GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

M.E. (STRUCTURAL ENGINEERING)

(Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

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GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE
DEPARTMENT OF CIVIL ENGINEERING
(Structural Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The following Programme Educational Objectives are designed based on the department mission

PEO 1: To impart conceptual knowledge and develop analytical skills to design and build sustainable structural systems with an exposure to real time projects.

PEO 2: To develop research attitude in the field of Structural Engineering covering a wide spectrum of themes.

PEO 3: To excel in the profession with team work and leadership qualities having social responsibility and ethical values.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE

DEPARTMENT OF CIVIL ENGINEERING
(Structural Engineering)

PROGRAMME OUTCOMES (POs)

Students in the Structural Engineering Programme should be at the time of their graduation be in possession of the following:

PO 1: To enhance knowledge in the area of applied science and mathematics with a well balanced preparation in engineering fundamentals and practical applications.

PO 2: To identify, analyze and design complex engineering problems.

PO 3: An ability to design and conduct experiments, as well as to analyze and interpret data.

PO 4: To gain research skills in the various field of structural engineering employing different methodologies and techniques.

PO 5: An ability to use the techniques advanced modern engineering skills, instrumentation and software packages necessary for structural engineering practice.

PO 6: An ability to lead, manage and to be productive in a multi disciplinary team.

PO 7: To execute and manage the multidisciplinary projects with global standards and sustainability.

PO 8: An ability to communicate effectively and to possess excellent report writing, making presentation and documentation.

PO 9: An ability to recognize the need for life-long learning to meet the challenging and demand driven needs of the society with a high level of enthusiasm.

PO 10: To demonstrate knowledge of professional and ethical responsibilities.

PO 11: To develop confidence for self-education through various case studies.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE

DEPARTMENT OF CIVIL ENGINEERING
(Structural Engineering)

PROGRAMME SPECIFIC OUTCOMES (POs)

PSO1 : An ability to obtain Global level research opportunities to pursue Ph.D programme with Institutions of National importance and Specific placements in R & D departments in Structural Engineering domain.

PSO2: An ability to apply design, develop and execution of projects including life – line services.

PSO3: An ability to become a good entrepreneur and to improve the management skills.

PSO4: An ability to face Discipline specific competitive exams that offer challenging and rewarding careers

CURRICULUM

M.E. STRUCTURAL ENGINEERING

CURRICULUM

(Full Time Candidates admitted during 2018-2019 and 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	18SEFCZ1	Research Methodology and IPR	FC	50	50	100	3	3	0	0	3
2	18SEPC01	Computer Methods of Structural Analysis	PC	50	50	100	3	3	0	0	3
3	18SEPC02	Design of Advanced Reinforced concrete structures	PC	50	50	100	3	3	0	0	3
4	18SEPC03	Theory of Elasticity and Plasticity	PC	50	50	100	3	3	0	0	3
5	18SEPEXX	Professional Elective I	PE	50	50	100	3	3	0	0	3
6	18SEPEXX	Professional Elective II	PE	50	50	100	3	3	0	0	3
7	18SEACXX	Audit Course I	AC	50	50	100	2	2*	0	0	0
Practical											
8	18SEPC04	Experimental Techniques Laboratory	PC	50	50	100	3	0	0	3	1.5
		Total		**400**	**400**	**800**	**23**	**20**	**0**	**3**	**19.5**

SEMESTER –II

S.No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18SEPC05	Finite Element Analysis	PC	50	50	100	3	3	0	0	3
2	18SEPC06	Structural Dynamics	PC	50	50	100	3	3	0	0	3
3	18SEPC07	Advanced Steel Structures	PC	50	50	100	3	3	0	0	3
4	18SEPEXX	Professional Elective III	PE	50	50	100	3	3	0	0	3
5	18SEPEXX	Professional Elective IV	PE	50	50	100	3	3	0	0	3
6	18SEACXX	Audit Course II	AC	50	50	100	2	2*	0	0	0
Practical											
7	18SEPC08	Finite Element analysis and Applications Laboratory	PC	50	50	100	3	0	0	3	1.5
8	18SEEE01	Design Project	EEC	50	50	100	4	0	0	4	2
		Total		**400**	**400**	**800**	**24**	**17**	**0**	**7**	**18.5**

SEMESTER –III

S.No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18SEPEXX	Professional Elective V	PE	50	50	100	3	3	0	0	3
2	18$OEXX	Open Elective I	OE	50	50	100	3	3	0	0	3
Practical											
3	18SEEE02	Project Phase I	EEC	100	100	200	20	0	0	20	10
		Total		**200**	**200**	**400**	**26**	**6**	**0**	**20**	**16**

SEMESTER –IV

S.No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
1	18SEEE03	Project Phase II	EEC	200	200	400	32	0	0	32	16
		Total		**200**	**200**	**400**	**32**	**0**	**0**	**32**	**16**

TOTAL CREDITS: 70

LIST OF PROFESSIONAL ELECTIVES FOR M.E STRUCTURAL 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	18SEPE01	Analytical and Numerical Methods (Common with ME Geotechnical Engineering)	PE	50	50	100	3	3	0	0	3
2	18SEPE02	Structural Optimization	PE	50	50	100	3	3	0	0	3
3	18SEPE03	Analysis of Laminated Composite Plates	PE	50	50	100	3	3	0	0	3
4	18SEPE04	Soil Structure Interaction (Common with ME Geotechnical Engineering)	PE	50	50	100	3	3	0	0	3
5	18SEPE05	Environmental Engineering Structures (Common with ME Environmental & Geotechnical Engineering)	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE II											
6	18SEPE06	Stability of Structures	PE	50	50	100	3	3	0	0	3
7	18SEPE07	Theory and Applications of Cement Composites	PE	50	50	100	3	3	0	0	3
8	18SEPE08	Advanced Concrete Technology	PE	50	50	100	3	3	0	0	3
9	18SEPE09	Fracture Mechanics	PE	50	50	100	3	3	0	0	3
10	18SEPE10	Substructure Design	PE	50	50	100	3	3	0	0	3
11	18SEPE11	Design of Advanced Industrial Structures	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE III											
12	18SEPE12	Design of Concrete Bridges	PE	50	50	100	3	3	0	0	3
13	18SEPE13	Prestressed Concrete Structures	PE	50	50	100	3	3	0	0	3
14	18SEPE14	Plastic Analysis of Structures	PE	50	50	100	3	3	0	0	3
15	18SEPE15	Plates and Shells	PE	50	50	100	3	3	0	0	3
16	18SEPE16	Maintenance and Rehabilitation of Structures	PE	50	50	100	3	3	0	0	3
17	18SEPE17	Smart Materials and Smart Structures	PE	50	50	100	3	3	0	0	3

PROFESSIONAL ELECTIVE IV											
18	18SEPE18	Structural Health Monitoring	PE	50	50	100	3	3	0	0	3
19	18SEPE19	Design of Formwork	PE	50	50	100	3	3	0	0	3
20	18SEPE20	Experimental Techniques and Instrumentation	PE	50	50	100	3	3	0	0	3
21	18SEPE21	Design of Steel Concrete Composite Structures	PE	50	50	100	3	3	0	0	3
22	18SEPE22	Prefabricated Structures	PE	50	50	100	3	3	0	0	3
23	18SEPE23	Offshore Structures	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE V											
24	18SEPE24	Corrosion Engineering	PE	50	50	100	3	3	0	0	3
25	18SEPE25	Earthquake Resistant Design of Structures	PE	50	50	100	3	3	0	0	3
26	18SEPE26	Design of Structures for Dynamic Loads	PE	50	50	100	3	3	0	0	3
27	18SEPE27	Design of Tall Buildings	PE	50	50	100	3	3	0	0	3
28	18SEPE28	Cold Formed Steel Structures	PE	50	50	100	3	3	0	0	3
29	18SEPE29	Geotechnical Earthquake Engineering (Common with ME Geotechnical Engineering)	PE	50	50	100	3	3	0	0	3

LIST OF OPEN ELECTIVES FOR M.E STRUCTURAL 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 FOR M.E STRUCTURAL ENGINEERING

S. No.	Subject Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Contact Periods	Hours/Week			
								L	T	P	C
1	18SEACZ1	English for Research Paper Writing	AC	50	50	100	2	2	0	0	0
2	18SEACZ2	Disaster Management	AC	50	50	100	2	2	0	0	0
3	18SEACZ3	Value Education	AC	50	50	100	2	2	0	0	0
4	18SEACZ4	Constitution of India	AC	50	50	100	2	2	0	0	0
5	18SEACZ5	Pedagogy Studies	AC	50	50	100	2	2	0	0	0
6	18SEACZ6	Stress Management by Yoga	AC	50	50	100	2	2	0	0	0
7	18SEACZ7	Personality Development Through Life Enlightenment Skills	AC	50	50	100	2	2	0	0	0
8	18SEACZ8	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	4.29 %
2.	Professional Cores	13.5	10.5	0	0	24	34.29 %
3.	Professional Electives	3	6	3	0	12	17.14 %
4.	Employability Enhancement Courses	0	2	10	16	28	40 %
5.	Open Elective Courses	0	0	3	0	03	4.29 %
Total Credits		**19.5**	**18.5**	**16**	**16**	**70**	**100%**

SYLLABI

18SEFCZ1 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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*									*M*	*L*	*H*			
CO2	*L*									*M*	*L*	*H*			
CO3	*H*	*H*	*H*	*M*	*M*	*M*	*L*					*H*	*H*		
CO4	*H*	*H*	*H*	*M*	*M*	*M*	*L*					*H*	*H*		
CO5								*H*				*H*			

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

18SEPC01 - COMPUTER METHODS OF STRUCTURAL ANALYSIS

Category: PC

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

COURSE OBJECTIVE:

- To analyse the structures by matrix methods and energy concepts.

UNIT I - FUNDAMENTAL CONCEPTS (9)

Force and displacement measurement–Generalized or Independent measurement–Constrained or Dependent measurements–Principle of superposition–Stiffness and flexibility matrices in constrained measurements–Stiffness and flexibility of systems and elements –computing stiffness and flexibility coefficients.

UNIT II - ENERGY CONCEPTS AND TRANSFORMATION OF INFORMATION (9)

Strain energy in terms of stiffness & flexibility matrices–Betti's law – Application of Betti's law - Computing displacements and forces from virtual work – other energy theorems - Transformation of forces and displacements in general – Stiffness and flexibility in general - Normal coordinates and orthogonal transformation – Principle of contragradience.

UNIT III - FLEXIBILITY METHOD (9)

Statically determinate structures – Indeterminate structures – Choice of redundants leading to ill and well conditioned matrices Transformation to one set of redundants to another – Internal forces due to thermal expansion and lack of fit – Reducing the size of flexibility matrix – Application to pin- jointed plane truss – continuous beams – Frames –Grids (Concept only).

UNIT IV - STIFFNESS METHOD (9)

Introduction – Development of the stiffness method – Analogy between flexibility and stiffness – lack of fit – Application of stiffness approach to pin jointed plane truss – Continuous beams – Frames – Grids (Concept only) – Space frames introduction only – Static condensation technique- Direct stiffness approach.

UNIT V - ANALYSIS BY SUBSTRUCTURING AND ITERATION (9)

Analysis by substructuring technique using the stiffness and the flexibility method with tridiagonalisation. Iteration method for frames with non-prismatic members.

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

REFERENCE BOOKS:

1. *William McGuire, Richard H. Gallagher, Ronald D. Ziemian,* ***"Matrix structural Analysis",*** *Wiley, 2015.*
2. *Pandit G.S, Gupta S.P,* ***"Structural Analysis-A matrix Approch"****, Tata McGraw Hill Publishing Company Ltd, 2008.*

3. *Manicka Selvam V.K,* ***"Elements of Matrix Stability Analysis of structures"****, Khanna Publishers, 2006.*
4. *Rajasekaran S. and, Sankarasubramanian G.,* ***"Computational Structural Mechanics",*** *PHI Learning Pvt. Ltd, 2001.*
5. *William Weaver JR. and James M. Gere,* ***"Matrix Analysis of framed structures",*** *CBS Publishers and Distributers, 3 rd edition, 1990.*
6. *Rubinstein, FM,* ***"Matrix Computer methods of Structural Analysis****", Prentice Hall, 1966*

COURSE OUTCOME:

The students are able to,

CO 1: apply fundamental principles to evaluate the characteristics of structures
CO 2: use energy concepts to analyse the structures and transform information in structures.
CO 3: Apply the flexibility matrix method for the analysis of beams, trusses and frames.
CO 4: Analyze the continuous beams, frames and trusses using stiffness matrix methods.
CO 5: Perform complex analysis procedures such as sub structuring and iteration techniques.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*L*										*M*			*H*
CO2	*M*	*H*	*M*						*L*						*L*
CO3	*H*	*M*	*M*	*L*								*M*			*M*
CO4	*H*	*M*	*M*	*L*								*M*			*M*
CO5	*M*	*H*		*L*								*L*			*M*

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

18SEPC02 – DESIGN OF ADVANCED REINFORCED CONCRETE STRUCTURES

Category: PC

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To impart knowledge on the limit state design of RCC Structural components and to inculcate design methodologies of special structural elements as per Indian standard code of practice.

UNIT I - DESIGN OF BEAMS (9)

Behaviour of RCC beams under combined Shear, Torsion and Bending-Modes of Failures-Inter action effects - Analysis and design of beams circular in plan and Spandrel beams-Design for Serviceability Limit states - Design calculation of deflections and crack width according to IS 456-2000.

UNIT II - DESIGN OF SLENDER COLUMNS (9)

Behaviour of slender RCC Columns- Failure modes and Interaction curves-Additional Moment method-Comparison of codal provisions- calculation of design moments for braced and unbraced columns-Principles of Moment magnification method-design of slender columns.

UNIT III - DESIGN OF SPECIAL RC ELEMENTS (9)

Design and detailing of Concrete braced and unbraced walls according to BIS code - Classification of shear walls, design principles, design of rectangular and flanged shear walls- Design and detailing of Corbels - Design and detailing of Deep beams- Approximate analysis and design of Grid floors.

UNIT IV - DESIGN OF FLAT SLABS AND FLAT PLATES (9)

Yield line theory of slabs - Hillerberg method of design of slabs- Design of Flat slabs and flat plates according to BIS method-Shear in Flat Slabs and Flat Plates.

UNIT V - INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND FRAMES (9)

Inelastic behaviour of concrete beams-moment-rotation curves-moment redistribution-Bakers method of analysis and design-Design of cast-in-situ joints in frames. Detailing requirements for ductility, durability and fire resistance.

