GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

M.E. (ENVIRONMENTAL ENGINEERING)

(Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

THADAGAM ROAD, COIMBATORE – 641 013

PHONE 0422 – 2433355 FAX: +91 0422 – 2433355

Email: gctcoe@gct.ac.in

GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641 013

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE – 641 013

ENVIRONMENTAL ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

To transpire as a centre of excellence in research with sustainable development to articulate professionals with pioneering vision.

MISSION

- To make the department of Environmental Engineering a renowned centre for research scholars.
- To transmit strong basics and applied research to bring out novel solutions by technocrats and the community at large.
- To create a nodal centre for providing consulting services for the benefit of Industries and Society.

GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE – 641 013

ENVIRONMENTAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

PEO 1: Graduates will achieve a high level of technical expertise in the subjects related to Environmental Engineering and also good in communication skills that help them to achieve and succeed in various positions.

PEO 2: Graduates will have a strong understanding in Environmental engineering principles to do doctorate programmes and to grab employment and entrepreneurship opportunities.

PEO3: Graduates will get interest on the learning processes and inculcate in them professional ethics, moral values and social concern.

GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE – 641 013

M.E. ENVIRONMENTAL ENGINEERING
PROGRAMME OUTCOMES (POs)

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 environmental engineering employing different methodologies and techniques.

PO 5: An ability to use the techniques, advanced modern engineering skills, instrumentation and software packages necessary for environmental 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: An ability to recognize the importance of Environmental Engineering by continuing lifelong professional development and take-up rewarding careers in Environmental Engineering.

GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE – 641 013

ENVIRONMENTAL ENGINEERING

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Graduates will be able to manage resources in a sustainable manner.

PSO2: Graduates will excel in the core areas of Environmental Engineering such as Water supply Engineering, Wastewater Engineering, Air pollution management, Solid and hazardous waste management etc.

PSO3: Graduates will execute excellence in solving the Environmental Engineering problems based on the learned principles and techniques within stipulated time.

PSO4: Graduates will be able to adapt themselves according to the developments in Environmental Engineering

Curriculum

CURRICULUM FOR CANDIDATES ADMITTED DURING 2018-2019 AND ONWARDS

TWO YEAR M.E PROGRAMME

ENVIRONMENTAL ENGINEERING

CHOICE BASED CREDIT SYSTEM-CURRICULUM

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.	18EEFCZ1	Research Methodology and IPR	FC	50	50	100	3	3	0	0	3
2.	18EEPC01	Statistical methods for Environmental Engineers	PC	50	50	100	3	3	0	0	3
3.	18EEPC02	Air Quality Management	PC	50	50	100	3	3	0	0	3
4.	18EEPC03	Transport of water and wastewater	PC	50	50	100	3	3	0	0	3
5.	18EEPC04	Physico –chemical processes for water and wastewater treatment	PC	50	50	100	3	3	0	0	3
6	18EEPEXX	Professional Elective I	PE	50	50	100	3	3	0	0	3
7	18EEACXX	Audit course I	AC	50	50	100	2	2*	0	0	0
Practical											
8.	18EEPC05	Environmental chemistry and Microbiology Laboratory	PC	50	50	100	3	0	0	3	1.5
Total				**400**	**400**	**800**	**23**	**20**	**0**	**3**	**19.5**

SECOND SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1.	18EEPC06	Biological processes for wastewater treatment	PC	50	50	100	3	3	0	0	3
2.	18EEPC07	Solid and Hazardous waste management	PC	50	50	100	3	3	0	0	3
3.	18EEPC08	Industrial wastewater management	PC	50	50	100	3	3	0	0	3
4	18EEPEXX	Professional Elective II	PE	50	50	100	3	3	0	0	3
5	18EEPEXX	Professional Elective III	PE	50	50	100	3	3	0	0	3
6	18EEACXX	Audit course II	AC	50	50	100	2	2*	0	0	0
Practical											
7	18EEPC09	Unit operation and processes laboratory	PC	50	50	100	3	0	0	3	1.5
8	18EEEE01	Mini project	EEC	50	50	100	4	0	0	4	2
Total				**400**	**400**	**800**	**24**	**17**	**0**	**7**	**18.5**

THIRD SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1.	18EEPEXX	Professional Elective IV	PE	50	50	100	3	3	0	0	3
2.	18$OEXX	Open Elective	OE	50	50	100	3	3	0	0	3
Practical											
3.	18EEEE02	Project Phase I	EEC	100	100	200	20	0	0	20	10
Total				**200**	**200**	**400**	**26**	**6**	**0**	**20**	**16**

FOURTH SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Practical											
1.	18EEEE03	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. ENVIRONMENTAL 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	18EEPE01	Water Quantity Modeling	PE	50	50	100	3	3	0	0	3
2	18EEPE02	Role of environmental legislation in industries	PE	50	50	100	3	3	0	0	3
3	18EEPE03	Environmental Engineering Structures	PE	50	50	100	3	3	0	0	3
4	18EEPE04	Environmental Biotechnology	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE II											
5	18EEPE05	Instrumentation, Selection and Management of Environmental Engineering Equipments	PE	50	50	100	3	3	0	0	3
6	18EEPE06	Operation and Maintenance of Water and Waste Water Treatment Systems	PE	50	50	100	3	3	0	0	3
7	18EEPE07	Computing Techniques in Environmental Engineering	PE	50	50	100	3	3	0	0	3
8	18EEPE08	Ground water contamination and transport modeling	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE III											
9	18EEPE09	Environmental Impact and Risk Assessment	PE	50	50	100	3	3	0	0	3
10	18EEPE10	Membrane separation for water and wastewater Treatment	PE	50	50	100	3	3	0	0	3
11	18EEPE11	Environmental Reaction Engineering	PE	50	50	100	3	3	0	0	3
12	18EEPE12	Environmental System Analysis	PE	50	50	100	3	3	0	0	3

PROFESSIONAL ELECTIVE IV											
13	18EEPE13	Remote Sensing and GIS Applications in Environmental Engineering	PE	50	50	100	3	3	0	0	3
14	18EEPE14	Air and Noise Quality Modeling	PE	50	50	100	3	3	0	0	3
15	18EEPE15	Environmental Auditing and New Product Management	PE	50	50	100	3	3	0	0	3
16	18EEPE16	Advanced Wastewater Treatment and Reuse	PE	50	50	100	3	3	0	0	3

LIST OF OPEN ELECTIVES FOR M.E. ENVIRONMENTAL 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 COURCES (AC)

S. No.	Subject Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Contact Periods	Hours/Week			
								L	T	P	C
1	18EEACZ1	English For Research Paper Writing	AC	50	50	100	2	2	0	0	0
2	18EEACZ2	Disaster Management	AC	50	50	100	2	2	0	0	0
3	18EEACZ3	Value Education	AC	50	50	100	2	2	0	0	0
4	18EEACZ4	Constitution of India	AC	50	50	100	2	2	0	0	0
5	18EEACZ5	Pedagogy Studies	AC	50	50	100	2	2	0	0	0
6	18EEACZ6	Stress Management By Yoga	AC	50	50	100	2	2	0	0	0
7	18EEACZ7	Personality Development Through Life Enlightenment Skills	AC	50	50	100	2	2	0	0	0
8	18EEACZ8	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	10.5	10.5	0	0	21	30 %
3.	Professional Electives	6	6	3	0	15	21.43 %
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%**

Syllabus

18EEFCZ1 RESEARCH METHODOLOGY AND IPR
(Common to All Branches)

Category : FC

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

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

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

UNIT I INTRODUCTION **L(9)**

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

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

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

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

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

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

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

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

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

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

Reference Books

1. *Stuart Melville and Wayne Goddard, "**Research methodology: an introduction for science & engineering students**", Juta Academic, 1996.*
2. *Donald H.McBurney and Theresa White, "**Research Methods**", 9th Edition, CengageLearning, 2013.*
3. *RanjitKumar, "**Research Methodology: A Step by Step Guide for Beginners**", 4th Edition, 2014.*
4. *Dr. C. R. Kotharia and GauravGarg, "**Research Methodology: Methods and Trends**", New age international publishers, Third Edition, 2014.*

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

CO1: Develop research question**[Usage]**
CO2: Perform exhaustive literature survey**[Usage]**
CO3: Apply right problem solving methods**[Usage]**
CO4: Prepare data for analysis**[Usage]**
CO5: Write research report**[Usage]**

COURSE ARTICULATION MATRIX:

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

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

18EEPC01 - STATISTICAL METHODS FOR ENVIRONMENTAL ENGINEERS

Category: PC

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

At the end of the course the students are able to:

1. Understand the numerical solutions to algebraic, exponential, logarithmic and linear system of equations, axioms of probability, discrete and continuous probability distributions.
2. Understand test of hypothesis for both small and large samples based on normal distribution and evaluate control limits using control charts to examine whether the product is within control.
3. Understand multivariate correlation analysis and forming Regression plane.

