Trees - Clustering - k-means, hierarchical, high-dimensional- Expectation Maximization.

UNIT III ENSEMBLE TECHNIQUES AND REINFORCEMENT LEARNING **L(9)**

Graphical Models - Directed and Undirected Models - Inference - Learning- maximum margin, support vector machines - Boosting and Bagging - Random Forests - PCA and variations - Markov models, hidden Markov models -Reinforcement Learning- introduction - Markov Decision Processes - Value-based methods - Q-learning- Policy-based methods

UNIT IV DEEP LEARNING **L(9)**

Neural Network Basics - Deep Neural Networks - Recurrent Neural Networks (RNN) - Deep Learning applied to Images using CNN - Tensor Flow for Neural Networks & Deep Learning

UNIT V AI APPLICATIONS **L(9)**

Applications in Computer Vision : Object Detection- Face Recognition - Action and Activity Recognition -Human Pose Estimation.

Natural Language Processing - Statistical NLP and text similarity - Syntax and Parsing techniques - Text Summarization Techniques - Semantics and Generation - Application in NLP - Text Classification -speech Recognition - Machine Translation - Document Summarization - Question Answering

Applications in Robotics : Imitation Learning - Self-Supervised Learning -Assistive and Medical Technologies - Multi-Agent Learning

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS

1. ***Peter Norvig and Stuart J. Russell, "Artificial Intelligence: A Modern Approach", Third edition***
2. ***Tom Mitchell, "Machine Learning", McGraw-Hill, 1997***
3. ***Ian Goodfellow, Yoshua Bengio, and Aaron Courvillem, "Deep Learning", MIT press, 2016.***
4. ***Michael Nielson , "Neural Networks and Deep Learning"***
5. ***Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006***
6. ***Richard Sutton and Andrew Barto, Reinforcement Learning: An introduction", MIT Press,1998***
7. ***Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.***
8. ***Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Second Edition ,Springer, 2011***

***COURSE OUTCOMES**: Upon completion of this course, the students will be able to:*

CO1: Develop expertise in popular AI & ML technologies and problem-solving methodologies. ***[Familiarity]***

CO2: Use fundamental machine learning techniques, such as regression, clustering, knearest neighbor methods, etc. ***[Usage]***

CO3: Distinguish between supervised and unsupervised machine learning methods. ***[Usage]***

CO4: Gain knowledge of the different modalities of Deep learning currently used. ***[Familiarity]***

CO5: Use popular AI & ML technologies like Python, Tensorflow and Keras todevelop Applications. ***[Usage]***

CORRELATION BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	H	H	M	H	H			L		M
CO2	H	M	M	M	M	M			L		M
CO3	H	H	H	M	H	M			L		L
CO4	H	H	M	H	M	H			L		L
CO5	H	H	H	M	H	M			L		L

L – Low, M – Moderate (Medium), H- High

18CSOE32 COMPUTER NETWORK ENGINEERING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- The hardware and software architecture of Computer Networks
- The concepts of internetworking
- Issues in resource allocation
- End-to-end protocols and data transmission
- Network management models

UNIT I FOUNDATION L(9)

Applications – Requirements – Network Architecture – Implementing Network software – Performance – Perspectives on connecting – Encoding – Framing – Error detection – Reliable transmission – Ethernet and Multiple Access Networks – Wireless.

UNIT II INTERNETWORKING L(9)

Switching and bridging – IP – Routing – Implementation and Performance – Advanced Internetworking – The Global Internet – Multicast – Multiprotocol and Label Switching – Routing among Mobile devices.

UNIT III CONGESTION CONTROL AND RESOURCE ALLOCATION L(9)

Issues in Resource allocation – Queuing disciplines – Congestion Control – Congestion avoidance mechanism – Quality of Service.

UNIT IV END-TO-END PROTCOLS AND DATA L(9)

Simple Demultiplexer – Reliable Byte Stream –Remote Procedure Call – RTP – Presentation formatting - Multimedia data.