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

REFERENCE BOOKS:

1. *Varghese P.C., **"Advanced Reinforced Concrete"**, Prentice Hall of India, New Delhi, 2009*
2. *Varghese P.C., **"Limit state design of Reinforced Concrete",** Prentice Hall of India, New Delhi, 2008*
3. *Krishna Raju, N., **"Advanced Reinforced Concrete Design",** CBS Publishers and Distributers, 2008*

4. *Unnikrishnan Pillai S and Menon D., **" Reinforced concrete Design",** Tata McGraw Hill Book Co., New Delhi, 2003.*
5. *N.C.Sinha and S. K.Roy, **"Fundamentals of Reinforced concrete",** S.Chand & Co Ltd., 2007*
6. *Pankaj Agarwal and Manish Shaikande, **"Earthquake Resistant Design of structures",** Prentice Hall of India Pvt. Ltd, New Delhi, 2006*
7. *N.Subramanian, **"Design of Reinforced Concrete Structures"** Oxford Publishers, 2013*
8. *Shah V.L., & Karve S.R. **"Limit state theory and Design of Reinforced Concrete",** Structures Publications, Pune (2003)*
9. *Park and Paulay T, **"Reinforced concrete Structures"**, John Wiley and Sons, New York, 2009.*
10. *Arthur H Nilson, **"Design of Concrete Structures",** Tata McGraw Hill Book Co.,2009.*

COURSE OUTCOME:

The students are able to,

CO 1: Design the beams subjected to torsion and verify the serviceability criteria.

CO 2: Design the slender columns based on various methods.

CO 3: Design various special RC elements namely RC walls, corbels, deep beams, grid floors.

CO 4: Apply the concepts of yield line theory and design of flat slabs and flat plates as per IS codes.

CO 5: Familiarize the concept of inelastic behaviour of concrete elements.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*H*	*M*	*M*	*M*					*M*			*H*	*M*	*M*
CO2	*M*	*H*	*M*	*M*	*M*					*M*			*H*	*M*	*M*
CO3	*M*	*H*	*M*	*M*	*M*					*M*			*H*	*M*	*M*
CO4	*M*	*H*	*M*	*M*	*M*					*M*		*M*	*H*	*M*	*M*
CO5	*M*	*H*	*M*	*M*	*M*							*M*			*M*

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

18SEPC03 – THEORY OF ELASTICITY AND PLASTICITY

Category: PC

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

COURSE OBJECTIVE:

- To impart knowledge on elastic and plastic behavior of systems in Cartesian coordinates subjected to stresses and strain.

UNIT I - ELASTICITY AND SOLUTIONS (9)

Analysis of stress and strain, Equilibrium equations - Compatibility equations - stress strain relationship. Generalized Hooke's law. Plane stress and plane strain - Simple two dimensional problems in Cartesian co-ordinates.

UNIT II - TORSION OF NON-CIRCULAR SECTION (9)

St.venant's approach - Prandtl's approach: Membrane analogy - Torsion of thin walled open and closed sections.

UNIT III - ENERGY METHODS (9)

Strain energy – Principle of virtual work – Energy theorems – Rayleigh Ritz method – Finite difference method – Application to elasticity problems.

UNIT IV - PLASTICITY (9)

Physical Assumptions – Yield criteria - Plastic stress strain relationship. Elastoplastic problems in bending

UNIT V - CONSTITUTIVE MODELS (9)

Metal Plasticity – Concrete and Soil Plasticity – Failure criterion and Constitutive models for the above materials

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

REFERENCE BOOKS:

1. *Timeshenko.S.P and Goodier.J.N **"Theory of Elasticity"** - McGraw Hill International edition, 2001.*
2. *Mendelson "**Plasticity: Theory and Application"**- A McMillan and co, NewYork 1968.*
3. *Sadhu Singh '**Theory of plasticity"**, Khanna publishers, 2005.*
4. *Hill.R "**Mathematical theory of plasticity"** - Oxford Publishers 1967*
5. *Sadhu Singh **"Theory of Elasticity and metal forming processes",** Khanna publishers,2005*
6. *Chakrabarthy J, **"Theory of plasticity"**, Mc Graw Hill Co., 2012*
7. *Chen W.F, **"Plasticity for Structural Engineers",** J.Ross Publishing, 2007*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the stress, deformation and constitutive relations.

CO 2: Analyze torsion of non-circular sections and thin walled sections

CO 3: Apply the concept of energy methods for elasticity problems.

CO 4: Familiarize the concept of plasticity and its applications in elasto plastic problems.

CO 5: demonstrate the plasticity constitutive models for various materials.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*H*		*H*	*L*							*H*			*L*
CO2	*M*	*H*		*H*	*L*							*H*			*L*
CO3	*H*	*H*		*M*	*L*							*H*			*L*
CO4	*H*	*H*		*M*	*L*							*M*			*L*
CO5	*M*				*L*							*H*			*M*

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

18SEPC04 - EXPERIMENTAL TECHNIQUES LABORATORY

Category: PC

PREREQUISITES: Nil

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVE:

- To have exposure on instruments and to conduct experiments on various structural elements to identify its behaviour.

SYLLABUS CONTENT:

1. Introduction to instrumentation (LVDT, Load cell, Hydraulic jack, Strain gauges)
2. Casting and Testing of Reinforced Concrete beams for deflection, flexure and shear.
3. Casting and Testing of Reinforced Concrete columns, beam – column joint and Frames.
4. Fabrication and testing of elements for steel structures
5. Use of Non destructive testing (NDT) equipments – Rebound hammer, Ultra sonic pulse velocity meter and Rebar locator

COURSE OUTCOMES:

The students are able to

CO 1: Familiarize with the various instruments used for testing structural elements.
CO 2: Execute the test on reinforced concrete beams.
CO 3: Conduct the experiments on reinforced concrete columns, joints and frames.
CO 4: Fabricate and conduct test on various steel elements.
CO 5: Employ Non destructive testing equipments for testing of structures.

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

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PSO1*	*PSO2*	*PSO3*	*PSO4*
CO1			*H*	*L*	*H*	*L*						*H*		*L*	
CO2			*H*		*M*			*L*				*M*			
CO3			*H*	*L*	*M*	*M*		*L*				*M*		*L*	
CO4			*H*		*H*	*L*						*H*		*L*	
CO5			*H*	*L*	*H*	*L*		*L*				*H*		*L*	

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

18SEPC05 – FINITE ELEMENT ANALYSIS

Category: PC

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To impart knowledge on the concepts of Finite Element Method and to analyse various finite elements using different techniques.

UNIT I - INTRODUCTION (9)

Engineering Problems – Numerical Methods – Brief History of the Finite Element Method– Basics steps in the Finite Element Method –Minimum Total Potential Energy Formulations - Weighted Residual Formulations - Direct method – Element stiffness matrix – Global stiffness matrix – Boundary conditions- Problems on bars, simple beams, Trusses and frames.

UNIT II - ELEMENT PROPERTIES (9)

Discretization – Displacement model – Element properties – convergence and compatibility requirements – Node Numbering procedure – Natural coordinate system - Generalized Coordinates – Shape function – Lagrange elements –stiffness matrix – Nodal load vector - elements in plane stress and plane strain– Static condensation – Simple problems only

UNIT III - ISOPARAMETRIC ELEMENTS (9)

Basic principles of Shape Functions - Mapping – Uniqueness of mapping - Sub – Iso – Super parametric elements – Numerical integration using Gaussian Quadrature - Examples in one dimension and two dimension

UNIT IV - AXISYMMETRIC STRESS ANALYSIS (9)

Analysis of solids of revolution under axisymmetric loading – Formulation of axisymmetric solid element – Simple examples

UNIT V - NONLINEAR ANALYSIS (9)

Types of nonlinearities – Geometric nonlinearity – Material nonlinearity – Introduction to nonlinear solution techniques – Newton Raphson and Modified Newton Raphson methods

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

REFERENCE BOOKS:

1. *Krishnamurthy C.S, **"Finite Element Analysis"** – Theory and programming, Second edition, Tata McGraw Hill Publishing Co. 2004*
2. *Desai C.S., **"Elementary Finite Element Method",** Prentice Hall, INC 1979*

3. *Rajasekaran S ., **"Finite Element Analysis in Engineering Design",** Wheeler publishing,2008*
4. *Chandrapatla Tirupathi.R and Belegundu, Ashok. D., **"Introduction to Finite Elements in Engineering",** Second edition, Prentice Hall of India, 2014*
5. *S.S.Rao, "**The Finite Element Method in Engineering",** Buttersworth - Heinemann publishing, 2000.*

COURSE OUTCOME:

The students are able to,

CO 1: Familiarize the basic concepts of FEM and analyse bars, beams, trusses and frames using direct element method.

CO 2: Apply the knowledge on element properties to solve various problems.

CO 3: Find solutions for problems involving isoparametric elements.

CO 4: Analyse solid elements using axisymmetric stress analysis.

CO 5: Identify the different types of non linearities and apply non linear solution techniques.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*			*H*		*L*						*H*			*L*
CO2	*H*			*H*	*M*	*L*						*H*			*L*
CO3	*H*	*M*		*H*	*M*	*L*						*H*			
CO4	*H*	*M*		*H*	*M*	*L*						*M*			
CO5	*H*	*M*		*H*	*H*	*L*						*H*			

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

18SEPC06 - STRUCTURAL DYNAMICS

Category: PC

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVE:

- To impart knowledge on analysis of SDOF and MDOF systems subjected to dynamic loading by various techniques.

UNIT I - SINGLE DEGREE OF FREEDOM SYSTEMS (9)

Formulation of equation of motion, Free and forced vibrations, Response to dynamic loading, Effect of damping.

UNIT II - MULTI DEGREE OF FREEDOM SYSTEMS (9)

Free and forced vibration of undamped and damped MDOF systems. Equation of motions, Evaluation of natural frequencies and mode shapes, Approximate methods, Mode superposition method.

UNIT III - CONTINUOUS SYSTEMS (9)

Dynamics of distributed parameter systems, Free and forced vibration of flexural beams, shear beams and columns.

UNIT IV - TRANSIENT AND DYNAMIC RESPONSE OF STRUCTURES (9)

Idealisation of structures to mathematical models, Mode superposition method, Numerical integration procedures

UNIT V – NUMERICAL METHODS IN STRUCTURAL DYNAMICS (9)

Evaluation of Structural property matrices - Introduction of modal analysis – Matrix method – Iteration method - Eigen Vector normalizations, Modal Coordinates - Rayleigh Method – Holzer Method – Dunkerleys method – Stodola method.

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

REFERENCE BOOKS:

1. *Clough R.W, and Penzien J, **"Dynamics of Structures"**, Second Edition, McGraw- Hill International Edition, 2003*
2. *Mario Paz, **"Structural Dynamics – Theory and Computations",** Third Edition, CBS publishers, 2012.*
3. *Craig.R.R, and Andrew J. Kurdila, "**Fundamentals of Structural Dynamics",** John Wiley & Sons, 2006*
4. *Manickaselvam,V.K., "**Elementary Structural Dynamics",** Dhanpat Rai & Sons, 2001*
5. *Madhujit Mukhopadhyay, "**Structural Dynamics: Vibrations & Systems"**, Ane Books Pvt. Ltd, 2010.*
6. *James C. Anderson, Farzad Naeim, **"Basic Structural Dynamics",** John Wiley & Sons, 2012*

COURSE OUTCOME:

The students are able to,

CO 1: Evaluate the response of SDOF and MDOF systems under dynamic loading.

CO 2: Analyze the continuous systems subjected to periodic and impulsive loading.

CO 3: Familiarize with the various vibration processes and response of structures.

CO 4: Analyze the multi degree of freedoms under dynamic loading.

CO 5: Familiarize with the numerical methods in structural dynamics.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*M*	*M*		*M*				*L*			*M*			*L*
CO2	*H*	*M*	*M*		*M*				*L*			*M*			*L*
CO3	*H*	*M*	*M*		*H*				*L*			*M*			*L*
CO4	*H*	*M*	*M*		*M*				*L*			*M*			*L*
CO5	*H*	*M*	*M*		*M*				*L*			*M*			*L*

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

18SEPC07 - ADVANCED STEEL STRUCTURES

Category: PC

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

COURSE OBJECTIVE:

- To impart knowledge on design of connections, industrial structures, light gauge sections and industrial building.

UNIT I - REVIEW OF DESIGN PHILOSOPHIES (9)

Philosophies of Limits State Design, WSD and LRFD Concepts of Plastic design – Local Buckling of thin plate elements – Section Classification – Limit State Design – Comparison of BIS and other International codes – Behaviour and Limit state design of beam columns.

UNIT II - BEHAVIOUR AND DESIGN OF CONNECTIONS (9)

Connection behaviour - Bolted and welded connections-unstiffened and stiffened seat connections –framed connections- Connections for force and moment transmission-tee stub and End plate connections- Column stiffeners and other reinforcement-principles of semi rigid connections

UNIT III - ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS (9)

Review of loads on structures-Dead, Live, wind and Seismic loads as per National standards-Analysis and Design of Industrial buildings and bents-Sway and non-sway frames- Design of Purlins - Analysis and Design of Gable frames.

UNIT IV - ANALYSIS AND DESIGN OF COLD-FORMED STEEL STRUCTURES (9)

Types of cross sections-concepts of local buckling, and Effective width-Design of compression and tension members- concepts of lateral buckling –Design of Beams, deflections of beams and design of beam webs- Combined stresses and connections-Empirical design of Z-purlins with lips and wall studs.

UNIT V - SPECIAL REQUIREMENTS OF DESIGN AND CONSTRUCTION (9)

Fire resisting properties of steel – Principles of Fire-resistant Design - Fatigue failures of steel structures – Principle of Fatigue-resistant Design As per IS code- Seismic Behaviour and advantages of steel – Principles of Earthquake resistant design of Steel Structures.

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

REFERENCE BOOKS:

1. *Horne. M.R. and Morris, L.J.,* ***"Plastic Design of Low-rise frames",*** *Granada Publishing Ltd., 1981.*
2. *Salmon. C.G. and Johnson.J.E.* ***"Steel Structure- Design and Behaviour",*** *Harper and Row, 1980.*

3. *Dayarathnam. P., **"Design of Steel Structure",** A.H.Wheeler, 1990.*
4. *Kuzamanovic.B.O. and Williams, N**., "Steel Design for Structural Engineers",** Prentice Hall, 1977.*
5. *Wie - Wen Yu., **"Cold-formed Steel Structures",** McGraw Hill Book Company, 1973.*
6. *William McGuire, **"Steel Structures",** Prentice Hall, Inc., Englewood Cliffs, N.J. 1986.*
7. *Subramanian.N, **"Design of Steel Structures",** Oxford University press, 2008*
8. *Shiyekar M.R, **"Limit State Design in Structural Steel",** Prentice Hall of India, 2011.*
9. *Duggal S.K, **"Limit State Design of Steel Structures",** Tata McGraw Hill, 2010.*
10. *William T. Segui **"LFRD Steel Design"** PWS Publishing.*
11. *Gregory J. Hancock, Thomas Murray, Duane S. Ellifrit**, "Cold-Formed Steel Structures to the AISI Specification",** CRC Press, 2001.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand various design philosophies as per various international codes.

CO 2: Design different types of eccentric bolted and welded connections.

CO 3: Analyse and design the components of industrial buildings.

CO 4: perform design of cold formed steel structures.