UNIT I NUMERICAL METHODS (9)

Linear system-Gauss elimination and Gauss Jordan method- matrix inversion-Gauss Seidal method-Nonlinear equations-RegulaFalsi and Newton Raphson methods-Interpolation - Newton's and Lagrange's interpolation.

UNIT II PROBABILITY THEORY (9)

Random experiments-Sample space– Axiomatic definition of Probability – Conditional Probability – Addition, Multiplication theorems-Total Probability and Baye's Theorem – Problems.

UNIT III RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS (9)

Discrete Random variable-Probability Function- Continuous Random variable- Probability density function-Two Dimensional Random Variables- Joint probability mass function – Marginal and conditional probability density functions. Distributions: Binomial, Poisson, Normal, Gamma – Chebyshev's inequality (Simple problems)

UNIT IV TEST OF HYPOTHESIS (9)

Large samples: Tests for Means, Variances and Proportions – Small samples: Tests for Means, Variances and Attributes using t, F, Chi square distribution– Goodness of fit using Chi Square distribution.

UNIT V STATISTICAL QUALITY CONTROL AND CORRELATION ANALYSIS (9)

Statistical basis for Control charts– Control limits – Control charts for variables: $\overline{X}$, R– charts, Control chart for defectives and defects: p, np charts, c chart-Correlation –Regression – Multiple and Partial Correlation.

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

REFERENCE BOOKS

1. *S. C. Gupta and V. K. Kapoor,* ***"Fundamental Statistics",*** *Sulthan Chand & Sons, New Delhi - 2002.*
2. *S. P. Gupta, Statistical Methods, Sulthan Chand & Sons, New Delhi - 2002.*
3. *Miller and Freund* ***"Probability and Statistics for Engineers****", Prentice Hall of India Ltd, New Delhi 2015*
4. *Dr. P. Kandasamy, Dr. K. Thilagavathy, Dr. K. Gunavathy,* ***'Numerical Methods',*** *S.Chand and sons, Ram Nagar, New Delhi, 2010.*
5. *T. Veerarajan,* ***"Probability, Statistics and Random Process",*** *Tata McGraw Hill, New Delhi, 2010.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: To acquire knowledge to understand the solutions to system of equations, algebraic equations and interpolation methods. Basics of Probability

CO2: To develop an understanding of probability concepts and distributions including some decision-making problems

CO3: To acquire knowledge to understand the statistical quality control problems and correlation analysis

COURSE ARTICULATION MATRIX:

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

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

18EEPC02 - AIR QUALITY MANAGEMENT

Category: PC

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

At the end of the course the students are able to

1. Apply sampling techniques
2. Apply modeling techniques
3. Suggest suitable air pollution prevention equipments and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

UNIT I INTRODUCTION (7)

Atmosphere as a place of disposal of pollutants – Definition- Air Pollution – Air Pollutants – Source and classification of pollutants – Units of measurements of pollutants - Ambient air quality standards - Air pollution indices - Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions.

UNIT II SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING (10)

Ambient air samplingand measurement of particulate and gaseous pollutants Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate - Wind Rose - Inversion – Wind velocity and turbulence - Stack sampling - Plume behaviour - Dispersion of air pollutants - Maximum mixing depth - Dispersion model - Fixed Box models – Multiple cell models - Estimation of plume rise - Stack design.

UNIT III CONTROL OF PARTICULATE CONTAMINANTS (10)

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators, cyclones, Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS (10)

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

UNIT V AIR POLLUTION SURVEY, LEGISLATIONS AND CASE STUDIES (8)

Air pollution survey - Air pollution legislation and regulations – Environmental criteria for siting industries and green belts - Air pollution in Indian cities. Case studies - some specific industries - cement industry - refineries - fertilizer - paper industry - Sources of pollutants and its controls - Cost benefit analysis.

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

REFERENCE BOOKS:

1. *C. S. Rao,* ***"Environmental Pollution Control Engineering",*** *Wiley Eastern Limited, 2006.*

2. *Stern A. C.,* ***"Air Pollution" (vol. I), "Air Pollution and its effects" (vol. II), "Analysis, Monitoring and Surveying" (vol. III), "Sources of Air Pollution and their control",*** *Academic press, New York, 1968.*

3. *Air Pollution act, 1981 (India).*

4. *Howard S. Peavy, Donald R. Rowe and GerogeTchobanoglous,* ***"Environmental Engineering",*** *McGraw - Hill Co., 2013.*

5. *Kenneth wark, Cecil F.warner,* ***"Air Pollution its Origin and Control",*** *Harper and Row Publishers, Newyork, 1997,3rd edition.*

6. *Dr. Y. Anjaneyulu,* ***"Air Pollution and Control Technologies",*** *Allied publishers (P) Ltd., 2nd edition,2018.*

COURSE OUTCOMES:

After completion of this course, the student will be able to:

CO1: Understand local and global air pollution scenario,

CO2: Apply modeling techniques for air pollution control.

CO3: Understand the use of air pollution control devices for Particulate matter.

CO4: Understand the use of air pollution control devices gaseous pollutants.

CO5: Get knowledge about air pollution legislations and carryout air pollution surveys.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L		L	L	M	M	M		L	L	0
CO2	M		M	M	M	M	M		L	H	L
CO3	M		M	M			L		L	L	0
CO4	M	M		M	H		M		M	L	L
CO5	M		H	M		M	L	L	L	M	L

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

18EEPC03 - TRANSPORT OF WATER AND WASTEWATER

Category: PC

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

At the end of the course the students are able to

1. select various pipe materials for water supply main, distribution network and sewer
2. design water supply main, distribution network and sewer for various field conditions Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

UNIT I GENERAL HYDRAULICS AND FLOW MEASUREMENT (8)

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

UNIT II WATER TRANSMISSION AND DISTRIBUTION (12)

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps-characteristics- economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

UNIT III WASTEWATER COLLECTION AND CONVEYANCE (10)

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

UNIT IV STORM WATER DRAINAGE (8)

Necessity- combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods

UNIT V CASE STUDIES AND SOFTWARE APPLICATIONS (7)

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

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

REFERENCE BOOKS:

1. Bajwa, G.S. "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003, 3rd edition, 2011.

2. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.

3. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.
4. Frank R. Spellman, " Water& Wastewater Conveyance", CRC Press 1st edition,2016.
5. "Water transmission and distribution", by American Water works associations 4th edition,2010.
6. Dr. R.K.Bansal, "Fluid mechanics and hydraulic machines", Laxmi Publications,2008.

COURSE OUTCOMES:

On Completion of the Course the student will be able to :

CO1 : Understand about types of flow and their hydraulics.

CO2 : Get knowledge about various pipe materials for water supply main, distribution network and sewer

CO3 : Able to identify the required design for water supply main, distribution network and sewer for various field conditions.

CO4 : Estimate storm runoff and design the sewer sections.

CO5 : Design of water and sewage network and solve operational problems in transmission using software.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M			M	L		L		L	1	L
CO2	M			M	L		L		L	L	L
CO3	M			M	L		M		L	L	
CO4	H	H	M	H	L		M		L	L	L
CO5	H	M		H	H	H	M	M	L	L	**M**

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

18EEPC04 - PHYSICO - CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT

Category: PC

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

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

1. Identification and assessment of the characteristics of water and wastewater along with their environmental impacts
2. Design of the various unit processes in wastewater treatment plants
3. Understanding the principles and mechanisms involved in advanced wastewater treatment

UNIT I GENERAL (9)

Water Quality-Physical, chemical and biological parameters of water- Water Quality requirement - Potable water standards -Wastewater Effluent standards -Water quality indices. Water purification in natural systems -Physical-chemical and Biological processes – Significance of physico- chemical treatment- Requirements of successful operation - Operational problems – Trouble shooting.

UNIT II PRIMARY TREATMENT (9)

Preliminary treatment: Screening, Principles of screening– different types of screens – description, analysis and design – Flow equalization-Types - Skimming tank – grit removal and disposal – velocity control in the grit chamber - Floatation – types – Theory of analysis and design.