UNIT V NETWORK MANAGEMENT L(9)

SNMPv1 and v2 Organization and information model - Communication model – Functional model - SNMP proxy server- Remote monitoring- RMON1 andRMON2.

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS

1 ***Larry L. Peterson, Bruce S. Davie, "Computer Networks a Systems approach", Fifth edition, Elsevier, 2011.***
2 ***Priscilla Oppenheimer, "Top-down Network Design: A Systems Analysis Approach to Enterprise Network Design", 3rd Edition, Cisco Press, 2010.***
3 ***James D. McCabe, Morgan Kaufmann, "Network Analysis, Architecture, and Design", Third Edition, Elsevier, 2007.***

4 *William Stallings, "SNMP, SNMPv2, SNMPv3, and RMON 1 and 2," Third Edition, Pearson Education, 2012*
5 *Mani Subramanian, "Network Management Principles and practice", Pearson Education, 2010.*

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

CO1: Explain the architecture and applications of Computer Networks. ***[Familiarity]***
CO2: Analyze the performance of MAC protocols. ***[Assessment]***
CO3: Configure switches and Routers. ***[Assessment]***
CO4: Design algorithms to ensure congestion control and QOS. ***[Usage]***
CO5: Appreciate the performance of End-to-End protocols and data transmission techniques. ***[Assessment]***
CO6: Use SNMP and RMON. ***[Usage]***

CORRELATION BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	M			M		M
CO2	H	H	M	H	M	H			M		M
CO3	H	H	M	H	M	H			M		M
CO4	H	H	H	M	H	M			M		M
CO5	H	H	M	H	M	H	L		M		M
CO6	H	H	H	M	H	M	L		M		M

L – Low, M – Moderate (Medium), H- High

18CSOE33 BIG DATA ANALYTICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- Statistical methods
- Bayesian, Support Vector and Kernel Methods
- Time Series Analysis and Rule Induction
- Neural networks and Fuzzy Logic
- Visualization Techniques

UNIT I STATISTICAL CONCEPTS AND METHODS L(9)

Statistical Concepts: Probability, Sampling and Sampling Distributions, Statistical Inference, Prediction and Prediction Errors–Resampling- Statistical Method: Linear Models, Regression Modeling, Multivariate Analysis.

UNIT II BAYESIAN METHODS AND SUPPORT VECTOR AND KERNEL METHODS L(9)

Bayesian Methods: Bayesian Paradigm, modeling, inference and networks – Support Vector and Kernel Methods: Kernel Perceptron, Overfitting and Generalization Bounds, Support Vector Machines, Kernel PCA and CCA.

UNIT III TIME SERIES ANALYSIS AND RULE INDUCTION L(9)

Analysis of time series: linear systems analysis, nonlinear dynamics, Delay Coordinate Embedding - Rule induction: Propositional Rule Learning, Rule Learning as search, Evaluating quality of rules, Propositional rule induction, First order rules-ILP systems.

UNIT IV NEURAL NETWORKS AND FUZZY LOGIC L(9)

Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees.

UNIT V STOCHASTIC SEARCH METHODS AND VISUALIZATION L(9)

Stochastic Search Methods: Stochastic Search by Simulated Annealing, Adaptive Search by Evolution- Evolution Strategies- Genetic Algorithms & Programming- Visualization : Classification of Visual Data Analysis Techniques, Data Type to be Visualized, Visualization Techniques, Interaction Techniques and Specific Visual Data Analysis Techniques.