CO 5: Design of steel structures for fire, fatigue and understand the principles of earthquake resistant design.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*		*M*	*L*			*M*					*M*			*L*
CO2	*M*	*H*	*M*	*M*	*M*					*M*			*H*	*M*	*M*
CO3	*M*	*H*	*M*	*M*	*M*								*H*	*M*	*M*
CO4	*M*	*H*	*M*	*M*	*M*					*M*		*M*	*H*	*M*	*M*
CO5	*M*	*H*	*M*	*M*						*M*		*H*			*M*

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

18SEPC08 – FINITE ELEMENT ANALYSIS AND APPLICATIONS LABORATORY

Category: PC

L	T	P	C
0	0	3	1.5

PREREQUISITES: Nil

COURSE OBJECTIVE:

- To provide students with an introduction to Finite Element Analysis and to help the students use this method and commercial software package to solve problems in mechanics of materials and structural engineering.

1. Finite element analysis of simple beams
2. Finite element analysis of trusses
3. Finite element analysis of frames
4. Finite element analysis of element subjected to combined axial load and bending.
5. Finite element analysis of complex elements.

Finite element analysis of above problems using commercially available finite element analysis software packages.

COURSE OUTCOMES:

The students are able to

CO 1: Perform finite element formulations for simple engineering problems.
CO 2: Develop the various structural models using commercially available software.
CO 3: Use commercial finite element software for analyzing the structural elements.
CO 4: Use finite element method to solve engineering problems.
CO 5: Develop and validate the numerical model of structural elements.

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

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PSO1*	*PSO2*	*PSO3*	*PSO4*
CO1		*H*		*L*	*H*	*L*						*H*	*M*		
CO2		*H*			*H*			*L*				*M*			
CO3		*H*		*L*	*H*	*M*		*L*				*M*	*M*		
CO4		*H*			*H*	*L*						*H*			
CO5		*H*		*L*	*H*	*L*		*L*				*H*	*M*		

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

18SEEE01 - DESIGN PROJECT

Category: EEC

L	T	P	C
0	0	4	2

COURSE OBJECTIVE:

- To develop knowledge on design and detailing of structures.

COURSE CONTENT:

- Design Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the design problem based on the recent trends and analyse the structural system using various techniques.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted, analysis, design and detailing of the entire structural system.

Continuous assessment of Design Project will be monitored by the departmental committee.

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

COURSE OUTCOMES:

The students are able to

CO 1: Identify structural engineering problems based on the current scenario.
CO 2: Familiarize with the various loads and load combinations as per IS codes.
CO 3: Apply different techniques to analyze complex structural systems.
CO 4: Acquire hands on experience in the analysis and design of entire structure.
CO 5: Prepare the structural drawings for concrete/steel structures.

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PSO1*	*PSO2*	*PSO3*	*PSO4*
CO1		*H*		*M*	*M*			*M*	*H*	*M*	*M*		*H*	*M*	
CO2		*H*		*M*	*M*			*M*	*H*	*M*	*M*		*H*	*M*	
CO3		*H*		*M*	*M*			*M*	*H*	*M*	*M*		*H*	*M*	
CO4		*H*		*M*	*M*			*M*	*H*	*M*	*M*		*H*	*M*	
CO5		*H*		*M*	*M*			*H*	*H*	*M*	*M*		*H*	*M*	

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

18SEEE02 - PROJECT PHASE I

Category: EEC

L	T	P	C
0	**0**	**20**	**10**

COURSE OBJECTIVE:

- To carry out the independent research work on the chosen topic and submit a thesis for evaluation.

COURSE CONTENT:

The project work is defined based on the interest of the students to specialize in a particular Structural Engineering area. Students are expected to carry out independent research work on the chosen topic and submit a thesis for evaluation.

The work at this stage may involve extensive review of literature in the chosen area of interest. Based on the literature review, the project may be carried out by numerical simulation using software packages and/or experimental work.

The students will give three periodical review seminars.

After completion of the thesis work, the student shall prepare and submit a report. The work will be evaluated by the panel of examiners.

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

COURSE OUTCOME:

The students are able to
CO 1 Collect the literatures relevant to their area of research.
CO 2: Identify the research problems based on current scenario.
CO 3: Perform analytical investigation.
CO 4: Conduct experimental work.
CO 5: Interpret the results and prepare the report.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1				*M*								*M*			
CO2				*M*	*M*		*M*			*M*		*M*			
CO3	*L*	*M*	*M*	*M*	*M*							*H*	*M*		
CO4	*L*	*M*	*M*	*M*	*H*						*M*	*H*	*M*		
CO5	*L*	*M*	*M*	*H*	*M*			*H*			*H*	*H*			

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

18SEEE03 - PROJECT PHASE II

Category: EEC

L	T	P	C
0	0	32	16

COURSE OBJECTIVE:

To develop the skills to formulate the methodology for the chosen topic, carry out the extensive research work and submit a thesis for evaluation.

COURSE CONTENT:

Students are expected to carry out research work on the chosen topic and submit a thesis for evaluation. The work at this stage may involve review of literature, extensive experimental work and/or Numerical simulation using software packages, development of analytical model, case study, field data collection and analysis etc. The students will give a periodical review seminar on each stage.

Student shall prepare a report on the project work outlining a review of literature published in the relevant area, need, objective and scope of work, methodology, and discusses about the results and come out with appropriate conclusions.

After completion of the thesis, the student shall prepare and publish a paper related to the thesis work in a Journal/Conference. The student shall have to appear for a Viva-voce examination for the thesis.

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

COURSE OUTCOME:

The students are able to

CO 1: Collect the literatures relevant to their area of research.
CO 2: Identify the research problems based on current scenario.
CO 3: Perform analytical investigation.
CO 4: Critically assess and propose solutions to Structural Engineering problems.
CO 5: Demonstrate the research findings and present the solutions of the thesis work.

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PSO1*	*PSO2*	*PSO3*	*PSO4*
CO1				*M*								*M*			
CO2				*M*	*M*		*M*			*M*		*M*			
CO3	*L*	*M*	*M*	*M*	*M*							*H*	*M*		
CO4	*L*	*M*	*M*	*M*	*H*						*M*	*H*	*M*		
CO5	*L*	*M*	*M*	*H*	*M*			*H*			*H*	*H*			

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

18SEPE01 - ANALYTICAL AND NUMERICAL METHODS
(Common with ME Geotechnical Engineering)

Category: PE

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

COURSE OBJECTIVE:

- 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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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:

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

CO5: Understanding 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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
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

18SEPE02 – STRUCTURAL OPTIMIZATION

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVE:

- To impart knowledge on cost effective designs, conventional and non-conventional optimization techniques for engineering applications

UNIT I -OPTIMIZATION FUNDAMENTALS (9)

Optimization methods - Introduction, Problem formulation, Introduction to mathematical principles in optimization - Mathematical models - Activity – Design methodology- Civil engineering case study- Unconstrained functions – single variable- several variable- equality constraints – inequality constraints- optimization- design space- Feasible and Infeasible- Convex and concave – Active constraints- Local and Global optima – differential Calculus- Optimality criteria- Lagrange multiplier method- Kuhn- tucker Criteria.

UNIT II - LINEAR PROGRAMMING (9)

Linear Programming – Formulation of problems- graphical solution- plastic design of frames- analytical methods- Simplex method – Basic ideas and steps- Duality sensitivity analysis – simple LP problems – Transportation Problem – Assignment Method.

UNIT III - NON-LINEAR PROGRAMMING (9)

Introduction to non-linear problems - One dimensional minimization methods – unimodal function - Exhaustive and unrestricted search – Dichotomous search – Fibonacci method- Golden section method - Interpolation methods.

Unconstrained multivariable function - univariate method- Cauchy's steepest descent method- conjugate gradient method (Fletcher Reeves) – Variable metric methods (Davison-Fletcher-Powell) - Direct and indirect methods- cutting plane method- Methods of feasible direction- Interior Penality function – External Penalty function method.

UNIT IV - GEOMETRIC PROGRAMMING AND DYNAMIC PROGRAMMING (9)

Geometric Programming- Polynomial – Degree of difficulty- Reducing G.P.P. to a set of simultaneous equations – Concepts of solving problems with zero difficulty and one degree of difficulty. Dynamic Programming - Bellman's principle of optimality –Representation of a multi stage decision problem - Concept of sub - optimisation problems – Truss optimization.

UNIT V - NON-TRADITIONAL METHODS (concepts only) **(9)**

Genetic Algorithm – Terminology – Natural Law of Evolutions – Genetic operators – steps for solution of problems. Simulated Annealing – Algorithm – Boltzman's equation. ANT Colony optimization – Algorithm – pheromone Trail – Travelling salesman problem. Introduction to TABU search – sample problem. Artificial Neural Network - Basic concepts – Biological systems – Artificial neural network – application characteristics – overview of learning methods.

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

REFERENCE BOOKS:

1. *Rao. S.S., " **Optimisation Theory and Applications"** , New Age International Private Limited Publisher, New Delhi , 2009*
2. *Belegundu, A.D.and Chandrapatla,T.R., **"Optimisation Concepts and Applications in Engineering",** Pearson Education, 2011.*
3. *K.Deb, **"Optimisation for Engineering Design : Algorithms and examples",** Prentice Hall, New Delhi, 2012.*
4. *J.S.Arora, **"Introduction to Optimum Design",** McGraw –Hill Book Company , 2011.*
5. *Taha, H.A., **" Operations Research – An Introduction ",** Prentice Hall of India,2008.*
6. *Spunt.L., **" Optimum Structural Design" ,** Prentice Hall, New Jersey, 1971.*
7. *Goldberg.D.E., **"Genetic Algorithms in Search, Optimisation and Machine Learning",** Addison & Wesley , 1999*
8. *Dorigo.M and Stutzle.T., **" Ant Colony Optimisation",** Prentice Hall of India, 2004.*
9. *Kirsch.U, **" Structural Optimisation :Fundamentals and Applications",** Springer-Verlog,2012.*
10. *David Corns, Marco Dorigo and Fred Gloves, **"New Ideas in Optimization",** the McGraw Hill Company, London, 1999.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the fundamentals of various optimization techniques.

CO 2: Formulate and solve linear programming problems.

CO 3: Familiarize the various methods for solution of Non linear programming problems.

CO 4: Use the various solution techniques for Geometric and Dynamic Programming problems.

CO 3: Understand the concepts of non traditional methods.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*M*	*L*	*L*	*L*	-	-	-	*M*	*L*	*M*	*L*	*L*	-	*L*
CO2	*L*	*H*	*H*	*M*	*M*	-	-	-	-	*M*	*L*	*L*	*M*	-	-
CO3	*M*	*H*	*L*	*H*	*M*	-	-	-	-	*H*	*H*	*L*	*M*	-	-
CO4	*L*	*M*	*H*	*L*	*M*	-	-	-	-	*M*	*L*	*L*	*M*	-	-
CO5	*H*	*M*	*M*	*H*	*L*	-	-	-	-	*M*	*L*	*H*	*M*	-	-

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

18SEPE03 - ANALYSIS OF LAMINATED COMPOSITE PLATES

Category: PE

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

COURSE OBJECTIVE:

- To develop knowledge on identification of research problem based on the literature review and propose methodology.

UNIT I – INTRODUCTION **(9)**

Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT.

UNIT II - GOVERNING EQUATIONS **(9)**

Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates using FSDT.

UNIT III – CLASSICAL LAMINATED PLATE THEORY **(9)**

Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT. Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses.

UNIT IV - FIRST ORDER SHEAR DEFORMATION THEORY **(9)**

Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C0 Element Formulation, Post Computation of Stresses.

UNIT V – ANALYTICAL METHODS **(9)**

Analysis of Rectangular Composite Plates using Analytical Methods.

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

REFERENCE BOOKS:

1. *J.N. Reddy, **"Mechanics of Laminated Composite Plates: Theory and Analysis",** CRC-Press, 1996.*
2. *G.J. Turvey, **"Buckling and Post buckling of Composite Plates",** I.H. Marshall Springer Science & Business Media, 1994.*
3. *Jianqiao Y, **" Laminated Composite Plates and Shells",** Springer-Verlag,London, 2003.*
4. *Yi-Ming Fu, **"Nonlinear Analyses of Laminated Plates and Shells with Damage",** WIT Press, 2013.*
5. *O.O. Ochoa, J.N. Reddy, **"Finite Element Analysis of Composite Laminates",** Springer Science & Business Media, 2013.*

- ***Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.***

COURSE OUTCOMES:

The students are able to

CO 1: Understand the various theories behind the analysis of laminated composite plates.

CO 2: Develop the governing equations for laminated composite plates.

CO 3: Apply the Classical Laminated Plate Theory on laminated plates using FEM.

CO 4: Execute the FEM analysis of laminated plates using First Order Shear Deformation Theory

CO 5: Analyse the rectangular laminated composite plate using the analytical method.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*		*M*	*M*	*H*	*L*	*M*			-	*H*	*M*		-	*L*
CO2	*H*	*H*				*M*	*M*			-	*L*	*M*		-	*L*
CO3	*H*	*H*	*H*			*L*				-	*M*	*M*		-	*L*
CO4	*M*	*M*		*M*	*M*	*M*	*M*			-	*M*	*M*		-	*L*
CO5	*M*		*M*	*M*	*M*	-	*M*			-	*H*	*M*		-	*L*

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

18SEPE04 – SOIL STRUCTURE INTERACTION

[Common with ME Geotechnical 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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*			*H*	*H*							*M*			*L*
CO2	*H*				*H*							*M*	*L*		*L*
CO3	*H*		*H*	*M*		*M*						*L*			*L*
CO4	*L*				*M*		*H*		*H*			*M*			*L*
CO5	*L*				*M*		*H*		*H*			*L*			*M*

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

18SEPE05 – ENVIRONMENTAL ENGINEERING STRUCTURES

[Common with ME Geotechnical Engineering & Environmental Engineering]

Category: PE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

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

UNIT I - DESIGN OF PIPES (9)

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 (9)

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 (9)

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 (9)

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 (9)

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 Krishna Raju, 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: To 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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*		*H*			*M*						*M*			*L*
CO2	*H*		*H*		*M*							*M*	*L*		*L*
CO3			*H*		*H*				*H*		*H*	*L*			*L*
CO4	*H*		*H*			*M*						*M*			*L*
CO5	*H*		*H*			*M*						*L*			*M*

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

18SEPE06 – STABILITY OF STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To impart Knowledge on the concepts of stability and phenomenon of buckling and its effects on structural components

UNIT I - CONCEPT OF STABILITY (9)

Concept of stability approaches to stability analysis, characteristics. Columns Buckling of columns with various end conditions, imperfect columns, non prismatic columns.

UNIT II - APPLICATION OF STABILITY (9)

Inelastic buckling, Empirical column formulae, Buckling of bars on elastic foundations. Approximate Methods- Energy methods, Iterative procedures, Finite Difference methods and Matrix methods.