UNIT III PRIMARY TREATMENT (9)

Mixing, Clarification - Sedimentation; Types - Aeration and gas transfer – Application in water treatment Coagulation and Flocculation, processes and Design - stability and destabilization of colloids Clariflocculation-Design.

UNIT IV FILTRATION AND ADSORTION (9)

Filtration - theory of granular media filtration; Classification of filters; Theory and design of slow sand filter and Rapid sand filter; mechanism of filtration; modes of operation and operational problems; Negative head and air binding; dual and multimedia filtration. Adsorption, adsorption equilibrium - adsorption isotherms.

UNIT V ADVANCED TREATMENT PROCESSES (9)

Ion Exchange-processes, Photocatalytic degradation. Applications of Membrane Processes - Reverse osmosis, Ultrafiltration, Nanofiltration, and Electrodyalisis -Electrocoagulation. Disinfection and its significance – Physical and Chemical disinfection. – description of various methods

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

REFERENCE BOOKS:

1. ***METCALF & EDDY, "Wastewater Engineering Treatment Disposal Reuse",Tata McGraw-Hill, New York, 2003 5th edition,2013.***
2. ***HOWARD S. PEAVY, DONALD R. ROWE & GEORGE TCHOBANOGLOUS, "Environmental Engineering", McGraw-Hill,2013.***
3. ***QASIM. S.R., "Wastewater Treatment Plant – Planning, Design and operation, Holt Rinchart and Winston, New York, 2002.***
4. ***WEBER, W.J. Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.***
5. ***S.K.GARG, "Water supply engineering" and "Sewage waste disposal and air pollution engineering" (VOL 1 & 2), Khanna Publishers, 2017.***
6. ***KARIA.G.L, "Wastewater treatment- Concepts and design approach", PHI learning private ltd, 2013.***

COURSE OUTCOMES:

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

CO1 : Identify the water quality requirements and understand the unit processes for water purification.

CO2 : Design different primary unit operation for the treatment of wastewater.

CO3 : Design different primary unit operation for the treatment of water.

CO4 : Understand the role of filtration and adsorption for treatment of water and wastewater.

CO5: Analyse the recent developments in the treatment technologies.

COURSE ARTICULATION MATRIX:

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

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

18EEPC05 - ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY LABORATORY

Category: PC

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

At the completion of this course, the students are able to

1. Determine the physico-chemical parameters
2. Do various biological and microbiological techniques, enzymes assay, pollutant removal and bioreactors.

EXPERIMENTS:

Chemistry

1.Good Laboratory Practices, Quality control, calibration of

2.Sampling and Analysis of water (pH, alkalinity, hardness, chloride, Sulphate , turbidity EC, TDS,TS, nitrate, fluoride)

3.Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).

4. Sampling and characterization of soil (CEC & SAR, pH and K).

Microbiology

1. Preparation of culture media,

2. Isolation, culturing and Identification of Microorganisms

3. Microorganisms from polluted habitats (soil, water and air)

4. Measurement of growth of microorganisms,

5. Assay of enzymes involved in biotransformation.

6. Biodegradation of organic matter in waste water

7. Analysis of air borne microorganisms,

8. Staining of bacteria.

9. Effect of pH, temperature on microbial growth

10. Pollutant removal using microbes from industrial effluent.

11. Effect of pesticides on soil microorganisms.

12. Bacteriological analysis of wastewater (Coliforms, *E.coli, Streptococcus*) – MPN

13. Bacteriological analysis of wastewater (Coliforms, *Streptococcus)* - MF techniques, Effect of Heavy metals on microbial growth.

14. Detection of Anaerobic bacteria (*Clostridium* sp.) 15. Bioreactors (cultivation of microorganisms)

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

REFERENCE BOOKS:

1. APHA, "Standard Methods for the Examination of Water and Wastewater", 22nd Ed. Washington, 2012.

2. "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist, H. – Second Edition, VCH, Germany, 3rd Edition, 1999.

3. "Methods of air sampling & analysis" ,James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

4. Charles P. Gerba, "Environmental Microbiology: A laboratory manual", Elsevier Publications, 2012.

5. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, "Manual of Environmental Microbiology", 3rd Edition, ASM Press, 2007.

COURSE OUTCOMES:

CO1: Develop skill on the determination of physical and chemical characteristics of water and wastewater

CO2: Able to carryout various biological and microbiological techniques for pollutant removal

COURSE ARTICULATION MATRIX:

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

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

18EEPC06 - BIOLOGICAL PROCESSES FOR WASTEWATER TREATMENT

Category: PC

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

At the end of the course the students are able to

1. Develop conceptual schematics required for biological treatment of wastewater
2. Translate pertinent criteria into system requirements

UNIT I INTRODUCTION, PROCESS ANALYSIS AND SELECTION (9)

Biological treatment processes – objectives - Choice of treatment method – Environmental impact and other considerations in planning the treatment – Cost of Wastewater treatment – Reactors used for the treatment – mass balance analysis – Reactions, Reaction rates – Enzyme reaction. Modelling of ideal flow and non ideal flow reactors – Reactors in parallel – Reactors in series – Tracer tests – Estimation of dispersion coefficient.

UNIT II FUNDAMENTALS OF PROCESS KINETICS (9)

Role of microorganisms – Microbial growth kinetics - Biological oxidation process - loading – MCRT - F/ M ratio - Determination of biokinetic coefficients – Modelling of suspended growth treatment process – Description, Design and operating parameters – Modelling of plug flow reactors.

UNIT III SUSPENDED GROWTH TREATMENT PROCESS – ACTIVATED SLUDGE PROCESS AND PONDS (9)

Treatment Process Loading – Biological & solids retention time – F/M ratio – Determination of Bio-kinetic constants – application of kinetics to Biological Treatment - Suspended Growth Treatment Process – Modelling of Suspended Growth Treatment Process – CFSTR – PFR - Design of Activated Sludge Process – Modifications (only theory) – Oxidation pond – Aerated lagoons – Oxygen requirements – arrangement for transfer of oxygen – Secondary clarifier - design features.

Stabilization ponds – Classification – Application – Process design, flow pattern and analysis of Aerobic ponds – Facultative ponds – Anaerobic ponds – maturation ponds – Construction and performance.

UNIT IV SUSPENDED GROWTH TREATMENT PROCESS – DIGESTION PROCESS (9)

Sludge Digestion – Sources of sludge – Characteristics – Quantities – Anaerobic digestion – Process – Kinetic relationship – gas production – design considerations. Anaerobic treatment of liquid wastes – Anaerobic sludge blanket process – design considerations. Aerobic Digestion – Kinetics – Oxygen requirements – Design considerations.

UNIT V ATTACHED GROWTH TREATMENT PROCESS (9)

Attached Growth Treatment Process – Substrate Removal in Attached Growth Treatment Process - Trickling Filter – Process – Classification - design based on popular design equations – NRC, Rankine's and Eckenfelder equation - Rotating Biological contactors – Anaerobic attached growth treatment processes – upflow packed bed – upflow expanded bed – Fluidized bed – Down flow bed. (only theory)

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

REFERENCE BOOKS:

1. ***Metcalf and Eddy, "Waste Water Engineering – Treatment and reuse", Tata McGraw-Hill, New Delhi, 2003.***
2. ***Arceivala S. J., "Waste Water Treatment and disposal, Marceldekker publishers,1981.***
3. ***Larry D. Benefield and Clifford W. Randall, "Biological process design for Wastewater Treatment", 1994.***
4. ***Howard S. Peavy, Donald R. Rowe and George Techobanoglous, "Environmental Engineering", McGraw – Hill co., 2013.***
5. ***Arceivala S. J., "Wastewater Treatment and Pollution control", Tata McGraw-Hill Co., New Delhi, 1998.***
6. ***Linvil G. Rich., "Low-Maintenance, Mechanically simple wastewater treatment Systems" , McGraw-Hill Co., 1980.***

COURSE OUTCOMES:

CO1 : Understand the background of biological treatment processes,
CO2 : Get required knowledge on design parameters and coefficients,
CO3: Acquire knowledge on the design of suspended growth treatment plants
CO4 : Design sludge digestion and disposal facilities,
CO5 : Design attached growth treatment process facilities

COURSE ARTICULATION MATRIX:

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

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

18EEPC07 - SOLID AND HAZARDOUS WASTE MANAGEMENT

Category: PC

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

On the completion of course,the students are able to:

1. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
2. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
3. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges
4. Design the different elements of waste management systems

UNIT I SOLID WASTE GENERATION, STORAGE AND MANAGEMENT SYSTEM (9)

Definition of solid wastes – types of solid wastes –solid Waste Management - Goals and objectives – Functional elements in a solid waste management system – Interrelationships - public awareness. Generation of solid waste - Sources and types of solid wastes – sampling - Composition – Generation rates – Factors affecting generation rates. Onsite handling, Storage and Processing of solid wastes - necessary equipments.