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS

1 ***Michael Berthold, David J. Hand, "Intelligent Data Analysis-An Introduction", Second Edition, Springer, 2007.***

2 ***Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics", John Wiley & sons, 2012.***

3 ***Jimmy Lin and Chris Dyer, "Data Intensive Text Processing using Map Reduce", Morgan and Claypool Publishers, 2010.***

4 ***Tom White, "Hadoop: The Definitive Guide", O`Reilly Publishers, 2012***

5 ***David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann, 2013.***

6 ***Paul Zikopoulos, Chris Eaton, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw-Hill Education, 2011.***

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Explain the statistical concepts and methods. ***[Familiarity]***

CO2: Use Bayesian, support vector and kernel Methods. ***[Usage]***

CO3: Perform Time series analysis. ***[Usage]***

CO4: Use Rule induction. ***[Usage]***

CO5: Apply Neural network and Fuzzy logic. ***[Usage]***

CO6: Use Stochastic search methods. ***[Usage]***

CO7: Explain Visualization Techniques. ***[Familiarity]***

CORRELATION BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	M	M	M	M	M			M		M
CO2	H	H	H	M	H	M			M		M
CO3	H	H	H	M	H	M	L		M	L	M
CO4	H	H	H	M	H	M			M		M
CO5	H	H	H	M	H	M			M		M
CO6	H	H	H	M	H	M	L		M		M
CO7	H	M	M	M	M	M			M	L	M

L – Low, M – Moderate (Medium), H- High

18GEACZ1 - ENGLISH FOR RESEARCH PAPER WRITING
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Writing quality research papers in English*

UNIT I **L(6)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II **L(6)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism

UNIT III **L(6)**

Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV **L(6)**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V **L(6)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 ***Goldbort R (2006) Writing for Science, Yale University Press*** *(available on GoogleBooks).*

2 ***Day R (2006) How to Write and Publish a Scientific Paper****, Cambridge University Press.*

3 ***Highman N (1998), Handbook of Writing for the Mathematical Sciences****, SIAM. Highman's book.*

4 ***Adrian Wallwork, English for Writing Research Papers****, Springer New York Dordrecht Heidelberg London, 2011.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: Utilize writing skills to write best quality research paper and provide better readability.

CO2: Describe each section of a paper with clarity.

CO3: Review the papers efficiently.

CO4: Utilize the key skills to write title, abstract, introduction and literature review of the paper.

CO5: Write the methods, results, Discussion and Conclusion using the required skills and useful phrases.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	L	L	M			H			
CO2	H	H	L	L	M			H			
CO3	H	H	L	L	M			H			
CO4	H	H	L	L	M			H			
CO5	H	H	L	L	M			H			

L – Low, M – Moderate (Medium), H- High

18GEACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Key concepts in disaster risk reduction.*
- *Types of disasters and hazards.*
- *Disaster prone areas in India.*
- *Strengths and weaknesses of disaster management approaches.*
- *Risk assessment methods.*

UNIT I INTRODUCTION **L(6)**

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **L(6)**

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **L(6)**

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **L(6)**

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V RISK ASSESSMENT **L(6)**

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 ***R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.***

2 *Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India. New Delhi.*
3 *Goel S. L. , "Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.*
4 *Jagbir Singh, "Disaster Management: Future Challenges and Opportunities", I.K. International Publishing House Pvt. Ltd. , New Delhi, 2007.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: Differentiate hazard and disaster and types of disasters.

CO2: Identify the causes and types of manmade and natural disaster.

CO3: Describe the disaster prone areas in India.

CO4: To predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences

CO5: Provide survival strategies based on risk assessment.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M		M	M	L		H		M		M
CO2	M		M	M	L		H		M		M
CO3	M		M	H	L		H		M		M
CO4	M		M	M	L		H		M		M
CO5	M		M	H	L		H		M		M

L – Low, M – Moderate (Medium), H- High

18GEACZ3 - VALUE EDUCATION
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Value of education and self- development
- Requirements of good values in students
- Importance of character

UNIT I - ETHICS AND SELF-DEVELOPMENT **L(6)**

Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II - PERSONALITY AND BEHAVIOR DEVELOPMENT **L(6)**

Soul and Scientific attitude .Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness.Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.