UNIT III - BEAM-COLUMNS (9)

Beam-Column subjected to concentrated lateral loads, distributed lateral loads – Effect of Axial Load on Bending Stiffness - Failure of beam columns- Buckling of frames – Modes of buckling – Calculation of critical loading in frames – Stability of a frame.

UNIT IV - TORSIONAL BUCKLING (9)

Torsional Load-Deformation characteristics of Structural members – Strain energy of Torsion – Combined torsional and flexural buckling - Lateral buckling of beams – Pure bending of simply supported beam and cantilever beam – Design simplifications for lateral buckling.

UNIT V - BUCKLING OF PLATES (9)

Buckling of thin plates with various edge conditions – Strain energy of bending in a plate – Calculation of critical load of plates – Inelastic buckling – Post buckling behavior of axially compressed plates – Ultimate strength of axially compressed plates.

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

REFERENCE BOOKS:

1. *Chajes. A,* ***"Principles of Structural Stability Theory",*** *Prentice Hall, 1974.*
2. *Ashwini Kumar,* ***"Stability Theory of Structures",*** *Tata McGraw Hill Publishing Company Ltd, N.Delhi, 1998.*
3. *Iyengar NGR,* ***"Elastic Stability of Structural Elements",*** *Macmillan, 2007.*
4. *Allen H.G and Bulson.P.S,* ***"Background to buckling"****, McGraw Hill Publishing Company Ltd, 1980.*
5. *Smites,* ***"Elastic Stability of Structures"****, Prentice Hall, 1974.*
6. *Timoshenko.S, and Gere,* ***"Theory of Elastic Stability",*** *McGraw Hill Publishing Company Ltd, 2012.*
7. *Brush and Almorth****, "Buckling of Bars, Plates and Shells",*** *McGraw Hill Publishing Company Ltd, 1975.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand basic concepts of structural stability, various approaches to

CO 2: Execute and workout the inelastic buckling using various methodologies

CO 3: Understand the application of various methods, concepts and examine the buckling behaviour of beam columns and frames.

CO 4: Examine the lateral buckling, torsional buckling and flexural torsional buckling of various beams

CO 5: develop stability analysis of various structural members and methods of analysis of buckling of thin plates.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*		*L*	*L*	*L*			*L*	*L*	*L*	*L*		*L*	*L*	
CO2	*L*	*M*	*M*	*M*	*M*			*L*	*L*	*M*	*M*		*M*	*M*	
CO3	*M*	*H*	*H*	*H*	*M*			*M*	*M*	*H*	*H*	*H*	*M*	*M*	*L*
CO4	*M*	*H*	*H*	*H*	*M*			*M*	*M*	*H*	*H*	*H*	*M*	*M*	*L*
CO5	*M*	*H*	*H*	*H*	*H*			*H*	*H*	*H*	*H*	*H*	*M*	*M*	*M*

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

18SEPE07 - THEORY AND APPLICATIONS OF CEMENT COMPOSITES

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on cement composite materials, behaviour and its applications.

UNIT I - INTRODUCTION (9)

Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.

UNIT II - MECHANICAL BEHAVIOUR (9)

Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.

UNIT III - CEMENT COMPOSITES (9)

Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

UNIT IV – MECHANICAL PROPERTIES OF CEMENT COMPOSITES (9)

Behaviour of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

UNIT V - APPLICATION OF CEMENT COMPOSITES: (9)

FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.

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

REFERENCE BOOKS:

1. *Barzin Mobasher , "**Mechanics of Fiber and Textile Reinforced Cement Composites",** CRC Press, 2011.*
2. *Andrzej M. Brandt, **"Cement-Based Composites: Materials, Mechanical Properties and Performance",** Second Edition, CRC Press, 2005.*
3. *Gustavo J. Parra-Montesinos, Hans W. Reinhardt , **"High Performance Fiber Reinforced Cement Composites 6 : HPFRCC 6Volume 2 of RILEM Bookseries",** Springer Science & Business Media, 2012.*

4. *Arnon Bentur, Sidney Mindess,* ***"Fibre Reinforced Cementitious Composites",*** *CRC Press, 2014.*
5. *Chris L. Page, M M Page, "****Durability of Concrete and Cement Composites",*** *Elsevier, 2007.*

COURSE OUTCOMES:

The students are able to

CO 1: Formulate constitutive behaviour of composite materials by understanding their strain-stress behaviour.

CO 2: Estimate strain constants using theories applicable to composite materials.

CO 3: understand the construction techniques of various cement composites.

CO 4: Familiarize the mechanical properties of cement composites.

CO 5: Classify and identify the appropriate composite material based on its behaviour and properties.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*		*L*	*L*	*L*			*L*	*L*	*L*					
CO2	*L*							*L*	*L*	*L*					
CO3	*L*	*L*	*L*	*L*	*L*			*L*	*L*	*L*	*L*	*M*	*L*	*L*	
CO4	*L*		*L*	*L*	*L*										
CO5	*L*	*M*	*M*	*L*	*L*			*L*	*L*	*L*		*L*	*L*	*L*	

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

18SEPE08 - ADVANCED CONCRETE TECHNOLOGY

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on the advancements in the field of Concrete Technology and sustainable construction.

UNIT I - INTRODUCTION **(9)**

Concrete - Understanding the quassi-brittle nature of concrete - Failure of concrete under low stress - Micro— cracking, crack propagation - stress concentration at openings –Destructive, semi-destructive & Non-destructive testing methodology - Rebound hammer test - Ultrasonic Pulse Velocity (UPV) Test - Penetration resistance test - Pull-out Test - Pull-off Method - Break-off test - Cover Measurement - Core Sampling and Testing - Half-cell electrical potential method - Resistivity Mapping Problems faced during Non-destructive evaluation - Microscopic Analysis – XRD, SEM, TEM Analysis.

UNIT II - ADMIXTURES AND POLYMERS **(9)**

Chemical Admixtures- Mechanism of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh Cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, and new generation super plasticiser.

Mineral Admixture-Fly ash, Silica fume, GGBS, and their effect on concrete property in fresh state and hardened state.

Polymers in Civil Engineering-Structural Plastics And Composites- Polymer Membranes Coatings.

UNIT III - DURABILITY PROPERTIES **(9)**

Permeability – chemical attack – Sulphate attack – Carbonation - Quality of water – marine conditions – Thermal properties of concrete – fire resistance – methods of making durable concrete

UNIT IV - SPECIAL CONCRETE **(9)**

Light weight concrete, Fiber and Hybrid Fiber reinforced concrete, Polymer Concrete, Super plasticized concrete, Epoxy resins and screeds for rehabilitation Fly ash and High volume flyash concrete, -High performance concrete - Self compacting concrete - Self curing concrete – Recycled aggregate concrete - Bacterial concrete – Nanoconcrete

UNIT V - SUSTAINABILITY **(9)**

Introduction - Need for sustainability - Concept of sustainability - social, environmental and economic sustainability concepts. Sustainable development - Engineering for sustainable development - Threats for sustainability - Low Impact development techniques-Green materials -Material selection for sustainable design

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

REFERENCE BOOKS:

1. *Neville, A.M., **"Properties of Concrete",** Pitman Publishing Limited, London, 2012.*
2. *Shetty M.S., **"Concrete Technology",** S.Chand and Company Ltd. Delhi, 2013.*
3. *Gambhir.M.L., **"Concrete Technology",** Tata McGraw Hill, Publishing Co. Ltd New Delhi, 2013.*
4. *Santhakumar .A.R., **" Concrete Technology",** Oxford University Press, NewDelhi.*
5. *Metha P.K. and Montreio P.J.M., **"Concrete Structure Properties and Materials",** 2nd edition, Prentice Hall .*
6. *A. M. Neville & J. J. Brooks, **"Concrete Technology",** 4th Impression, Pearsons Education Ltd, 2009.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the overview of concrete behaviour and various NDT Test methods.

CO 2: Familiarize about the various admixtures and polymers.

CO 3: Understand the Durability Properties of concrete.

CO 4: Familiarize about the various types of special concrete.

CO 5: Understand the definition, need and concepts of sustainability.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*L*	*H*	*H*	*L*	*M*	*L*	-	*L*	-	-	*L*	*L*	-	*H*
CO2	*H*	*M*	*M*	*H*	*L*	*L*	*L*	-	*L*	-	-	*L*	*L*	-	*H*
CO3	*M*	*L*	*H*	*H*	*L*	*M*	*L*	-	*L*	-	-	*L*	*L*	-	*M*
CO4	*H*	*L*	*H*	*M*	*L*	*L*	*L*	-	-	-	-	*L*	-	-	*H*
CO5	*M*	*L*	*M*	*L*	*L*	*L*	*L*	-	-	-	-	*L*	-	-	*H*

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

18SEPE09 – FRACTURE MECHANICS

Category: PE

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

COURSE OBJECTIVE:

- To identify the modes of failure, types of fracture and determination of fracture parameters, the concept of elasto-plastic fracture and mechanics of concrete fracture.

UNIT I - INTRODUCTION **(9)**

History of fracture mechanics – Fracture mechanics approach to design – Effect of material properties on fracture – Dimensional Analysis in Fracture mechanics.

UNIT II - LINEAR ELASTIC FRACTURE MECHANICS **(9)**

Stress Concentration effect – Griffith Energy Balance – Energy release rate – R Curve – Crack Tip Plasticity

UNIT III - ELASTIC PLASTIC FRACTURE MECHANICS **(9)**

Crack Tip Opening Displacement – J Integral – Crack Growth Resistance curves - Scaling Model for Cleavage fracture

UNIT IV - FRACTURE MECHANISMS IN METALS AND NON-METALS **(9)**

Fracture Mechanisms in Metals – ductile, cleavage and intergranular fracture – Fracture Mechanisms in fiber-reinforced plastics and concrete

UNIT V - FRACTURE TOUGHNESS TESTING OF METALS AND NON-METALS **(9)**

General Considerations – KIC testing – J testing - CTOD testing – Qualitative toughness tests.

REFERENCE BOOKS:

1. *Anderson T.L,* ***"Fracture mechanics: Fundamentals and Applications",*** *CRC Press, 2005.*
2. *John.M.Barson and Stanley.TRolfe,* ***"Fracture and Fatigue control in Structures",*** *Prentice Hall, Inc, USA 1987.*
3. *David Broek,* ***"Elementary Engineering Fracture Mechanics",*** *Martinus Nijhoff Publishers, The Hague, 1982.*
4. *David Broek,* ***"The practical use of fracture mechanics",*** *Kluwer Academic Publishers, 1997.*
5. *Jean Lemative and Jean Louis Chboche,* ***"Mechanics of Solid Materials",*** *Cambridge University Press, Cambridge, 1987.*
6. *Gdoutos.E.E,* ***"Fracture Mechanics-An Introduction",*** *Kluwer Academic publishers, Dordrecht, 1993.*
7. *Knott.J.F,* ***"Fundamentals of Fracture Mechanics",*** *John Wiley & Sons, New York, 1973.*
8. *Kanninen.M.F & Popelar.C.H,* ***"Advances in Fracture Mechanics",*** *Oxford University Press, New York, 1985*
9. *Prashant Kumar,* ***"Elements of Fracture Mechanics",*** *McGraw Hill Companies, 2010.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the basics of fracture mechanics and dimensional analysis.

CO 2: Recognize the different fracture mechanisms and modes of fracture.

CO 3: Analyze the behavior of plastic materials, fracture analysis of concrete and various non-linear models.

CO 4: Predict various fracture parameters for brittle and ductile materials.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*M*	*H*	*H*	*H*	*L*	*L*	-	*M*	-	*M*	*M*	*M*	-	*M*
CO2	*M*	*L*	*M*	*H*	*M*	*M*	*H*	-	*H*	-	*H*	*H*	*H*	-	*M*
CO3	*M*	*H*	*H*	*H*	*M*	*M*	*M*	-	*M*	-	*M*	*M*	*M*	-	*L*
CO4	*M*	*M*	*H*	*H*	*H*	*L*	*H*	-	*H*	-	*M*	*M*	*L*	-	*M*

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

18SEPE10 – SUBSTRUCTURE DESIGN

Category: PE

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

COURSE OBJECTIVE:

- To discuss and evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behavior and to build the necessary theoretical background for design and construction of foundation systems.

UNIT I - INTRODUCTION **(9)**

Design of soil investigation report for design of foundation structure – Types – Selection of foundation – Basic requirement of foundation – Computation of loads – General principle of design of reinforced concrete shallow and deep foundation.

UNIT II - DESIGN OF SHALLOW FOUNDATION **(9)**

Shallow foundation – bearing capacity of footings – floating raft – Capacity of footing – Beams on Elastic foundation – Design of raft and buoyancy – Rafts and basement design .

UNIT III - DESIGN OF DEEP FOUNDATION **(9)**

Deep foundation – Load carrying capacity of different types of piles and detailing of reinforcement according to IS 2911 – Design of pile caps – Uplift capacity of piles – Lateral pile load test.

UNIT IV - FOUNDATION FOR BRIDGES AND MACHINES **(9)**

Foundation for bridges – Well and caisson foundation – Design of pier cap - Design of pier – General principles, planning and design of machine foundation.

UNIT V - TOWER FOUNDATIONS **(9)**

Introduction – Design of foundation for towers – forces on tower foundation – General design criteria – Structural design of supports for foundation excavation – Design of ground anchors.

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

REFERENCE BOOKS:

1. *Swami Saran,* ***"Analysis and Design of Substructures"****, Oxford & IBH Publishing Company Private Limited, 2009.*
2. *Bowels J. E,* ***"Foundation Analysis and Design",*** *McGraw-Hill International Book Co, 2007.*
3. *Thomlinson, M.J. and Boorman. R., "****Foundation Design and Construction",*** *ELBS Longman VI edition, 2005.*
4. *Nayak, N.V.,* ***"Foundation Design manual for Practicing Engineers",*** *Dhanpat Rai and Sons, 2009.*
5. *Winterkorn H.F., and Fang H.Y.,* ***"Foundation Engineering Hand Book",*** *Van Nostrard - Reinhold - 2004.*
6. *Braja M. Das,* ***"Principles of Foundations Engineering",*** *Thomson Asia (P) Ltd- 2009.*

COURSE OUTCOME:

The students are able to,

CO 1: Interpret subsurface information and to identify a suitable foundation system for a structure.

CO 2: Design shallow foundations for various types of structures.

CO 3: Calculate capacity of piles and Design deep foundation.

CO 4: Analyse and design foundations for bridges and machines.