UNIT II COLLECTION AND TRANSFER OF SOILD WASTES (9)

Collection of solid waste - Collection services - collection system, equipments – Time and frequency of collection - labour requirements – Factors affecting collection – Analysis of collection systems – collection routes – Preparation of Master schedules. Transfer and Transport – Need for transfer operations - Transfer stations – types Transport means and methods - location of transfer stations.

UNIT III PROCESSING TECHNIQUES AND RECOVERY OF ENERGY (9)

Processing Techniques – purposes – Mechanical volume reduction – necessary equipments – Chemical volume reduction – incinerators – Mechanical size reduction – Selection of equipments - Component separation – Methods – Drying and Dewatering.

Incineration of solid wastes – Disposal in landfills: site selection, design, and operation of sanitary landfills – Leachate and landfill gas management; landfill closure and post-closure environmental monitoring landfill remediation – Regulatory aspects of municipal solid waste management. Composting – anaerobic and aerobic composting – Vermi composting – unit operations associated with composting anaerobic digestion of municipal solid waste – Pyrolysis – reduction methods- Mechanical and Biological Treatment and landfilling

UNIT IV HAZARDOUS WASTES (9)

Hazardous waste definition – Physical and biological routes of transport of hazardous substances – sources and characterization categories and control. Sampling and analysis of hazardous wastes – analytical approach for hazardous waste characterization – proximate analysis – survey analysis – directed analysis – analytical methods.

UNIT V HAZARDOUS WASTE MANAGEMENT (9)

Biomedical waste: Definition, sources, classification, collection, segregation Treatment and Disposal – Radioactive waste: Definition, Sources, Low level and high level radioactive wastes and their management, Radiation standard by ICRP and AERB – E-waste characteristics, generation, collection, transport and disposal.

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

REFERENCE BOOKS:

1. ***TechbanoglousThiesenEllasen : Solid waste Engineering Principles and Management, McGraw Hill, 1977.***
2. ***Hagerty D.J., Pevani J. L., and Heer J. E., Solid Waste Management , Van NostrandReinhld, 1979.***
3. ***Vesilind P.A. and Rimer A.E. Unit operations in resources recovery engineering, Prentice Hall, 1981.***
4. ***S. K. Shukla, P. R. Srivastava, Waste Management and control Commonwealth Publishers, New Delhi, 1991.***
5. ***B. B. Sundaresan, A. D. Bhide – Solid Waste Management, Collection, Processing and Disposal, Mudrashilpa Offset Printers, 2001.***
6. ***Manual on Solid Waste Management, CPHEEO, Ministry of Urban Development, GOI,New Delhi, 2000.***
7. ***Management of Solid waste in developing countries by FrankFlintoff , WHO regional publications 1984, 2nd edition.***
8. ***Theisen.H& Vigil S.A. "Integrated solidwaste management ,engineering, principles & management issues", McGraw – Hill c,. 1993.***
9. ***P.M.Cherry, " Solid and Hazardous waste management", CBS publishers and distribution PVT Ltd, 2016, 1st edition.***
10. ***M.S.Bhatt, Asherefilliyan, " Solid waste management – An Indian perspective ", Synergy books India 2012.***

COURSE OUTCOMES:

On completion of the course, the student will be able to,

CO1 : Understand the characteristics of different types of solid and hazardous wastes

CO2 : Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for collection and transport of municipal and industrial waste.

CO3 : Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste

CO4: Get basic knowledge about hazardous waste and its properties

CO5: Get knowledge on Hazardous waste management

COURSE ARTICULATION MATRIX:

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

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

18EEPC08 - INDUSTRIAL WASTEWATER MANAGEMENT

Category: PC

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

After completion of this course, the students is expected to do,

1. Qualitative and quantitative assessment of industrial wastewater
2. Analysis of effect of disposal of industrial wastewater
3. Understanding the principles of waste minimization technique on environment
4. Knowledge about Pollution from major industries and treatment Technologies

UNIT I SOURCES (9)

Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – Industrial wastewater monitoring and sampling – generation rates – characterization and variables – Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution– Source reduction techniques- effect of Industrial Effluents on Streams, Sewer and Human health– Waste Audit- Evaluation of pollution prevention options. Industrial scenario in India – Industrial activity and environment – Uses of water by Industry

UNIT II TREATMENT (9)

Waste minimization - Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal – adsorption – Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – management of RO reject - Nutrient removal – Cost benefit analysis – pay- back period - Implementing and promoting pollution prevention programs in industries.

UNIT III DISPOSAL (9)

Individual and Common Effluent Treatment Plants – Advantages – Joint treatment of Industrial and domestic wastewater - zero polluting industry concept –Reduce, Reuse and Recycle of wastewater – Disposal of effluent on land – Quantification, characteristics and disposal of sludge

UNIT IV INDUSTRIAL WASTEWATER TREATMENT-I (9)

Industrial manufacturing process description, wastewater characteristics, source reduction points and effluent treatment flow sheet for Textiles - Sugar mill – distilleries - Thermal power plant - Nuclear power plant - Petroleum refineries - Fertilizers – Dairy - Pharmaceutical industry

UNIT V INDUSTRIALWASTEWATER TREATMENT-II (9)

Industrial manufacturing process description, wastewater characteristics, source reduction points and effluent treatment flow sheet for , Pulp and Paper mill - Chemical industries - Metal finishing industries - Iron and Steel industries - Meat packing industries and Poultry plant - Automobile Industry- Industrial estates and Industrial Clusters.

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

REFERENCE BOOKS:

1. ***Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hill, 2014.***
2. ***Soli. J Arceivala, Shyam. R Asolekar "Wastewater Treatment for Pollution Control and Reuse", McGraw-Hill, 2006.***
3. ***Frank Woodard, "Industrial waste treatment Handbook", Butterworth Heinemann, New Delhi, 2006.***
4. ***Nemerow N. L., "Industrial Water Pollution", Addison - Wesley Publishing Company Inc., USA, 2007.***
5. ***Mahajan S. P. "Pollution Control in process industries", Tata McGraw Hill Publishing Co Ltd., New Delhi, 2008.***
6. ***Patwardhan, A.D., "Industrial Waste Water Treatment", PHI Learning, 2009***
7. ***M.N.Rao, A.K.Datta, "Wastewater treatment",McGraw Hill , 2007.***

COURSE OUTCOMES:

At the end of the course the students are able to

CO1: Carry out qualitative and quantitative assessment of industrial wastewater

CO2: Understand the principles of waste minimization techniques

CO3: Identify and select appropriate disposal methods

CO4: Manage the effluent treatment from major industries

CO5: Understand the concept of industrial clusters

COURSE ARTICULATION MATRIX:

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

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

18EEPC09 - UNIT OPERATION AND PROCESSES LABORATORY

Category : PC

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

COURSE OBJECTIVES:

After the completion of the course the students will be able to design and analyse various treatability options for water and wastewater and monitor ambient air and noise quality.