UNIT III - VALUES IN HUMAN LIFE **L(6)**

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature ,Discipline

UNIT IV - VALUES IN SOCIETY **L(6)**

True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT V - POSITIVE VALUES **L(6)**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 ***Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi***

2 ***Dr. Yogesh Kumar Singh, "Value Education", A.P.H Publishing Corporation,New Delhi***

3 ***R.P Shukla, "Value Education and Human Rights", Sarup and Sons, NewDelhi.***

4 ***https://nptel.ac.in/courses/109104068/36***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the values and work ethics

CO2: Enhance personality and behaviour development

CO3: Apply the values in human life.

CO4: Gain Knowledge of values in society.

CO5. Learn the importance of positive values in human life.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	H		H				H	
CO2	H	M	M	H		H				M	
CO3	H	M	M	H		H				M	
CO4	H	M	M	H		H				M	
CO5	H	M	M	H		H				M	

L – Low, M – Moderate (Medium), H- High

18GEACZ4 - CONSTITUTION OF INDIA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Indian constitution
- Constitutional rights & duties
- Organs of governance
- Local administration
- Roles and functions of Election commission

UNIT I - INDIAN CONSTITUTION **L(6)**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features

UNIT II - CONSTITUTIONAL RIGHTS & DUTIES **L(6)**

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III - ORGANS OF GOVERNANCE **L(6)**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT IV - LOCAL ADMINISTRATION **L(6)**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V - ELECTION COMMISSION **L(6)**

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 ***The Constitution of India, 1950 (Bare Act), Government Publication.***

2 ***Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.***

3 ***M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.***

4 ***D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.***

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Understand the various organs of Indian governance.

CO4: Familiarize with the various levels of local administration.

CO5: Gain knowledge on election commission of India.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				H		L	H			H	M
CO2				H		L	H			H	M
CO3				H		L	H			H	M
CO4				H		L	H			H	M
CO5				H		L	H			H	M

L – Low, M – Moderate (Medium), H- High

18GEACZ5 - PEDAGOGY STUDIES
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Understanding of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies.
- Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology.

UNIT I - INTRODUCTION **L(6)**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT II - PEDAGOGICAL PRACTICES **L(6)**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the

UNIT III - PEDAGOGICAL APPROACHES **L(6)**

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teacher's attitudes and beliefs and Pedagogic strategies.

UNIT IV - PROFESSIONAL DEVELOPMENT **L(6)**

Professional development: alignment with classroom practices and follow-up support. Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes.

UNIT V - CURRICULUM AND ASSESSMENT **L(6)**

Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 ***Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools,Compare, 31 (2): 245-261.***

2 *Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.*

3 *Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.*

4 *Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.*

5 *Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.*

6 *Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.*

7 *www.pratham.org/images/resource%20working%20paper%202.pdf.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: Explain the concept of curriculum, formal and informal education systems and teacher education.

CO2: Explain the present pedagogical practices and the changes occurring in pedagogical approaches.

CO3: Understand the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class.

CO4: Perform research in design a problem in pedagogy and curriculum development.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				H		H	M			H	L
CO2				H		H	M			H	M
CO3				H		H	M			H	M
CO4				H		H	H			H	M

L – Low, M – Moderate (Medium), H- High

18GEACZ6 - STRESS MANAGEMENT BY YOGA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Eight parts of yoga*
- *Techniques to achieve overall health of body and mind*
- *Breathing techniques and its effects*

UNIT I **L(6)**

Definitions of Eight parts of yog. (Ashtanga).

UNIT II **L(6)**

Yam and Niyam.-Do`s and Don't's in life.

UNIT III **L(6)**

Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT IV **L(6)**

Asan and Pranayam : Various yog poses and their benefits for mind & body.