CO 5: Analyse and Design foundations for tall towers.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*H*	*H*	*M*	*H*	*L*	*M*	-	*M*	-	*M*	*H*	*M*	-	*M*
CO2	*H*	*H*	*H*	*M*	*M*	*M*	*M*	-	*M*	-	*M*	*H*	*H*	-	*M*
CO3	*H*	*H*	*H*	*M*	*M*	*L*	*M*	-	*H*	-	*M*	*H*	*H*	-	*H*
CO4	*H*	*H*	*H*	*M*	*M*	*M*	*M*	-	*M*	-	*M*	*H*	*H*	-	*L*
CO5	*H*	*H*	*H*	*M*	*M*	-	*M*	-	*M*	-	*M*	*M*	*H*	-	*M*

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

18SEPE11 - DESIGN OF ADVANCED INDUSTRIAL STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To provide relevant knowledge on planning and functional requirements of structures and design of industrial building systems, material handling systems and multistorey building systems

UNIT I - PLANNING AND FUNCTIONAL REQUIREMENTS (9)

Planning of an industrial building based on the functional requirements, Lighting and ventilation - Fire safety norms - factories act, Different types of loadings.

UNIT II - INDUSTRIAL FRAMING (9)

Types of roofing Design of Roof, Portals, Pre Engineered Buildings - Design of multi storied deck slab, Steel platform, wind columns - Foundations and pedestals.

UNIT III - MATERIAL HANDLING SYSTEMS (9)

Cranes –Types-design of EOT - Manual overhead travelling cranes – Jib Cranes-Design of A-cranes, monorails. Design of conveyers, conveyer towers

UNIT IV - INDUSTRIAL STORAGE STRUCTURES (9)

Design of silos, bins and bunkers – Design of supporting system for storage hoppers and bunkers.

UNIT V - ENVIRONMENTAL CONTROL STRUCTURES (9)

Concept of Electro-static precipitators, functioning and components – wet and dry scruppers – Design of chimneys – Self supporting, Guyed and braced.

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

REFERENCE BOOKS:

1. *Bye law's of Inspector of Factories*
2. *Alexander Newman, "**Metal Building System – Design and specifications",** Second Edition, Mc Graw Hill, New Delhi-2004*
3. *Punmia B.C.,Ashok kumar Jain, **"Design of Steel Structures",**Laxmi Publictions, New Delhi-2004*
4. *Gaylord E H,Gaylord N C and Stall Meyer J E, **"Design of Steel Structures",** Third Edition,McGraw Hill Publications,1992*
5. *Arya A.S and Ajmani J.L., **"Design of Steel Structures",** NemChand Brothers,Roorkee,1987*

COURSE OUTCOMES:

The students are able to,

CO1: Acquire the knowledge about the planning and functional requirements of Industrial structures.

CO 2: Understand the current design trends of multistorey building systems and industrial structures.

CO3: Design the crane girder and gantry girder.

CO4: Design the silos, bunkers and bins along with supporting structures.

CO 5: Understand and design the environmental control structures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	-	-	*L*	*L*	*M*	*L*	*M*	*L*	-	-	*M*	-	-	*L*
CO2	*M*	*H*	*M*	*L*	*L*	-	*L*	-	-	-	-	*M*	*L*	-	*L*
CO3	*H*	-	-	*H*	*L*	*M*	*M*	*M*	*M*	*L*	-	*L*	-	-	*L*
CO4	*M*	*H*	*M*	*L*	*L*	*M*	*L*	*L*	*L*	-	-	*M*	-	-	*L*
CO5	*H*	-	-	*H*	*L*	*H*	*M*	*L*	*M*	*L*	-	*L*	-	-	*M*

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

18SEPE12 – DESIGN OF CONCRETE BRIDGES

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on design of different types of reinforced concrete bridges, steel bridges and pre stressed concrete bridges along with the sub structures and foundation.

UNIT I - INTRODUCTION (9)

Classification, investigations and planning, choice of type, I.R.C. Specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

UNIT II - SHORT SPAN BRIDGES (9)

Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges.- Design Problems

UNIT III - LONG SPAN GIRDER BRIDGES (9)

Design principles of continuous bridges, box girder bridges, bow string girder bridges, balanced cantilever bridges

UNIT IV - DESIGN OF PRESTRESSED CONCRETE BRIDGES (9)

Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections

UNIT V - BEARINGS, CONSTRUCTION AND MAINTENANCE OF BRIDGES (9)

Bearings – Steel rocker and roller bearings – Reinforced concrete rocker and roller bearings – Elastomeric bearings - Expansions joints-Design of abutments and piers – Bridge Construction and Maintenance. Types of bridge foundations – Design of foundations

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

REFERENCE BOOKS:

1. *Raina V.K. "**Concrete Bridge Practice**" , Tata McGraw Hill Publishing Company, New Delhi, 2010.*
2. *Jagadeesh T.R and Jayaram M.A, **"Design Of Bridge Structures",** PHI Learning Private Limited, 2009*
3. *Krishnaraju, N., "**Design of Bridges** " Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 2010.*
4. *Bakht, B. and Jaegar, L.G., "**Bridge Analysis simplified**", McGraw Hill, 1985.*
5. *Ponnuswamy, S**., "Bridge Engineering",** Tata McGraw Hill, 2008*
6. *Derrick Beckett, "**An introduction to Structural Design of Concrete Bridges",** Surrey University Press, Henley Thomes, Oxford Shire, 1973.*

COURSE OUTCOME:

The students are able to,

CO 1: Acquire basic knowledge on the planning and design aspects of bridges.

CO 2: Design the short span bridges and slab culverts.

CO 3: Design the long span girder bridges and box girder bridges.

CO 4: Design the pre stressed concrete bridges.

CO 5: Design the various components of bridges.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*		*L*		*L*					*L*	*L*		*L*	*L*	*L*
CO2	*L*	*M*	*M*		*M*		*L*	*L*		*M*	*L*		*M*	*L*	*L*
CO3	*L*	*H*	*H*	*M*	*H*		*L*	*L*		*H*	*H*		*M*	*M*	*M*
CO4	*L*	*H*	*M*	*M*	*M*		*M*	*L*		*H*	*H*		*M*	*M*	*M*
CO5	*L*	*M*	*M*		*M*		*L*	*L*		*M*	*L*		*L*	*L*	*L*

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

18SEPE13 – PRESTRESSED CONCRETE STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on the basic principles of Prestressed concrete members and its design.

UNIT I - ANALYSIS OF BEAMS AND LOSSES IN PRESTRESS (9)

Principles of prestressing – Different systems of prestressing – Materials and Allowable stresses –Elastic Design of prismatic beams – Simple cable profile Design of beams for shear.

LOSSES AND DEFLECTION IN BEAMS

Losses in prestress - Deflections –Short Term and Long Term deflection.

UNIT II - DESIGN OF TENSION AND COMPRESSION MEMBERS (9)

Design of compression and tension members – Design of Compression members with bending *END BLOCK* Introduction- Stress Distribution in End Block – Anchorage Zone Stresses -Design of end block – Guyon's method, Magnel's method – I.S 1343 recommendations.

UNIT III - CONTINOUS BEAMS AND COMPOSITE CONSTRUCTION (9)

Concept of concordancy and Linear Transformation – Elastic analysis of continuous beams– Sketching of pressure lines for continuous beams and single span single storey rigid frames – Load balancing method - Design of continuous beams. Composite construction – Types and behavior – Analysis and design for flexure and shear – Differential shrinkage

UNIT IV - SPECIAL TOPICS (9)

One way slabs – Two way slabs – Circular prestressing – Prestressed concrete pipes – Analysis and design of liquid retaining tanks – Design of prestressed concrete sleepers and poles.

UNIT V - LIMIT STATE DESIGN (9)

Safety and Serviceability requirements – Partial safety factors – Limit state Design of beams in flexure and shear – Limit state Design of Compression members.

Non prestressed reinforcements – partial prestressing.

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

REFERENCE BOOKS:

1. *Lin.T.Y. and Ned.H.Burns,* ***"Design of Prestressed concrete structures"*** *(S.I Version), John wiley & Sons Inc., New York, 1982.*
2. *Sinha.N.C. and Roy.S.K.* ***"Fundamentals of prestressed Concrete",*** *S.Chand and Co., 1985.*
3. *Krishnaraju N.,* ***"Prestressed Concrete",*** *Tata McGraw Hill publishing Co.Ltd. New Delhi, 1986.*

4. *Leonhardt.F.* ***"Prestressed Concrete Design and Construction",*** *Wiley Ernst and Sons, 1964.*
5. *Mallick S.K and Gupta A.P.,* ***"Prestressed Concrete",*** *Oxford and IBH Publishing Company Pvt.Ltd. New Delhi, 1986.*
6. *Pasala Dayaratnam,* ***"Prestressed Concrete Structures"*** *(Fourth Edition), Oxford & Ibh Publishing Co.Pvt Ltd., New Delhi, 1982.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the principles of prestressing and design the PSC beam sections.

CO 2: Design the prestressed concrete tension, compression members and end block.

CO 3: Analyse the statically indeterminate structure and design the continuous beams and composite beams.

CO 4: Design the prestressed concrete pipes, sleepers, tanks, poles and slabs.

CO 5: Understand the limit state design concept of PSC beams and compression members.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*	*L*	*L*	*L*	*M*			*L*		*L*	*L*		*L*	*L*	*L*
CO2	*L*	*L*	*L*	*L*	*L*			*L*		*L*	*L*		*L*	*L*	*L*
CO3	*M*	*H*	*H*	*H*	*H*			*L*	*M*	*M*	*M*		*L*	*L*	*L*
CO4	*M*	*H*	*H*	*H*	*H*			*M*	*M*	*M*	*M*		*M*	*M*	*L*
CO5	*L*	*L*	*M*	*M*	*M*			*L*	*L*	*L*	*L*		*L*	*L*	*L*

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

18SEPE14 – PLASTIC ANALYSIS OF STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To impart the required knowledge on basic hypothesis, theorems and applications of plastic analysis.

UNIT I - BASIC HYPOTHESIS (9)

Introduction to plastic method of structural analysis – basic hypothesis - stress strain relation for mild steel – evaluation of fully plastic hinge assumption for other structural materials. Failure and Yield criteria (Von Mises and Tresca)

UNIT II - METHODS AND THEOREMS OF PLASTIC ANALYSIS (9)

Theorems of plastic analysis – Principle of virtual work – Superposition of mechanism – Method of inequalities – Moment distribution method – Replacement theorem – The shake down theorem

UNIT III - APPLICATION OF PLASTIC ANALYSIS (9)

Application of the methods to multi storey frames - Beams and frames with concentrated and distributed loads - Virendeel trusses – Gable frames and Grids.

UNIT IV - DISPLACEMENTS (9)

Importance of displacements in plastic analysis – Methods of computing displacements – Displacements in beams and frames – Displacement theorem.

UNIT V - AXIAL FORCES IN FRAMES AND ARCHES (9)

Combined axial and bending forces - Effect of axial forces in simple frames – Approximate interaction curves.

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

REFERENCE BOOKS:

1. *Neal ,B.G., **"Plastic Methods Of Structural Analysis",** Chapman & Hall Ltd & Science Paper Backs, 1965, Reprinted 1970.*
2. *Beedle, L.S . **"Plastic Design Of Steel Frame".,**1992*
3. *Hodge, **"Plastic Analysis Of Structures",**1993*
4. *Massonet ,C.E., And Save,M.A., **"Plastic Analysis And Design"**, Vol 1, Blaisdell Publishing Company,London. 1994*
5. *Baker,J.,Heyman,J., **"Plastic Design of Frames"** , Cambridge University Press.,**1992***

COURSE OUTCOME:

The students are able to,

CO 1: Understand the basic hypothesis of plastic analysis and yield criteria.

CO 2: Acquire knowledge on methods and theorems of plastic analysis.

CO 3: Analyse multistorey frames and virendeel trusses using plastic analysis.

CO 4: Evaluate the displacements in beams and frames.

CO 5: Acquire knowledge on effects of axial forces in frames and arches.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*L*	*H*	*H*	*L*	*M*	*L*	-	*L*	-	-	*L*	*L*	-	*H*
CO2	*H*	*M*	*M*	*H*	*L*	*L*	*L*	-	*L*	-	-	*L*	*L*	-	*H*
CO3	*M*	*L*	*H*	*H*	*L*	*M*	*L*	-	*L*	-	-	*L*	*L*	-	*M*
CO4	*H*	*L*	*H*	*M*	*L*	*L*	*L*	-	-	-	-	*L*	-	-	*H*
CO5	*M*	*L*	*M*	*L*	*L*	*L*	*L*	-	-	-	-	*L*	-	-	*H*

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

18SEPE15 – PLATES AND SHELLS

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on structural behaviour and analysis of different types of plates and shells under different boundary conditions.

UNIT I - LATERALLY LOADED PLATES (9)

Thin Plates with Small Defection. Laterally Loaded Thin Plates, Governing Differential Equation, Boundary Conditions. Rectangular Plates, Simply Supported Rectangular Plates, Navier Solution and Levy's Methods, Plates with Various Edge Conditions Symmetrical Bending of Circular Plates, Plates on Elastic Foundation.

UNIT II - NUMERICAL METHODS (9)

Finite Difference Method – Isotropic Rectangular plates – Boundary Conditions – All-round simply supported square plate, clamped square plate and fixed square plate subjected to uniformly distributed load.

UNIT III - ANISOTROPIC PLATES AND THICK PLATES (9)

Orthotropic Plates and Grids, Moderately Thick Plates.

UNIT IV - MEMBRANE THEORY OF SHELLS (9)

Classification of Shells - Types of Shells - Structural Action - Membrane Theory - Shells of Revolution and Shells of Translation - Examples - Limitations of Membrane Theory.

UNIT V - FOLDED PLATES (9)

Folded Plate structures - structural behavior and analysis - Types - Design by ACI - ASCE Task Committee method.

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

REFERENCE BOOKS:

1. *Szilard, R.,* ***"Theory of Analysis of Plates"*** *, Prentice Hall Inc. 2004*
2. *Timoshenko, S. and Krieger S.W.* ***"Theory of Plates and Shells"*** *, McGraw Hill Book Company,1990*
3. *Wilhelm Flügge,* ***"Stresses in shells",*** *Springer – Verlag, 1988*
4. *Ramasamy, G.S.,* ***"Design and Construction of Concrete Shells Roofs",*** *CBS Publishers,1986*

COURSE OUTCOME:

The students are able to,

CO 1: Analyse the plates subject to vertical and gravity load.
CO 2: Apply various numerical methods for analysis of plates.
CO 3: Analyse the anisotropic plates and thick plates.
CO 4: Analyse and design of shells.
CO 5: Analyse and design of folded plates.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*	*H*	*L*	*L*								*L*	*L*	*M*	
CO2	*H*	*H*	*M*	*L*	*L*							*L*		*M*	
CO3	*M*	*H*	*M*	*L*		*L*	*L*			*L*		*M*	*M*	*M*	
CO4	*M*	*H*	*M*	*M*		*M*	*L*		*L*			*M*	*M*	*M*	
CO5	*M*	*H*	*M*	*M*		*M*	*L*		*L*			*M*	*M*	*M*	

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

18SEPE16 – MAINTENANCE AND REHABILITATION OF STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To emphasize the importance of maintenance, inspection of structures and to impart fundamental knowledge on various repairing strategies

UNIT I - GENERAL **(9)**

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking and types of cracks.