LIST OF EXPERIMENTS

1.	Coagulation and Flocculation	6
2.	Batch studies on settling	6
3.	Studies on Filtration- Characteristics of Filter media	6
4.	Water softening	6
5.	Adsorption studies/Kinetics	6
6.	Langelier Saturation Index and Silt Density Index- For Membrane Filtration	6
7.	Kinetics of suspended growth process (activated sludge process)-and Sludge volume Index	12
8.	Sludge Filterability Test	6
9.	Anaerobic Reactor systems / kinetics (Demonstration)	6
10.	Advanced Oxidation Processes – (Photo catalysis)	6
11.	Disinfection for Drinking water (Chlorination)	6
12.	Ambient Air Sampling-Determination of PM_{10}, $PM_{2.5}$, SO_2 and NO_2	12
13.	Noise Monitoring-Determination of Equivalent Noise Level	6

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

REFERENCE BOOKS:

1. ***Metcalf and Eddy. Inc.„ „Wastewater Engineering, Treatment, Disposal and Reuse" Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.***
2. ***Lee, C.C. and Shundar Lin. "Handbook of Environmental Engineering Calculations", Mc Graw Hill, New York, 1999.***
3. ***AEESP Environmental Processes Laboratory Manual, Association of Environmental Engineering and Science Professors Foundation, Washington, 2002.***
4. ***Aery N C., "Manual of Environmental Analysis", Ane Books Pvt. Ltd. New Delhi, 2014***
5. ***CPCB, Guidelines for the Measurement of Ambient Air Pollutants, Volume I, Central Pollution Control Board, Ministry of Environment and Forests, Government of India, 2001***

COURSE OUTCOMES:

After the completion of the course, the students will be able to

CO1: Design and analyze various treatability options for water and wastewater

CO2: To monitor ambient air and noise quality

COURSE ARTICULATION MATRIX:

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

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

18EEEE01 - MINI PROJECT

Category: EEC

COURSE OBJECTIVES:

L	T	P	C
0	0	4	2

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

1. Identify structural engineering problems reviewing available literature.
2. Study different techniques used to analyze complex structural systems.
3. Work on the solutions given and present solution by using his/her technique applying engineering principles.

SYLLABUS :

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

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

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

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

COURSE OUTCOMES:

At the end of the course students able to identify a problem, methodology for solving the problem in micro level.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	H	H	L	L	H	L	H	L

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

18EEEE02 - PROJECT PHASE I

Category: EEC

L	T	P	C
0	0	20	10

COURSE OBJECTIVES:

1. To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2. To develop the methodology to solve the identified problem.
3. To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

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

COURSE OUTCOMES:

At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	H	H	L	L	H	L	H	L

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

18EEEE03 - PROJECT PHASE II

Category: EEC

	L	T	P	C
COURSE OBJECTIVES:	**0**	**0**	**32**	**16**

To solve the identified problem based on the formulated methodology.

To develop skills to analyze and discuss the test results, and make conclusions

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

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

COURSE OUTCOMES:

On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	H	H	L	L	H	L	H	L

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

18EEPE01 - WATER QUANTITY MODELING

Category: PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of the course, graduates are expected to attain the following outcomes:

1. To learn about the surface water hydrology and surface run off model.
2. To acquire knowledge about ground water hydrology and flow.
3. To attain knowledge about ground water modeling

UNIT – I SURFACE WATER HYDROLOGY (9)

Land Processes – Subsurface and Channel Processes- Precipitation – Rain gauge network, Abstractions, Infiltration, Evaporation, Transpiration, Process and models.

UNIT – II SURFACE RUNOFF MODEL (9)

Unit Hydrograph & S-Curve Hydrograph, Dimensionless Unit hydrograph, IUH, Watershed Model and Conceptual Models.

UNIT – III GROUNDWATER HYDROLOGY (9)

Occurrence and Movement of Ground water, Properties of aquifer, Groundwater flow equations, DupuitForchheimer assumptions, Well hydraulics, Partial penetration of wells, Interference of wells, Collector wells and Infiltration galleries.

UNIT – IV GROUNDWATER FLOW (9)

Pumping tests, Analysis for unconfined and non leaky and leaky confined aquifer and watertable aquifer, locating hydro geologic boundaries, Well design criteria.

UNIT – V GROUNDWATER MODEL (9)

Natural and Artificial Recharge of Ground water- Salt water intrusion, Application of Finite Difference methods in ground water.

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

REFERENCE BOOKS:

1. VenTe Chow, "Applied Hydrology", Mc GrawHill Science Publishers, 2017, 1st edition

2. Singh, Vijay ., "Elementary Hydrology", Prentice Hall,2008, 1st edition.

3. Raghunath. "Ground Water", Mc Graw Hill, 2007

4. Bear, J., Hydraulics of Ground water, Mc Graw Hill, 2007

COURSE OUTCOMES:

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

CO1 : Understand the surface water hydrological parameters such as precipitation, evaporation, infiltration and transpiration.

CO2 : Apply the surface runoff model and evaluate the runoff.

CO3 : Analyze the factors that contribute to the movement of groundwater flow.

CO4: Evaluate the ground water flow based on pumping test.

CO5: Create ground water models with the interpretation of recharge intrusion.

COURSE ARTICULATION MATRIX:

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

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

18EEPE02 - ROLE OF ENVIRONMENTAL LEGISLATIONS IN INDUSTRIES

Category: PE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on the policies, legislation frame work and enforcement mechanisms for environmental management in india.

UNIT I THE WATER (PREVENTION & CONTROL OF POLLUTION) ACT, 1974 (9)

Definitions-Salient features-Powers &functions of Regulatory agencies–Responsibilities of occupier, provisions relating to prevention& control-procedures to obtain consent-Monitoring and compliance mechanisms-legal provision for violation of Water(P&CP)Act-Case studies on water polluting industries-Textile dyeing, Paper mills-Electroplating, Starch industries-inventorisation of new water polluting industry and its management-field visits.

UNIT II THE AIR (PREVENTION & CONTROL OF POLLUTION) ACT, 1981 (9)

Definition-Salient features- Powers &functions of Regulatory agencies -National ambient Air quality standards-Emission standards for industries specific- Responsibilities of occupier, provisions relating to prevention& control-procedures to obtain consent Monitoring and compliance mechanisms- legal provision for violation of Air(P&CP)Act- Case studies on Air polluting industries-Foundries, Cement, Thermal power plants- inventorisation of new Air polluting industry and its management-field visits.

UNIT III THE ENVIRONMENT (PROTECTION) ACT, 1986 (9)

Genesis of the Act-Salient features-Role of Central Government-various notifications and rules –prohibition on import of genetically modified organisms-chemicals-hazardous wastes- Batteries management-Restriction on Ozone depleting substances-EIA notification-Siting of industries-State level EIA Authorities-eco-mark-Control on noise pollution-coastal regulations- Monitoring and compliance mechanisms-Role of National Green Tribunals(NGT),Environmental courts & Public interest litigation -Case studies

UNIT IV REGULATIONS ON INDUSTRIAL SOLID WASTE MANAGEMENT (9)

Restriction on Hazardous waste-Bio-medical wastes-Recycled plastic wastes-Municipal solid wastes-e-waste-Salient features-Responsibilities of occupier/generator/local bodies/PCBs-Monitoring and compliance mechanisms-consent clearance , Authorisation, Registration procedures for industry specific-Issues & Challenges-Best practices-Case studies on lead refining, engineering units , hospitals, plastic units, Municipal landfills,-field visits.

UNIT V ELECTRONIC WASTE (MANAGEMENT & HANDLING) RULES2011 (9)

Definition-Environmental & Occupational Health hazards of e-waste-Salient features of E-waste Rules-Extended producers responsibility-issues and challenges –Compliance and Consent Clearance mechanisms-Best practices of E-waste management-Case studies on E-waste recycling units, Bulk consumers, Collection Centres-field visits.

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

TEXT BOOKS:

1. ***Rosencrannz, S. Divan, M.L.Noble, Environmental law and policy in India, cases, materials and statutes, Tripathipvt.Ltd. Bombay.***
2. ***Stem A.C. Air pollution, Vol. I to VIII, Academic press.***
3. ***Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.***
4. ***The safe disposal of hazardous waste. Vol. I, II, & III Bat stone, Smith, Wilson, Joint study Sponsored by the world bank, the WHO, & UN Environmental Program UNEP, The world bank Freeman, H.M. standard Handbook of Hazardous Waste Treatment and Disposal, 1989.***
5. ***E WASTE MANAGEMENT IN INDIA (2009), Electronics for you, www. efymag.com.***

REFERENCE BOOKS:

1. ***Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, Integrated Solid WasteManagement, McGraw- Hill, New York, 1993***
2. ***CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000***
3. ***Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.***
4. ***Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.***
5. ***Charles A. Wentz, Hazardous Waste Management, Second Edition, Pub: McGraw Hill International Edition, New York, 1995.***

LIST OF WEBSITES :

1. *www.usepa.gov/epaoswer/hazwaste/recycle/ecycling/index.htm*
2. *www.defra.gov.uk/environment/waste/index.htm*
3. *www.ec.gc.ca*
4. *www.environment.gov.au*

5. http://ec.europa.eu/environment/waste/weee/index_en.htm

6. www.ewasteguide.info

7. www.basel.int

8. www.unep.org

9. http://www.unep.ch/ozone/index.shtml

10. www.cpcb.nic.in/Hazardous%20Waste/default_Hazardous_Waste.html

11. http://www.basel.int/industry/mppiwp/guid-info/index.html

COURSE OUTCOMES:

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

CO1 : To understand the National and international Environmental Policies
CO2 : To apply the knowledge in Planning and decision making of Environmental policies
CO3 : To summarize the pollution control acts for water and air pollution
CO4 : To understand the management and handling of Industrial solid waste and E- waste
CO5 : To understand the management and handling of E- waste

COURSE ARTICULATION MATRIX:

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

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

18EEPE03 - ENVIRONMENTAL ENGINEERING STRUCTURES
(Common with Structural & Geotechnical Engineering)

Category: PE

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

Upon completion of the course, graduates are expected to attain the following outcomes:

1. To acquire knowledge about design of pipes and concrete roofing
2. Able to do design of water tank and special structures
3. To learn about repair and rehabilitation of structure.