UNIT V **L(6)**

Regularization of breathing techniques and its effects-Types of pranayam.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 **'Yogic Asanas for Group Tarining-Part-I"** :Janardan Swami Yogabhyasi Mandal, Nagpur

2 "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama(Publication Department), Kolkata

3 Pandit Shambu Nath, "Speaking of Stress Management Through Yoga and Meditation",New Dawn Press,New Delhi.

4 K.N Udupa,"Stress and its management by Yoga", Motilal Banarsidass Publ,New Delhi.

***COURSE OUTCOMES**:*

Upon completion of this course, the students will be able to:

CO1: understand the basics of Yoga.

CO2: Identify Do's and Dont's in life.

CO3: Follow ethical and moral guidelines given by Yamas and Niyamas in life.

CO4: Develop healthy mind in a healthy body thus improving social health by Asan and Pranayam.

CO5: Use breathing techniques to live a stress free life.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				H		M	H			H	
CO2				H		M	H			H	L
CO3				H		M	H			H	
CO4				H		M	H			H	
CO5				H		M	H			H	

L – Low, M – Moderate (Medium), H- High

18GEACZ7 - PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Techniques to achieve the highest goal happily
- How to become a person with stable mind, pleasing personality and determination
- Awakening wisdom in students

UNIT I **L(6)**

Neetisatakam-Holistic development of personality-Verses- 19,20,21,22 (wisdom)-Verses- 29,31,32 (pride & heroism)-Verses- 26,28,63,65 (virtue)

UNIT II **L(6)**

Verses- 52,53,59 (dont's)-Verses- 71,73,75,78 (do's). - Approach to day to day work and duties.- Shrimad Bhagwad Geeta - Chapter 2-Verses 41, 47,48,

UNIT III **L(6)**

Shrimad Bhagwad Geeta -Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,-Chapter 18-Verses 45, 46, 48.

UNIT IV **L(6)**

Statements of basic knowledge.-Shrimad Bhagwad Geeta: -Chapter2-Verses 56, 62, 68 -Chapter 12 -Verses 13, 14, 15, 16,17, 18-Personality of Role model.

UNIT V **L(6)**

Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39-Chapter18 – Verses 37,38,63

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.
3. "Bhagavad Gita: The Song of God", Swami Mukundananda, Jagadguru Kripaluji Yog, USA
4. "Bhagavad-Gita As It Is", A.C. Bhaktivedanta Swami Prabhupada,, Bhaktivedanta Book Trust Publications

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the Holistic development

CO2: Understand the day to day to day work and duties

CO3: Understand mankind to peace and prosperity

CO4: Become versatile personality.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							H	M	L		H
CO2							H		M		H
CO3							H		M		H
CO4							H	M	M		H

L – Low, M – Moderate (Medium), H- High

18GEACZ8 - SANSKRIT FOR TECHNICAL KNOWLEDGE

(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Alphabets and tense of the language.
- Sentence formation
- The Technical information in Sanskrit Literature

UNIT I **L(6)**

Alphabets in Sanskrit, Past/Present/Future Tense

UNIT II **L(6)**

Simple Sentences - Order, Introduction of roots

UNIT III **L(6)**

Technical information about Sanskrit Literature

UNIT IV **L(6)**

Technical concepts of Engineering-Electrical, Mechanical

UNIT V **L(6)**

Technical concepts of Engineering-Architecture, Mathematics

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. *"* **"Abhyaspustakam"** – *Dr.Vishwas, Samskrita-Bharti Publication, New Delhi*
2. **"Teach Yourself Sanskrit"** *Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication*
3. **"India's Glorious Scientific Tradition"** *Suresh Soni, Ocean books (P) Ltd., New Delhi.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: Read and write sentences

CO2: Explore the huge knowledge from ancient literature

CO3: Use technical concepts to develop logic in mathematics and engineering.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								M	L		H
CO2	L								M		H
CO3		L	H	H					H	M	H

L – Low, M – Moderate (Medium), H- High