INFLUENCE ON SERVICEBILITY AND DURABILITY

Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNIT II - MAINTENANCE AND REPAIR STRATEGIES **(9)**

Definitions : Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

UNIT III - MATERIALS FOR REPAIR **(9)**

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fiber reinforced concrete.

UNIT IV - TECHNIQUES FOR REPAIR **(9)**

Rust eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete - Epoxy injection, Mortar repair for cracks, shoring and underpinning.

UNIT V - EXAMPLES OF REPAIR TO STRUCTURES **(9)**

Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure.

DEMOLITION TECHNIQUES

Engineered demolition techniques for Dilapidated structures - case studies

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

REFERENCE BOOKS:

1. *Denison Campbell, Allen and Harold Roper,* ***"Concrete Structures, Materials, Maintenance and Repair",*** *Longman Scientific and Technical UK, 1991.*
2. *R.T.Allen and S.C.Edwards,* ***"Repair of Concrete Structures"*** *, Blakie and Sons, UK, 1992*
3. *M.S.Shetty,* ***"Concrete Technology - Theory and Practice",*** *S.Chand and Company, NewDelhi, 2005.*

4. *Santhakumar, A.R.**, "Training Course notes on Damage Assessment and repair in Low Cost Housing" ,"RHDC-NBO" Anna University, July 1992.*
5. *Raikar, R.N., Learning from failures - **"Deficiencies in Design, Construction and Service - R & D Centre(SDCPL)",** Raikar Bhavan, Bombay, 1987.*
6. *N.Palaniappan, **"Estate Management" ,** Anna Institute of Management, Chennai, 1992*
7. *Lakshmipathy, M. et. al. Lecture notes of Workshop on "**Repairs and Rehabilitation of Structures",** 29 - 30th October 1999.*

COURSE OUTCOME:

The students are able to,

CO 1: Identify the causes of distress in concrete structures by conducting various tests.

CO 2: Familiarize the maintenance and repair strategies.

CO 3: Familiarize about the materials for repair and to suggest appropriate materials for repair.

CO 4: Demonstrate the remedial measures for various structures using proper techniques.

CO 5: Acquire sufficient knowledge to use appropriate methods of demolition techniques for damaged structures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*	*L*	*L*	*L*	*L*				*L*	*M*	*M*	*M*	*M*	*M*	*M*
CO2	*M*	*M*	*M*	*M*	*M*				*M*	*M*	*M*	*M*	*M*	*M*	*M*
CO3	*M*	*H*	*H*	*M*	*M*				*M*	*M*	*M*	*H*	*H*	*H*	*M*
CO4	*M*	*H*	*H*	*M*	*M*				*M*	*L*	*L*	*M*	*M*	*M*	*L*
CO5	*H*	*H*	*H*	*M*	*M*				*M*	*M*	*M*	*M*	*M*	*M*	*M*

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

18SEPE17 - SMART MATERIALS AND SMART STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To give an exposure on measuring techniques, sensors and actuators.

UNIT I - INTRODUCTION (9)

Properties of smart materials - mechanisms – instrumented structures functions and response sensing system – self diagnosis – signal processing consideration – actuation systems and effectors

UNIT II - MEASURING TECHNIQUES (9)

Strain measuring techniques using electrical strain gauges, types – resistance-capacitance – inductance- wheatstone bridges-pressure transducers-load cells- temperature compensation – strain rosettes

UNIT III - SENSORS AND ACTUATORS (9)

Sensing technology – types of sensors – physical measurement using piezo electric strain measurement – inductively read transducers – LVDT – fiber techniques - fiber optic strain sensors - Actuator techniques – Actuator and Actuator materials - piezo electric and electro resistive material – magneto structure material – shape memory alloys – electro ortheological fluids – electromagnetic actuation – role of actuators and actuator materials

UNIT IV - SIGNAL PROCESSING AND CONTROL SYSTEMS (9)

Data Acquisition and processing – signal processing and control for smart structures – sensors as geometrical processors – signal processing – control system – linear and non linear.

UNIT V - INTRODUCTION TO STRUCTURAL HEALTH MONITORING (SHM) (9)

Definition & motivation for SHM, SHM – a way for smart materials and structures – SHM and bio mimetic – analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and Active SHM, NDE, SHM and NDECS – basic components of SHM – Applications – SHM of a bridge – applications for external post tensioned cables, monitoring historical buildings.

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

REFERENCE BOOKS*:*

1. *Brain Culshaw,* ***"Smart structures and mateials Artech – Borton",*** *London.*
2. *L.S.Srinath,* ***"Experimental stress analysis",*** *Tata McGraw Hill, 1998.*
3. *J.W.Dally & W.F.* ***"Riley, Experimental stress analysis",*** *Tata McGraw Hill, 1998.*
4. *Daniel Balageas, Claus - Peter FritzenamI Alfredo Guemes,* ***"Structural Health Monitoring",*** *Published by ISTE Ltd., U.K. 2006.*

5. *Guide Book on Non-destructive Testing of Concrete Structures,Training course series No. 17,International Atomic Energy Agency,Vienna, 2002.*
6. *Hand book on **"Repair and Rehabilitation of RCC Buildings",** Published by Director General, CPWD, Govt. of India, 2002.*
7. *Hand Book on Seismic Retrofitting of Buildings, Published by CPWD & Indian Building Congress in Association with IIT, Madras, Narosa Publishing House, 2008.*

COURSE OUTCOME:

The students are able to,

CO 1: Gain knowledge on smart materials and structures.

CO 2: Understand the function and response sensing systems

CO 3: Understand about the working mechanism of sensors and actuators.

CO 4: Use data acquisition signal processing and control systems effectively.

CO 5: Familiarize about Structural Health Monitoring system and its application in civil field.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	-	*M*	*M*	*L*	-	-	-	*H*	*L*	*M*	*H*	-	-	*M*
CO2	*H*	-	*M*	*L*	*M*	-	-	-	*H*	*L*	*M*	*M*	-	-	*M*
CO3	*M*	-	*M*	*L*	*L*	-	-	-	*M*	*L*	*H*	*M*	-	-	*M*
CO4	*M*	-	*H*	*L*	*M*	-	-	-	*H*	*L*	*M*	*L*	-	-	*L*
CO5	*H*	-	*L*	*M*	*M*	-	-	-	*H*	*M*	*H*	*M*	*L*	*M*	*M*

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

18SEPE18 - STRUCTURAL HEALTH MONITORING

Category: PE

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

COURSE OBJECTIVE:

To acquire knowledge on structural health monitoring, Structural Audit, testing methods and rehabilitation techniques.

UNIT I - STRUCTURAL HEALTH (9)

Factors affecting Health of Structures, Causes of Distress, Regular Maintenance. Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration.

UNIT II - STRUCTURAL AUDIT (9)

Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT III - STATIC FIELD TESTING (9)

Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT IV - DYNAMIC FIELD TESTING (9)

Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT V - REPAIRS AND REHABILITATION TECHNIQUES (9)

Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

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

REFERENCE BOOKS:

1. ***"Structural Health Monitoring",*** *Daniel Balageas, ClausPeter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.*
2. ***"Health Monitoring of Structural Materials and Components Methods with Applications",*** *Douglas E Adams, John Wiley and Sons, 2007.*
3. ***"Structural Health Monitoring and Intelligent Infrastructure",*** *Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.*
4. *"**Structural Health Monitoring with Wafer Active Sensors",** Victor Giurglutiu, Academic Press Inc, 2007.*

COURSE OUTCOMES:

The students are able to

CO 1. Diagnosis the distress in the structure by understanding the causes and factors.
CO 2. Prepare the structural audit report.
CO 3: Access the health of the structure using static field testing.
CO 4: Analyse the condition of structures using dynamic field testing methods.
CO 5. Suggest repairs and rehabilitation measures of the structure

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*L*	*L*	*H*	*H*	*M*	*M*	-	*H*	*M*	*H*	*H*	*M*	-	*L*
CO2	*L*	*L*	*M*	*M*	*L*	*M*	*M*	-	*M*	-	*H*	*M*	*L*	-	*L*
CO3	*M*	*L*	*H*	*M*	*H*	*L*	*M*	-	*H*	*L*	*M*	*M*	*M*	-	*M*
CO4	*H*	*H*	*M*	*H*	*H*	*L*	*H*	-	*M*	*L*	*M*	*H*	*H*	-	*M*
CO5	*M*	*L*	*M*	*M*	*H*	*M*	*M*	-	*M*	*M*	*H*	*H*	*M*	-	*M*

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

18SEPE19 - DESIGN OF FORMWORK

Category: PE

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

COURSE OBJECTIVE:

- To provide an exposure on the significance of formwork, materials and design procedures.

UNIT I - INTRODUCTION (9)

Requirements and Selection of Formwork. Formwork Materials- Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.

UNIT II - FORMWORK DESIGN (9)

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT III - FORMWORK DESIGN FOR SPECIAL STRUCTURES (9)

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT IV - FLYING FORMWORK (9)

Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre and Post Award.

UNIT V - FORMWORK FAILURES (9)

Causes and Case studies in Formwork Failure, Formwork Issues in MultiStory Building Construction.

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

REFERENCE BOOKS:

1. *Austin, C.K., **"Formwork for Concrete",** Cleaver -Hume Press Ltd., London, 1996.*
2. *Hurd, M.K., **"Formwork for Concrete",** Special Publication No.4, American Concrete Institute, Detroit, 1996*
3. *Michael P. Hurst, Construction Press, London and New York, 2003.*
4. *Robert L. Peurifoy and Garold D. Oberlender, **"Formwork For Concrete Structures",** McGraw -Hill , 1996.*

COURSE OUTCOMES:

The students are able to

CO 1: Select proper formwork, accessories and material.

CO 2: Design the form work for conventional structural elements.

CO 3: Design the form work for Special Structures.

CO 4: Understand the working of flying formwork.

CO 5: Judge the formwork failures through case studies.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*	*L*	*M*	*M*	*H*	*L*	*M*	-	*M*	-	*H*	*M*	*L*	-	*M*
CO2	*M*	*H*	*H*	*M*	*M*	*M*	*M*	-	*M*	-	*L*	*M*	*H*	-	*M*
CO3	*H*	*H*	*H*	*M*	*M*	*L*	*M*	-	*H*	-	*M*	*H*	*H*	-	*H*
CO4	*L*	*M*	*L*	*M*	*M*	*M*	*M*	-	*M*	-	*M*	*M*	*M*	-	*L*
CO5	*L*	*L*	*M*	*M*	*M*	-	*M*	-	*M*	-	*H*	*M*	*M*	-	*M*

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

18SEPE20 – EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

Category: PE

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

COURSE OBJECTIVE:

- To learn various experimental techniques and instrumentation procedure.

UNIT I - FORCE AND STRAIN MEASUREMENT (9)

Strain Gauges, principle, types, performance and uses - Photo elasticity, principle and applications - Moiré fringes hydraulic jacks and pressure gauges - Electrical load cells- proving rings - calibration of testing machines.

UNIT II - VIBRATION MEASUREMENTS (9)

Characteristics of structural vibration - linear variable differential transformer (LVDT) - Transducers for Velocity and acceleration measurements- vibration meter - seismographs - vibration analyzer - display of recording of signals- cathode ray oscilloscope- XY plotter- chart plotters - Digital data acquisition systems.

UNIT III - ACOUSTICS AND WIND FLOW MEASURES (9)

Principles of pressure and flow measurements- pressure transducer- sound level meter - venturimeter and flow meters - Wind tunnel and its use in structural analysis- structural modeling - direct and indirect model analysis.

UNIT IV - DISTRESS MEASUREMENTS (9)

Diagnosis of distress in structures - crack observation and measurement - Corrosion of reinforcement in concrete- Half cell, construction and use- damage assessment - controlled blasting for demolition.

UNIT V - NON DESTRUCTIVE TESTING METHODS (9)

Load testing on structures, buildings, bridges and towers - Rebound hammer- Acoustic emission- Ultrasonic testing, Principles and applications - Holography - Use of laser for structural testing- Brittle coatings.

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

REFERENCE BOOKS:

1. *Sadhu Singh,* ***"Experimental stress analysis",*** *Khanna publishers, New Delhi, 1996.*
2. *Dalley and Riley,* ***"Experimental stress analysis"-*** *McGraw Hill Book Company, New York 1991*
3. *L.S.Srinath.* ***"Experimental stress Analysis",*** *Tata McGraw Hill company Book Ltd., NewDelhi. 1984*
4. *Bray and Stanley,* ***"Non Destructive Evaluation",*** *McGraw Hill Publishing co., New York,1989*

COURSE OUTCOME:

The students are able to,

CO 1: Apply concepts of measurements and related instruments in the real time application areas.

CO2: Use various vibration measuring instruments and analyze the structures using digital display units.

CO3: Gain knowledge about acoustic and flow measurements.

CO4: Diagnosis the distress in structures using various methods.

CO 5: Perform NDT methods in accessing the load testing of structures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*			*L*	*H*			*L*			*H*	*H*	*L*		
CO2	*M*		*M*	*M*	*H*							*L*	*L*		
CO3	*M*	*M*						*L*				*M*	*M*		
CO4	*M*	*H*	*H*	*H*	*H*		*L*	*L*	*M*		*H*	*H*	*M*		*L*
CO5	*L*	*H*	*H*	*H*	*H*	*M*			*M*		*H*	*M*	*M*		*L*

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

18SEPE21 – DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To impart Knowledge on design of composite beams, columns, trusses and box girder bridges including the related connections.

UNIT I - FUNDAMENTALS (9)

Introduction to steel-concrete composite construction – Design Philosophy- Advantages – Types of composite construction – Basic concepts of composite structures- Material properties under static loads and dynamic loads. Shear connection- Methods- Properties- Partial interaction- Effect of slip on stresses and deflection – Longitudinal shear in compression slabs.

UNIT II - COMPOSITE SLABS AND BEAMS (9)

Composite floor slabs - conventional composite beams - resistance to sagging bending, longitudinal shear and vertical shear – stresses in service – design examples.
Continuous composite beams -Elastic and inelastic design considerations.

UNIT III - COMPOSITE COLUMNS AND FRAMES (9)

Encased columns – concrete filled steel tubes – resistance to axial compression – resistance to combined compression and uniaxial bending. Composite column and frames- Design of beam-column joints and rigid joints - jointed composite frames – Modular co-ordination.

UNIT IV - COMPOSITE TRUSSES (9)

Composite Trusses – Behaviour and Design - Design of connections- case studies on steel concrete composite construction in buildings – seismic Behaviour.

UNIT V - SPECIAL STRUCTURES (9)

Steel sandwich construction- Box Girder Bridge- Case studies – seismic Behaviour- Different codal provisions - Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction.