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 : Analyzeand 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
CO1	H	M	H	H			L		L	L	L
CO2	H	M	H	H	H		L		L	L	L
CO3	H	H	H	H	H		L		L	L	L
CO4	M	M	M	M			L		L	L	L
CO5	M	M	M	M			L		L	L	L

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

18EEPE04 - ENVIRONMENTAL BIOTECHNOLOGY

Category : PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of the course, graduates are expected to attain the following outcomes:

1. To learn about the principles and biological intervention.
2. To attain knowledge about application biotechnology in industry and genetic modifications.
3. Able to learn about biotechnology applications in waste management

UNIT I INTRODUCTION: BASICS& PRINCIPLES (9)

Basic information on DNA and RNA Microbes- prokaryotes and eukaryotes, metabolism-carbohydrate, protein, lipids. Analysis of metabolism for environmental application and its mechanism, effective microorganism, Mechanism of detoxification, Photorespiration, immobilization, biodegradation, biogeochemical cycle

UNIT II FUNDAMENTALS OF BIOLOGICAL INTERVENTION (9)

Extremophiles and thermophiles and its potential applications in environmental issues, diverse degradative abilities of microbes, inhibitors of degradation-xenobiotics, endocrine disrupters

UNIT III INDUSTRIAL APPLICATION (9)

Decontamination of ground water, biofertilizers, physical, chemical and microbiological factors of composting, health risk, odor management, biological removal of nutrients- biotrickling filters, biomembrane technology

UNIT IV GENETIC MANIPULATION (9)

Basic principles of genetic engineering, concept of recombinant technology-expression vectors-cloning of DNA – mutation, protoplast fusion technology, genetically modified organisms, risk assessment

UNIT V INTEGRATED ENVIRONMENTAL BIOTECHNOLOGY (9)

Bioenergy, biogas production, biodiesel, Bioremediation, factors affecting bioremediation , Biosorption, mechanism of biosorption, waste minimization, ,pollution prevention, Biosensors and its application in environmental issues, integrated agricultural application, plant disease suppression, biomonitoring, phytoremediation, microbes external to the plants, plant/microbe interaction, Biotransformation

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

REFERENCE BOOKS:

1. ***Rehm H J and Reed G, Biotechnology, a comprehensive treatise, VCH Verleg, Germany, 1999.***
2. ***A K Chaterjee, Introduction to Environmental Biotechnology, PHI, India, 2000.***
3. ***Andrew D Eaton, Lenore S Clesceri, Eugene W Rice and Arnold E Greenberg, Standard Methods – For the Examination of Water and Wastewater, American Public Health Association, 2005.***
4. ***Raina M Maier, Ian L Pepper and Charles P Gerba, Environmental Microbiology, 2nd Ed., Academic Press, 2009.***
5. ***Bimal C. Bhattacharyya and Rintu Banerjee, Environmental Biotechnology, Oxford Higher Education, 2007.***
6. ***Godfrey Boyle, Renewable Energy – Power for a sustainable future, 2nd Ed, Oxford, Indian Edition, 2011 reprint.***
7. ***Anjaneyulu Y, Introduction to Environmental Science, BS Publications, 2004.***
8. ***Laxmi Lal and DK Gupta, Composting Technology, Agrotech Publishing Academy, 2008.***
9. ***Howard S Peavy, Donald R Rowe, George Tchobanoglous, Environmental Engineering, Mc Graw-Hill International Editions, Civil Engineering Series, 2013.***
10. ***LL Somani, Vermicomposting and Vermiwash, Agrotech Publishing Academy, 2008***

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: Know basic details of microorganism and its applications

CO2: Get idea about the principles and biological intervention

CO3: Know biotechnology applications in waste management

CO4: Attain knowledge about application biotechnology in industry and genetic modifications

CO5: Understand integrated management option and their applications

COURSE ARTICULATION MATRIX:

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

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

18EEPE05 - INSTRUMENTATION, SELECTION AND MANAGEMENT OF ENVIRONMENTAL ENGINEERING EQUIPMENTS

Category: PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of the course, graduates are expected to attain the following outcomes:

1. Able to get knowledge about Machineries and maintenance and analytical instruments
2. Able to learn about water and waste water machineries and equipments
3. Able to learn about equipments in air pollution control

UNIT I GENERAL (9)

Study of machinery, electric motors types and characteristics, other prime covers, pumps, capacity, operation and maintenance of pumping machinery, air compressors preventive maintenance, break-down maintenance, schedules – Factors to be considered in the selection of the equipments.

UNIT II INSTRUMENTATION (9)

pH meter - Flame Emission Spectrometry. Absorption spectrometry - Nephelometry - Atomic Absorption Spectrometry - Gas chromatography – working principle and components. Total carbon analyser Mercury Analyser polar graph for metal estimation and organic compounds - Ion selective Electrode -SO2 and CO analyser – Instrument components and its working principle.

UNIT III WATER SUPPLY MACHINERY AND WASTEWATER MACHINERY (9)

Drilling equipment, pumping equipment for wells. Machinery required for primary and secondary treatment, sewage pumps , sludge pumps, vaccum filtration equipment.

UNIT IV EQUIPMENTS FOR TREATMENT UNITS (9)

Equipment for treatment unit - electrically and mechanically operated agitators, mixers, aerators, chlorinators, Surface aerators. Meters for measurement of flow, head, and electricity.

UNIT V AIR POLLUTION CONTROL EQUIPMENTS (9)

Working principles of electrostatic precipitator – cyclone separators – settling chamber – operation and Maintenance. Machinery for solid waste collection and disposal incineration – compactors – magnetic separators- incinerators.

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

REFERENCE BOOKS:

1. ***Operation and Control of Water Treatment Processes COX CR WHO 1969.***
2. ***Course Manual on Preventive Maintenance of Water Distribution System, NEERI, 1993.***

3. ***Trivedy R. K. &Goel P.K., Chemical and Biological methods for water pollution studies, Environmental publication, Karat, 1986, Aravind Kumar, 2006.***
4. ***Standards Methods for the Examination of Water and Waste Water, 17th Edition, WPCF, APHA and AWWA, USA, Eugene W.Rice 2012..***

COURSE OUTCOMES:

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

CO1 : To get knowledge about Handling and maintenance of water and waste water machineries and equipment
CO2 : To understand the principle and operation of various Analytical instruments.
CO3 : To get knowledge about water and wastewater supply conduits.
CO4: To know about equipment used in treatment units.
CO5: To know about equipment used in air pollution control.