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

REFERENCE BOOKS:

1. *Johnson R.P., **" Composite Structures of Steel and Concrete" ,** Blackwell Scientific Publications, UK, 1994.*
2. *Owens G.W. and Knowles P., **" Steel Designers Manual"** , Fifth Edition, Steel Concrete Institute, UK, Oxford Blackwell Scientific Publications, 1992.*
3. ***"Workshop on Steel –concrete Composite Structures",** conducted at Anna University, chennai, 2000.*
4. *IS 11384 -1985 Code of "**Practice for Steel concrete Composite structures",** Euro Code 4 BS 5950- Part 3*

COURSE OUTCOME:

The students are able to,

CO 1: Acquire sufficient knowledge on behavior of composite structures under various loads.

CO 2: Select appropriate design methods for composite structures such as slabs and beams.

CO 3: Design the Composite columns and frames.

CO 4: Design the Composite trusses including connecting elements.

CO 5: Formulate and execute the construction sequence of special composite structures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*M*	*L*	*L*	*L*	-	-	-	*L*	*L*	*L*	*L*	*L*	-	*M*
CO2	*L*	*M*	*H*	*M*	*M*	-	-	-	-	*M*	*L*	*L*	*M*	-	-
CO3	*L*	*M*	*H*	*H*	*M*	-	-	-	-	*M*	*L*	*L*	*M*	-	-
CO4	*L*	*M*	*H*	*H*	*M*	-	-	-	-	*M*	*H*	*L*	*M*	-	-
CO5	*M*	*M*	*H*	*H*	*L*	-	-	-	-	*M*	*L*	*L*	*M*	-	-

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

18SEPE22 – PREFABRICATED STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To impart Knowledge on pre fabricated elements and the technologies used in fabrication and erection.

UNIT I - INTRODUCTION AND DESIGN PRINCIPLES (9)

General Civil Engineering requirements, specific requirements for planning and I layout of prefabricates plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II - REINFORCED CONCRETE (9)

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, single storey industrial buildings with trusses and shells, Crane -gantry systems.

UNIT III - FLOORS, STAIRS, ROOFS AND WALLS (9)

Types of floor slabs, analysis and design example of cored and panel types and two -way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure. Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls.

UNIT IV - DESIGN OF INDUSTRIAL BUILDINGS (9)

Components of single -storey industrial sheds with crane gantry systems, Design of R.C. Roof Trusses, Roof Panels, Design of R.C.crane -gantry girders, corbels and columns, wind bracing design.

UNIT V - DESIGN OF SHELL ROOFS FOR INDUSTRIAL SHEDS (9)

Cylindrical, Folded plate and hyper -prefabricated shells, Erection and jointing, joint design, hand book based design.

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

REFERENCE BOOKS:

1. ***"Structural Design Manual, Precast Concrete Connection Details",*** *Society for the Studies in the use of Precase Concrete, Netherland Betor Verlag, 1978.*
2. *Lasslo Mokk,* ***"Prefabricated Concrete for Industrial and Public Sectors"*** *, Akademiai Kiado, Budapest, 1964.*
3. *Murashev.V., Sigalov.E., and Bailov.V.,* ***"Design of Reinforced Concrete Structures"*** *, Mir Publishers, 1968.*
4. *CBRI,* ***"Building Materials and Components",*** *1990, India.*

5. *Gerostiza. C.Z., Hendrikson, C., Rehat D.R.,* ***"Knowledge Based Process Planning for Construction and Manufacturing",*** *Academic Press, Inc., 1989.*
6. *Warszawski, A.,* ***"Industrialization and Robotics in Building - A managerial approach",*** *Harper & Row, 1990.*

COURSE OUTCOME:

The students are able to,

CO 1: Gain knowledge on the basics of prefabricated structure design principles.

CO 2: familiarize with the construction of Single storey industrial buildings with trusses and shells.

CO 3: Analyze the behavior of various prefabricated structural members, floors, stairs, roofs and walls.

CO 4: Design the prefabricated industrial buildings and its components.

CO 5: Design the prefabricated shell roof and its installation.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*L*		*M*			*L*				*L*	*M*			
CO2	*M*	*L*		*M*					*M*		*L*	*M*			
CO3	*L*	*M*	*M*			*L*	*L*					*L*	*M*		
CO4	*M*	*M*	*H*		*M*	*M*	*L*		*L*			*L*	*M*	*L*	
CO5	*M*	*M*	*H*		*H*	*M*	*L*		*L*			*M*	*M*	*L*	

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

18SEPE23 – OFFSHORE STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on forces due to ocean waves and to design off shore structures.

UNIT I - WAVE THEORIES **(9)**

Wave generation process, small and finite amplitude wave theories.

UNIT II - FORCES OF OFFSHORE STRUCTURES **(9)**

Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

UNIT III - OFFSHORE SOIL AND STRUCTURE MODELING **(9)**

Different types of offshore structures, foundation modeling, structural modeling.

UNIT IV - ANALYSIS OF OFFSHORE STRUCTURES **(9)**

Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT V - DESIGN OF OFFSHORE STRUCTURES **(9)**

Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

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

REFERENCE BOOKS:

1. *Chakrabarti, S.K.* ***"Hydrodynamics of Offshore Structures",*** *Computational Mechanics Publications, 1987.*
2. *Thomas H. Dawson,* ***"Offshore Structural Engineering",*** *Prentice Hall Inc Englewood Cliffs, N.J. 1983*
3. *API, Recommended Practice for Planning,* ***"Designing and Constructing Fixed Offshore Plat- forms"****, American Petroleum Institute Publication, RP2A, Dalls, Tex.*
4. *Wiegel, R.L.,* ***"Oceanographical Engineering, Prentice Hall Inc, Englewood Cliffs****", N.J. 1964.*
5. *Brebia, C.A.Walker, S.,* ***"Dynamic Analysis of Offshore Structures"*** *, New-nes Butterworths, U.K. 1979.*
6. *Reddy, D.V. and Arockiasamy, M., "****Offshore Structures",*** *Vol.1, Krieger Publishing Com- pany, Malabar, Florida, 1991.*

COURSE OUTCOME:

The students are able to,

CO 1: understand the basics of wave generation process and wave theories
CO 2: Analyse for the forces in off shore structures.
CO 3: Formulate the structural modeling of offshore structures.
CO 4: Demonstrate foundation modeling of offshore structures.
CO 5: Design various components of offshore structures.

COURSE ARTICULATION MATRIX:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PSO1*	*PSO2*	*PSO3*	*PSO4*
CO1	*M*	-	*L*	*M*	-	-	*M*	-	*M*	*M*	-	*L*	-	-	*L*
CO2	*M*	-	*L*	*M*	-	-	*L*	-	*M*	*M*	-	*L*	-	-	*L*
CO3	*L*	-	*M*	*L*	-	-	*M*	-	*H*	*M*	-	*H*	-	-	*L*
CO4	*M*	-	*L*	*M*	-	-	*M*	-	*M*	*L*	-	*L*	-	-	*M*
CO5	*M*	*H*	*L*	*M*	-	-	*M*	-	*H*	*M*	-	*L*	-	-	*L*

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

18SEPE24 – CORROSION ENGINEERING

Category: PE

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

COURSE OBJECTIVES

- To have an exposure on corrosion mechanism, testing and identify practices for prevention and remediation of corrosion.

UNIT I - CORROSION (9)

General, electrochemical corrosion of metals, galvanic cells, corrosion rates (kinetics), types of corrosion with properties and phenomenon, oxidation metals.

UNIT II - CORROSION TESTING (9)

Importance, classification materials and specimens, surface preparation, measuring and weighing, exposure techniques, duration, planned interval tests.

UNIT III - CORROSION PREVENTION (9)

Material selection, modification of metal, alternate of environment, design, cathodic and anodic protection, coatings (metallic, inorganic, non metallic and organic)

UNIT IV - CORROSION IN SELECTED ENVIRONMENTS (9)

Atmospheric Corrosion, Corrosion in Automobiles, Corrosion in Soils, Corrosion of Steel in Concrete, Corrosion in Water, Microbiologically Induced Corrosion, Corrosion in the Body

UNIT V - CORROSION IN INDUSTRIES (9)

Corrosion in the Petroleum Industry, Corrosion in the Aircraft Industry, Corrosion in the Microelectronics Industry

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

REFERENCE BOOKS:

1. *Jones, D.A.* ***"Principles and Prevention of Corrosion",*** *2nd Edition, Macmillan Publishing Co., 1995.*
2. *Balasubramanian, M.R., Krishnamoorthy, S. and Murugesan, V.,* ***"Engineering Chemistry",*** *Allied Publisher Limited., Chennai, 1993.*
3. *Sadasivam, V.* ***"Modern Engineering Chemistry - A Simplified Approach",*** *Kamakya Publications, Chennai, 1999.*
4. *Kuriakose, J.C. and Rajaram J. "****Chemistry in Engineering and Technology",*** *Vol. I and II, Tata McGraw-Hill Publications Co. Ltd., New Delhi, 1996.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the causes and mechanism of various types of corrosion.
CO 2: conduct various tests for corrosion measurement.
CO 3: apply suitable techniques for corrosion prevention
CO 4: familiarize with the occurrence of corrosion under different environment.
CO 5: able to identify corrosion related issues in various industries

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*M*	*L*	*M*	*L*	-	-	-	*M*	*M*	-	*L*	*L*	-	*H*
CO2	*L*	*M*	*H*	*M*	*M*	-	-	-	-	*M*	-	*L*	*M*	-	*M*
CO3	*M*	*H*	*L*	*H*	*M*	-	-	-	-	*H*	-	*H*	*M*	-	*H*
CO4	*L*	*H*	*M*	*L*	*M*	-	-	-	-	*M*	-	*L*	*L*	-	*H*
CO5	*H*	*M*	*L*	*H*	*L*	-	-	-	-	*M*	-	*H*	*M*	-	*L*

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

18SEPE25 – EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To understand the causes and effects of earthquake and the structural systems subjected to earthquake forces as per the recommendations of IS code of practice.

UNIT I - INTRODUCTION (9)

Elements of engineering seismology – causes of earthquakes, seismic waves, magnitude, intensity and energy release – Indian seismology –Earthquake history – Seismic zone Map of India – seismographs – seismogram – accelerograph – strong motion characteristics-initiation into vibration of structures .

UNIT II - SEISMIC DESIGN OF BUILDINGS (9)

Introduction to methods of seismic analysis – Equivalent static analysis IS 1893 provisions – Design horizontal seismic coefficient – design base shear – distribution – idealization of building frames - seismic analysis and modeling – determination of lateral forces – equivalent static lateral force method – response spectrum method – time history method – push over analysis - mathematical modeling of multistorey RC Building.

UNIT III - IS CODE PROVISIONS (9)

Modal response contribution – modal participation factor – response history – spectral analysis – approximate methods for lateral load analysis – IS 1893-2002 provisions – IS 4326 provisions – behavior and design of masonry structures – discussion of codes IS 13827 and 13828.

UNIT IV - SEISMIC DESIGN CONCEPTS (9)

Concept of earthquake resistant design – concept of ductility – lateral force resisting systems – strong column weak beam concept - guidelines for seismic resistant construction - beam column joints –effect of structural irregularities – seismo-resistant building architecture – cyclic load behavior of RC, steel and prestressed concrete elements – Earthquake Resistant Design for multi storey RC frames, shear wall, braced frames and their combinations – capacity based design - Ductile detailing of reinforcement in RC Buildings as per IS 13920.

UNIT V - SPECIAL PROBLEMS AND MODERN CONCEPTS (9)

Soil performance - Liquefaction -Modern concepts – base isolation – adaptive system – seismic evaluation- retrofitting and strengthening of structures – seismic retrofitting strategies.

COMPUTER AIDED ANALYSIS AND DESIGN: (For internal assessment only – not for theory examination) computer aided analysis and design of building systems for earthquake loads – response spectrum - time history analysis – capacity based design – hands on session using computer software.

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

REFERENCE BOOKS:

1. *Chopra A K, "**Dynamics of Structures- Theory and Applications to Earthquake Engineering",** Prentice- Hall of India Pvt. Ltd., New Delhi, 2002.*
2. *Pankaj Agarwal and Manish Shrikhande, **"Earthquake Resistant Design of Structures",** Prentice – Hall of India Pvt. Ltd., NewDelhi – 110 001, 2006.*
3. *Clough R W and Penzien J, **" Dynamics of Structures",** McGraw Hill, INC, 1993.*
4. *Taranath B S, **"Wind and Earthquake Resistant Buildings - structural Analysis & Design"** ,Marcell Decker, NewYork, 2005.*
5. *Chen WF & Scawthorn, **"Earthquake Engineering Hand book",**CRC Press, 2003.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the causes of earthquake and its measurement.

CO 2: Analyse the seismic behaviour of structures.

CO3: Acquire knowledge on codal provisions for earthquake resistant design.

CO4: Understand the concepts of earthquake resistant design and detailing.

CO 5: Gain knowledge on effects of earthquake and retrofitting of structures.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*M*	*L*	*L*	*H*	*L*	*L*	-	*H*	-	*H*	*H*	*M*	-	*M*
CO2	*M*	*H*	*M*	*H*	*H*	*L*	*M*	-	*H*	-	*H*	*M*	*M*	-	*M*
CO3	*M*	*M*	*H*	*H*	*H*	*M*	*H*	-	*H*	-	*M*	*H*	*H*	-	*M*
CO4	*H*	*H*	*H*	*M*	*M*	*L*	*M*	-	*M*	-	*H*	*M*	*H*	-	*M*
CO5	*H*	*M*	*L*	*M*	*M*	*L*	*L*	-	*H*	-	*H*	*H*	*M*	-	*M*

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

18SEPE26 – DESIGN OF STRUCTURES FOR DYNAMIC LOADS

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on behaviour and design concepts for dynamic loads as per codal provisions and to learn about ductile detailing.

UNIT I - GENERAL (9)

Design philosophy to resist earthquake, cyclone, flood, blast and impact - National and International codes of practice – Behavior of concrete, steel, masonry and soil under impact and cyclic loads- Energy absorption capacity – Ductility of material and the structure.
DESIGN AGAINST CYCLONE AND FLOOD: Effect of cyclones on buildings and special structures – safety and precautionary steps in design.

UNIT II - DESIGN AGAINST EARTH-QUAKES (9)

Earth-quake characterisation – Response spectrum – seismic coefficient and response spectra methods of estimating loads – Response of framed, braced frames and shear wall buildings – Design as per BIS codes practice – Ductility based design.

UNIT III - DESIGN AGAINST BLAST AND IMPACT (9)

Characteristics of internal and external blast - Impact and impulse loads- Explosions- Threats – wave scaling law – Fire loading – restraints – Pressure distribution on buildings above ground due to external blast – underground explosion - Design of buildings for blast , fire and impact as per BIS code of practice.

UNIT IV - DESIGN AGAINST WIND (9)

Characteristics of wind – Basic and design wind speeds Aeroelastic and Aerodynamic effect - Design as per BIS code of practice including Gust factor approach-along wind and across wind response- effect on tall buildings, towers, chimneys, roofs, window glass, Cladding and slender structures - vibration of cable supported bridges and power lines due to wind effects- tornado effects.