COURSE ARTICULATION MATRIX:

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

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

18EEPE06 - OPERATION AND MAINTENANCE OF WATER AND WASTEWATER TREATMENT SYSYEMS

Category: PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The students who complete the course would have acquired the knowledge required to operate and maintain water treatment plants and wastewater treatment plants including trouble shooting

UNIT I ELEMENTS OF OPERATION AND MAINTENANCE (9)

Strategy for Good Operation and Maintenance- Knowledge of process and equipment- Preventive and Corrective maintenance scheduling- - Operation and Maintenance Plan - Proper and adequate tools, Spare units and parts - Training Requirements- Laboratory control- Records and Reports- Housekeeping - Corrosion prevention and control –Sampling procedure-Analytical techniques- Code of practice for analytical laboratories- Measurement of Flows, Pressures and Levels -Safety in O&M Operations - Management Information System - Measures for Conservation of Energy- management of residues from plant maintenance

UNIT II OPERATION AND MAINTENANCE OF WATER INTAKES AND SUPPLY SYSTEMS (9)

Operational problems, O&M practices and Records of Operation of Reservoir and Intakes - Causes of Failure of Wells- Rehabilitation of Tube wells & Bore Wells- Prevention of Incrustation and Corrosion- Maintenance of Lined and Unlined Canals- Problems in Transmission Mains- Maintenance of Pipelines and Leakage Control- Repair Method for Different types of Pipes- Preventive and corrective maintenance of water pumps – Algal Control - O&M of Service Reservoirs - Problems in the water Distribution System and remedies- Water Quality Monitoring and Surveillance- Water Meters, Instrumentation, Telemetry & Scada- Computerised Water Billing System

UNIT III OPERATION AND MAINTENANCE OF SEWER SYSTEMS (9)

Components and functions of sewer system – Conduits or pipes – Manholes – Ventilating shaft – Maintenance of collection system – Operational Problems– Clogging of pipes – Hazards – Precautions against gas hazards – Precautions against infections – Devices for cleaning the conduits – Preventive and corrective maintenance of sewage pumps –operation and maintenance of sewage pumping stations- Maintenance Hazards and Operator Protection -Case Studies

UNIT IV OPERATION AND MAINTENANCE OF PHYSICO-CHEMICAL TREATMENT UNITS (9)

Operation and maintenance in screen chamber, Grit Chamber and clarifiers- - Operation issues, trouble shooting guidelines and record keeping requirements for clarifier, Equalization basins, Neutralization unit - Chemical storage and mixing equipment - Chemical metering equipment - Flash mixer –Filters, thickeners and centrifuges- Filter Press - Start-up and maintenance inspection - Motors and Pumps - Hazards in Chemical Handling – Jar Test – Chlorination

Equipment - Membrane process systems- SDI and LSI determination- Process Chemistry and Chemical dosage calculations- Case Studies

UNIT V OPERATION AND MAINTENANCE OF BIOLOGICAL TREATMENT (9)

Construction, Operation and Maintenance aspects of activated sludge process, trickling filters, anaerobic digester, SBR, UASBR, MBRs- Startup and Shutdown Procedures-DO, MLSS and SVI monitoring- Trouble shooting guidelines – Interaction with other Treatment Processes - Planning, Organizing and Controlling of plant operations – capacity building, case studies of Retrofitting- Case studies

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

REFERENCE BOOKS:

1. CPHEEO , Manual on operation and maintenance of water supply systems, Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, Government of India 2005

2. Ministry of Drinking Water and Sanitation, operation and maintenance manual for rural water supplies, Government of India, 2013

3. Metcalf & Eddy, Inc., G. Tchobanoglous, H. D. Stensel, R. Tsuchihashi, and F. L.Burton. "Wastewater Engineering: Treatment and Resource Recovery"5th edition). McGraw Hill Company.,2014

4. Ananth S Kodavasal, The STP Guide-Design, Operation and maintenance, Karnataka State Pollution Control Board, Bangalore,2011

5. FrikSchutte, handbook for the operation of water Treatment Works,The Water Research Commission, The Water Institute of Southern Africa, TT265/06, 2006.

COURSE OUTCOMES:

At the end of the course the students are able to

CO1 : Recognize the necessity for the operation and maintenance

CO2 : Acquire the knowledge required for the operation and maintenance of water treatment plants and wastewater treatment plants including trouble shooting.

CO3: Understand the sewer problems and their remedial measures.

CO4: Manage the physio chemical treatment units

CO5: Solve the operational problems of biological units

COURSE ARTICULATION MATRIX:

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

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

18EEPE07 - COMPUTING TECHNIQUES IN ENVIRONMENTAL ENGINEERING

Category: PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

On completion of this course, the students are able to

1. Understand the computing techniques.
2. Apply the principle of soft computing for solving Environmental problems
3. Assess the Environmental Impacts using ANN and Fuzzy logic.
4. Employ modern advanced computing tools in environmental studies

UNIT I COMPUTING PRINCIPLES (10)

Introduction to Computing techniques – Algorithms and Flowcharts, Numerical methods - Solution to ordinary and partial differential equation using Finite difference and Finite element method , Numerical integration and differentiation, Design of digital models for Environmental applications.

UNIT II ARTIFICIAL INTELLIGENCE (9)

Knowledge based Expert system concepts - Principle of Artificial Neural Network (ANN) – Neural Network Structure – Neural Network Operations – ANN Algorithm - Application of ANN Model to Environmental field – Genetic Algorithms

UNIT III FUZZY LOGIC (9)

Fuzzy sets, fuzzy numbers, fuzzy relations, fuzzy measures, fuzzy logic and the theory of uncertainty and information; applications of the theory to inference and control, clustering, and image processing - Network analysis models.

UNIT IV DATA MANAGEMENT (9)

Data base structure - Data acquisition - Data warehouse - Data retrieval-Data format Attribute - RDBMS - Data analysis - Network data sharing - Statistical Analysis (SYSTAT) - Regression - factor analysis - histogram - scatter diagram - Goodness of fit.

UNIT V ENVIRONMENTAL MODELING USING MATLAB (8)

Introduction to MATLAB Software – Environmental modeling principles and MATLAB Applications – Pollutants transport, decay and degradation modeling using MATLAB. Case studies.

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

REFERENCE BOOKS:

1. Aliev R. A, and Aliev Rashad, "Soft Computing and its Applications", World Scientific Publications Co. Pte.Ltd.Singapore, 2014.

2. Chepra S. C. and Canele R. P., "Numerical Methods for Engineers", McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. 6th Edition 2014.

3. Data-Driven Modeling: Using MATLAB in Water Resources and Environmental Engineering, Springer; 2014 edition.

4. Kotteguda, N.T., and Renzo Resso, Statistics, "Probability and Reliability for Civil and Environmental Engineers", McGraw Hill Companies Inc., New York, 2008.

5. Mathews J. H. and Fink K.D. , "Numerical methods using MATLAB", Pearson Education 2010.

COURSE OUTCOMES:

After completing this course, the students will be able to:

CO1: Apply the principle of soft computing for the analysis and design of engineering systems.

CO2: Assess the Environmental Impacts using ANN

CO3: Assess the Environmental Impacts using ANN and Fuzzy logic.

CO4: Collect, analyse and usage of datain the relevant tools.

CO5: Employ modern advanced computing tools in environmental studies

COURSE ARTICULATION MATRIX:

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

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

18EEPE08 - GROUND WATER CONTAMINATION AND TRANSPORT MODELING

Category : PE

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

1. To develop a basic knowledge about the groundwater contamination and transport modeling and apply the same in the field application.
2. To educate the students on the hydraulics related ground water contamination and modeling of ground water quality.

UNIT I INTRODUCTION TO GROUND WATER (12)

Ground water and the hydrologic cycles - Ground water contamination - Water quality standards - Sources of contamination - Land disposal of solid wastes - Sewage disposal on Land. Ground water and geologic processes. Physical properties and principles - Darcy's Law - Hydraulic Head and Fluid Potential - Piezometers and Nests. Hydraulic conductivity and permeability - Homogeneity and Anisotropy - Porosity and voids Ratio - Unsaturated flow and the water table - Steady state flow and Transient flow - Compressibility and effective stress.

UNIT II HYDRAULIC FLOW (6)

Flow nets - Graphical construction - Flow nets by numerical simulation. Steady state Regional Ground Water flow - steady state hydrologic budgets - Fluctuations in ground water levels.

UNIT III DEVELOPMENT OF GROUND WATER RESOURCES (9)

Development of Ground Water resources - Exploration for Aquifers - the response of Ideal aquifers to pumping - Measurement of parameters - Laboratory tests - Piezometer test - Pumping tests - Estimation of saturated hydraulic conductivity - Numerical simulation for aquifer yield prediction - Artificial recharge and induced infiltration - Land subsidence - Sea water intrusion.

UNIT IV CHEMICAL EQUILIBRIUM (9)

Constituents - Chemical equilibrium - Association and Dissociation of dissolved species - effects of concentration gradients - Mineral dissolution and solubility - Oxidation and reduction Process - Ion exchange and Adsorption - Environmental isotopes - Field Measurement of Index parameters. Chemical Evolution: HydroChemical sequences and facies - graphical methods - Hydro chemical Facies - Ground water in carbonate terrain.