UNIT V - SPECIAL CONSIDERATIONS (9)

Detailing for ductility – Passive and active control of vibrations – New and favorable materials - Response of dams, bridges, buildings- strengthening measures-safety analysis-methods of strengthening for different disasters - Maintenance and modifications to improve hazard resistance.

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

REFERENCE BOOKS:

1. *Raiker.R.N. "**Learning from failure Deficiencies in Design",** Construction and Service, R & D Centre(SDCPL) Raiker Bhavan, Bombay , 1987*
2. *Bela Goschy, "**Design of Buildings to withstand abnormal loading",** Butterworhts, 1990.*
3. *Paulay.T and Priestly. M.N.J, **"A seismic Design of Reinforced Concrete and Masonry Buildings",** John Wiley and Sons, 1991.*

4. *Dowling. C.H,* ***"Blast Vibration – Monitoring and Control",*** *Prentice Hall Inc, Englewoods Cliffs, 1985.*
5. *Alan G. Daven Port,* ***"Wind Effects on Buildings and Structures",*** *Proceedings of the Jubileum Conference on Wind effects on Structures", Port Alegne, Brazil, pp 25-29, May 1998, Balkema A.A. Publishers, 1998.*
6. ***"Concrete Structures Under Impact and Impulsive loading",*** *Synthesis Report, CEB. Lousanne, Germany, 1988.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the effects of dynamic loads like earthquake, blast and impact on structures.

CO 2: Familiarize with the concepts of seismic resistant design.

CO 3: Design the structures against blast and impact.

CO 4: Calculate effect of wind on structures and design against wind load.

CO 5: Understand the knowledge on the concepts of favorable materials for ductility based designing of structure along with strengthening methods.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*	*M*	*H*	*H*	*L*	-	*L*	-	*M*	*L*	-	*L*	*M*	*L*	*M*
CO2	*M*	*H*	*M*	*H*	*L*	-	*M*	-	*L*	*L*	-	*M*	*L*	-	*M*
CO3	*L*	*H*	*M*	*M*	*M*	-	*L*	-	*L*	-	-	*H*	*M*	-	*M*
CO4	*L*	*H*	*M*	*H*	*L*	-	*L*	-	*M*	-	-	*H*	*L*	*L*	*M*
CO5	*L*	*M*	*L*	*L*	*L*	-	*L*	-	*L*	-	-	*M*	*M*	-	*M*

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

18SEPE27 – DESIGN OF TALL BUILDINGS

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on behaviour, analyze and design of tall structural systems.

UNIT I - DESIGN CRITERIA (9)

Design philosophy, Loading, Sequential loading, materials - high performance Concrete - Fiber reinforced Concrete - Light weight Concrete - Design mixes

UNIT II - LOADING AND MOVEMENT (9)

Gravity Loading : Dead and live load, methods of live load reduction, Impact, gravity loading, construction loads. Wind loading : Static and dynamic approach, Analytical and wind tunnel experimental method. Earthquake loading : Equivalent lateral force, modal analysis, combinations of loading working stress design, Limit state design, plastic design.

UNIT III - BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS (9)

Factors affecting growth, Height and Structural form. High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega system.

UNIT IV - ANALYSIS AND DESIGN (9)

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of building as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist, computerized general three dimensional analysis. Structural elements : Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT V - STABILITY OF TALL BUILDINGS (9)

Overall buckling analysis of frames, wall -frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P -Delta analysis, Translational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation.

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

REFERENCE BOOKS:

1. *Taranath B.S., **"Structural Analysis and Design of Tall Building",** McGraw Hill, 1988.*
2. *Dr. Y.P.Gupta, Editor. Proceedings National Seminar on **"High Rise Structures - Design and Construction practices"** for middle level cities Nov. 14 -16, 1995, New Age International Limited, Publishers, Madras - 20.*
3. *Wilf gang Schuller, **"High Rise Building Structures" ,** John Wiley and Sons, 1977.*

4. *Bryan stafford Smith, Alexcoull,* ***"Tall Building Structures , Analysis and Design,"*** *John Wiley and Sons, Inc., 1991.*
5. *T.Y.Lin, D.Stotes Burry,* ***"Structural Concepts and system for Architects and Engineers"*** *. John Wiley, 1988.*
6. *Lynn S.Beedle,* ***"Advances in Tall Buildings"*** *, CBS Publishers and Distributors, Delhi, 1986.*

COURSE OUTCOME:

The students are able to,

CO 1: Familiarize with the problems associated with the large heights of structures with respect to different loads and materials.

CO 2: Analyse the structure subjected to vertical and lateral loads.

CO 3: Understand the behaviour of high rise building with various structural elements.

CO 4: Analyze and design various structural systems for high rise buildings.

CO 5: Carryout stability analysis, overall buckling analysis of frames and analysis of various secondary effects on tall building.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*	*H*	*H*	*H*	*H*	*L*	*L*	-	*M*	-	*M*	*H*	*H*	-	*M*
CO2	*H*	*H*	*M*	*M*	*M*	*L*	*M*	-	*H*	-	*M*	*M*	*H*	-	*M*
CO3	*M*	*M*	*M*	*H*	*H*	-	*M*	-	*H*	-	*H*	*H*	*M*	-	*M*
CO4	*H*	*H*	*H*	*H*	*M*	*L*	*H*	-	*H*	-	*M*	*M*	*H*	-	*M*
CO5	*H*	*H*	*H*	*M*	*H*	*M*	*M*	-	*M*	-	*H*	*H*	*H*	-	*M*

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

18SEPE28 - COLD FORMED STEEL STRUCTURES

Category: PE

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

COURSE OBJECTIVE:

- To impart knowledge on design of various cold formed steel structural elements.

UNIT I - INTRODUCTION (9)

General – Types of Cold Formed Steel Sections and their applications – Methods of Forming – Materials used in Cold Formed Steel Construction – Yield Point – Tensile Strength – Stress Strain Curve – Modulus of Elasticity and Tangent Modulus – Ductility – Weldability – Fatigue Strength and Toughness. Connections – Types of Connections – Welded Connections – Bolted Connections – Other Fasteners.

UNIT II - STRENGTH OF THIN ELEMENTS AND DESIGN CRITERIA (9)

General – Definitions of General Terms – Basic Design Stress – Wind, Earthquake and Combined forces – Structural Behavior of Compression Elements and Design Criteria – Stiffeners for Compression Elements – Structural Behavior of Perforated Elements – Plate buckling of Columns – Behavior of Webs of Beams and Cylindrical Tubular Elements.

UNIT III - DESIGN OF FLEXURAL MEMBERS (9)

General – Beam Strength and Deflection – Design of Webs of beams – Lateral Buckling of Beams – Bracing Requirements of Beams – Unusually Wide Beam Flanges and Unusually Short Span beams.

UNIT IV - DESIGN OF COMPRESSION MEMBERS (9)

General – Yielding – Flexural Column Buckling – Effect of Cold Work on Column Buckling – Effect of Local Buckling on Column Strength – AISI Design Formula for Flexural Buckling – Effective Length factor K – Torsional Buckling and Torsional-Flexural Buckling – Bracing and Secondary Members – Maximum Slenderness Ratio – Wall Studs – Testing of Wall Material for Lateral Bracing Value.

UNIT V - DESIGN OF BEAM COLUMNS (9)

General – doubly symmetric shapes and shapes not subjected to torsional or torsional-flexural buckling – thin walled open Sections which may be subjected to Torsional-Flexural Buckling – Singly Symmetric Open Shapes – Unsymmetric Shapes.

Light Gauge Steel Shear Diaphragms and shell Roof Structures - light Gauge Steel Shear Diaphragms – Columns and Beams braced by Steel Diaphragms – Shell Roof Structures.

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

REFERENCE BOOKS*:*

1. *Wie-Wen Yu, **"Cold Formed Steel Structures"**, Mcgraw Hill Book Company, 1973.*
2. *Horne M.R. and Morris L.J., **"Plastic Design of Low Rise Frames"**, Granada Publishing Ltd., 1981.*
3. *Salmon C.G. and Johnson J.E., "**Steel Structures-Design and Behaviour"**, Harper and Row, 1980.*
4. *Dayaratnam P. **"Design of Steel Structures"**, A.H. Wheeler, 1980.*

5. *Kuzamanovic B.O. and Willems N., **"Steel Design for Structural Engineers",** Prentice Hall, 1977.*
6. *William McGuire, **"Steel Structures",** Prentice Hall Inc., Englewood Cliffs, N.J., 1986.*

COURSE OUTCOME:

The students are able to,

CO 1: Understand the concepts on the behaviour of Cold formed steel structures.
CO 2: Apply the knowledge of thin elements in the design of cold formed steel.
CO 3: Design the cold formed steel flexural members as per codal provisions.
CO 4: Design the compression members as per codal provisions.
CO 5: Design the cold formed steel beam columns as per codal provisions.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*M*	*M*	*M*	*M*	*H*	*L*	*M*	-	*H*	-	*H*	*M*	*M*	-	*M*
CO2	*H*	*H*	*H*	*H*	*M*	*M*	*H*	-	*H*	-	*H*	*M*	*H*	-	*M*
CO3	*H*	*H*	*H*	*M*	*M*	*L*	*M*	-	*M*	-	*M*	*H*	*H*	-	*H*
CO4	*H*	*H*	*H*	*M*	*M*	*M*	*M*	-	*M*	-	*M*	*M*	*M*	-	*L*
CO5	*H*	*H*	*H*	*M*	*M*	-	*M*	-	*M*	-	*M*	*M*	*M*	-	*M*

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

18SEPE29 – GEOTECHNICAL EARTHQUAKE ENGINEERING

[Common with ME Geotechnical Engineering]

Category: PE

PREREQUISITES: Nil	**L**	**T**	**P**	**C**
	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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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 engineeing

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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*		*H*			*M*						*M*			*L*
CO2	*M*		*H*		*M*							*M*	*L*		*L*
CO3			*H*		*H*				*H*		*H*	*L*			*L*
CO4	*H*		*H*			*M*						*M*			*L*
CO5	*L*		*H*			*M*						*L*			*M*

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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*H*													*M*	
CO2	*H*													*L*	
CO3	*H*													*M*	
CO4	*H*								*M*					*L*	
CO5	*M*				*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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1													*M*		
CO2													*M*		
CO3									*M*	*M*			*M*		
CO4						*M*							*M*		
CO5	*L*	*H*				*L*							*M*		

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

18SEOE03 - GREEN BUILDING
(Common to All Branches)

Category: OE

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

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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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***	***PSO1***	***PSO2***	***PSO3***	***PSO4***
CO1	*L*													*M*	
CO2					*M*	*M*								*M*	
CO3						*M*								*M*	
CO4						*M*								*M*	
CO5	*M*								*L*	*M*	*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 equipmentmeant 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

18GEOE07 - 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 day lighting: 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.

UNITIII-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.

UNITIV- 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.

UNITV-AIR AND SOLIDWASTE (09)

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

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

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

UNITIII- 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*

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.

UNIT I - BUSINESS ANALYTICS AND PROCESS (9)

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.

UNIT II - REGRESSION ANALYSIS (9)

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.

UNIT III - STRUCTURE OF BUSINESS ANALYTICS (9)

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.

UNIT IV - FORECASTING TECHNIQUES (9)

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.

UNIT V - DECISION ANALYSIS AND RECENT TRENDS IN BUSINESS ANALYTICS

(9)

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.

UNIT I - INTRODUCTION TO COST MANAGEMENT (9)

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.

UNIT II - PROJECT PLANNING ACTIVITIES (9)

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.

UNIT III - COST ANALYSIS (9)

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.

UNIT IV - PRICING STRATEGIES AND BUDGETORY CONTROL (9)

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.

UNIT V - TQM AND OPERATIONS REASEARCH TOOLS (9)

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.

UNIT I - INTRODUCTION (9)

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.

UNIT II - PLANT LOCATION AND LAYOUT (9)

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.

UNIT III - WORK SYSTEM DESIGN (9)

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

UNIT IV - STATISTICAL QUALITY CONTROL (9)

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

UNIT V - PRODUCTION PLANNING AND CONTROL (9)

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 thefunctioning 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 & H****all 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

Contact Periods:

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.

UNIT I - INTRODUCTION **(9)**

Terminology relating to atmospheric particles – Aerosols-types, characteristics, measurements – Particle mass spectrometry. Anthropogenic-sources, effects on humans.

UNIT II - CLIMATE MODELS **(9)**

General climate modeling- Atmospheric general circulation model, Oceanic general circulation model, Sea ice model, Land model concept, Paleo-climate, Weather prediction by Numerical process. Impacts of climate change, Climate Sensitivity, Forcings and feedbacks.

UNIT III - 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.

UNIT IV - GREEN HOUSE GASES

Blackbody Radiation, Layer model, Earth's atmospheric composition and Green house gases effects on weather and climate. Radiative equilibrium. Earth's energy balance.

UNIT V - 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.

UNIT I - 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.

UNIT II - ELECTRONIC STRUCTURE AND MOTION **(9)**

Atoms- The Hydrogen Atom, Many-Electron Atoms, Many-Electron Atoms. Pseudo potentials, Nuclear Structure, Molecules, Crystals. Translational motion – Penetration through barriers – Particle in a box. Two Terminal Quantum Dot Devices, Two Terminal Quantum Wire Devices.

UNIT III - 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.

UNIT IV- CLASSICAL STATISTICS **(9)**

Probabilities and microscopic behaviors, Kinetic theory and transport processes in gases, Magnetic properties of materials, The partition function.

UNIT V - UANTUM STATISTICS

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.

UNIT I - INTRODUCTION **(9)**

Logistics – aim, activities, importance, progress, current trends. Integrating logistics with an organization.

UNIT II - 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.

UNIT III - 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.

UNIT IV- ACTIVITIES IN THE SUPPLY CHAIN

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.

UNIT V - SUPPLY CHAIN MANAGEMENT STRATEGIES

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: 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
(Common to all Branches) **Category : OE**

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

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*

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

18PEOE22 - VIRTUAL INSTRUMENTATION **Category:OE**
(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

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 : VI 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)

PREREQUISITES: Nil

Category: OE

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: 45 Periods

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)

PREREQUISITES: Nil

Category: OE

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: 45 Periods

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

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

***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: 45 Periods

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	-	M	-	M	-	-	-	-	-	-	-
CO2	-	-	H	-	-	-	-	-	-	-	-
CO3	M	L	-	M	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	H	L	M	-	L	-	-	-	M	-	-
CO2	H	L	M	-	L	-	-	-	M	-	-
CO3	H	L	M	-	L	-	-	-	M	-	-

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

18VLOE29 ANALOG & MIXED MODE VLSI CIRCUITS
(Common to all Branches)

Category: OE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

***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

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

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

18SEACZ1 - 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

18SEACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVE:

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 IIREPERCUSSIONS 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 IVDISASTER 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

18SEACZ3 - 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

18SEACZ4 - 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

18SEACZ5 - 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 effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of

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

18SEACZ6 - 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

18SEACZ7 - 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

18SEACZ8 - 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