UNIT V TRANSPORT MODELING (9)

Transport process - non-reactive constituents in homogeneous media and Heterogeneous media - Transport in Fracture media - Hydro chemical behavior of contaminants - Trace metals - Trace nonmetals - Nitrogen, organic substances - Measurement of parameters - Velocity - Dispersivity - chemical partitioning. Modelling Principles - MOC Modelling. Case studies

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

REFERENCE BOOKS:

1. ***Randall J. Charbeneau, "Ground water Hydraulics and Pollutant transport", Prentice Hall, Upper Saddle River, 2009.***
2. ***Todd David Keith, "Ground water Hydrology", Second edition, John Wiley and Sons, New York, 2010.***
3. ***Allen Freeze, R. and John A. Cherry, "Ground Water", Prentice Hall, Inc., 2009.***
4. ***Bear, Jacob,cheng, Alexander H.D. "Modelling Ground Water Flow and contaminant Transport" , 2010.***
5. ***Philip B, Bedient, Hanadis, Rifari,chareless J,NEWELL "Ground Water Contamination: Transport and Remediation", 1999.***

COURSE OUTCOMES:

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

CO1 : To get knowledge about groundwater formation.

CO2 : Attain knowledge about groundwater flow

CO3 : Assess the ground water quantity

CO4 : Understand the chemical equilibrium of groundwater

CO5 : Analyze the behavior of contaminants in groundwater and its modeling

COURSE ARTICULATION MATRIX:

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

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

18EEPE09 - ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Category : PE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of the course, graduates are expected to attain the following outcomes:

1. After the completion of course, the student will be able to understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
2. The student will also know about the legal requirements of Environmental and Risk Assessment for projects.

UNIT I INTRODUCTION (8)

Historical development of Environmental Impact Assessment (EIA).EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA-EIA Consultant Accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION (10)

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment

UNIT III SOCIAL IMPACT ASSESSMENT AND EIA DOCUMENTATION (8)

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials.

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN (7)

EIA Report preparation. Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies

UNIT V ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT (12)

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs

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

REFERENCE BOOKS:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996

2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003

3. World Bank –Source book on EIA

4. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999, Bimal Kanti Paul 2011.

5. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.

6. Raghavan K. V. and Khan A A, Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.

7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

COURSE OUTCOMES:

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

CO1 : Understand the importance of EIA in project development

CO2 : Apply the mathematical modeling for EIA

CO3 : Assess the environmental impact assessment of major projects

CO4 : Analyze the environmental management plan including the preparation, implementation and mitigation aspects

CO5 : Evaluate the risk assessment based on dose response analysis

COURSE ARTICULATION MATRIX:

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

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

18EEPE10 - MEMBRANE SEPARATION FOR WATER AND WASTEWATER TREATMENT

Category: PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

UNIT I MEMBRANE FILTRATION PROCESSES (10)

Solid Liquid separation systems- Theory of Membrane separation – mass Transport Characteristics - Cross Flow filtration - Membrane Filtration- Flux and Pressure drop -Types and choice of membranes, porous, non porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

UNIT II MEMBRANE SYSTEMS (10)

Microfiltration principles and applications – Ultra filtration principles and applications - Nano Filtration principles and applications – Reverse Osmosis: Theory and design of modules, assembly, plant process control and applications – Electro dialysis : Ion exchange membranes, process design- Pervaporation – Liquid membrane – Liquid Pertraction – Supported Liquid Membrane and Emulsion Liquid membrane - Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection– Plant operations – Economics of Membrane systems

UNIT III MEMBRANE BIOREACTORS (9)

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation. MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies

UNIT IV PRETREATMENT SYSTEMS (8)

Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning , Biofoulant control

UNIT V CASE STUDIES (8)

Case studies on the design of membrane based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

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

REFERENCE BOOKS:

1. ***Anthony Wachinski, Membrane Processes for water reuse, McGraw-Hill, USA, 2013***
2. ***Baker, R.W., "Membrane technology and applications", 2nd., John Wiley 2004***
3. ***Jorgen Wagner, "Membrane Filtration handbook, Practical Tips and Hints, 2nd Edition, Revision2, Osmonics Inc., 2001.***
4. ***Noble, R.D. and Stern, S.A., "Membrane Separations Technology: Principles and Applications", Elservier,Netherlands,1995.***
5. ***Symon Jud, MBR Book – "Principles and application of MBR in water and wastewater treatment", Elservier, 2006.***
6. ***Yamamoto K. and Urase T, "Membrane Technology in Environmental management", special issue, Water Science and technology, Vol.41, IWA Publishing, 2000.***
7. ***WEF, Membrane Bioreactors, WEF manual of Practice No.36, Water Environment Federation, USA.2012.***

COURSE OUTCOMES:

On Completion of the Course the student will be able to,

CO1: Understand the selection criteria for different membrane processes

CO2: Know the principle of the most common membrane applications and

CO3: Carry out design of project for a particular membrane technology application.

CO4: Rectify the problems encountered in membrane treatment

CO5: Study the performance of the existing membrane treatment units

COURSE ARTICULATION MATRIX:

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

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

18EEPE11 - ENVIRONMENTAL REACTION ENGINEERING

Category: PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of the course, graduates are expected to attain the following outcomes:

1. Successfully apply advanced concepts of fundamental sciences and engineering to identify, formulate, and solve complex environmental engineering problems, also to design, analyze, and develop technologies to meet desired needs of society, both, professionally and ethically.
2. Be knowledgeable of contemporary issues and research challenges/opportunities related to chemical and environmental engineering, and engage in life-long learning to keep abreast of such issues.
3. Use advanced techniques, skills, and modern scientific and engineering tools for problems related to professional practice in the field of environmental reaction engineering.

UNIT I INTRODUCTION (9)

Reaction engineering principles with applications to environmental systems, general reaction mechanisms: Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization– Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends. Rate relationships: Concepts and applications to homogenous systems and heterogeneous systems with respective chemical and biological reactions.

UNIT II POLLUTANTS AND REACTIONS IN ENVIRONMENT (10)

Reaction leading to generation of pollutants, impact of pollutants and theirs reactions on environment, ozone depletion, smog formation, acid rain, chemical reactions in major treatment technologies- gas – solid catalytic reactions, catalytic oxidation of VOCs, incineration, selective catalytic reduction. Gas – liquid reaction FCC (fluid catalytic cracking) off gas cleaning, wet-gas scrubbing, H2S removal and spent caustic oxidation.

UNIT III REACTORS MODELLING AND DESIGN (8)

Ideal systems modeling and design, reactor concepts, ideal reactors, reaction rate measurements, hybrid system modeling and design, sequencing batch reactor, reactors in series and reactors in recycle. Non-ideal system modeling and design, non-ideal reactor behavior, RTD analysis, PFDR model.

UNIT IV MASS TRANSFER AND ITS APPLICATIONS IN ENVIRONMENTAL ENGINEERING (8)

Principles of diffusion and mass transfer between phases, Gas absorption, humidification operations, leaching and extraction, drying of solids, fixed-bed separation, membrane separation process, fluid solid surface reactions, Gas-liquid bulk phase reaction, adsorption.

UNIT V BIOLOGICAL REACTION ENGINEERING (10)

Biological kinetics, enzyme kinetics, Michaelis – Menden equation, bioreactors, Batch and continuous operation in bioreactors, Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes: Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. bio concentration, bioaccumulation, biomagnification, bioassay, bio monitoring. Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications. Vermi technology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.

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

REFERENCE BOOKS:

1. Weber, W.J and Di Giano, F.A., "Process Dynamics in Environmental systems", John Wiley sons Inc, 2013.

2. Metcalf and Eddy, "wastewater engineering, treatment, disposal and Reuse", Inc. Third edition McGraw – hill 2013.

3. Dunn I.J, ElmarHeinzle, John Ingham, Prenosil J.E, „Biological reaction engineering, Wiley inter science, 2005.

4. The Engineering of Chemical reactions by Lanny.D.Schmidt,Oxford University Press , 1997

COURSE OUTCOMES:

CO1 : Successfully apply advanced concepts of fundamental sciences and engineering to identify, formulate, and solve complex environmental engineering problems

CO2: Identify the pollutants and their reaction with environment

CO3: Design, analyze, and develop technologies to meet desired needs of society, both, Professionally and ethically.

CO4: Be knowledgeable of contemporary issues and research challenges/opportunities related to chemical and environmental engineering, and engage in life-long learning to keep abreast of such issues.

CO5 : Use advanced techniques, skills, and modern scientific and engineering tools for problems related to professional practice in the field of environmental reaction engineering.

COURSE ARTICULATION MATRIX:

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

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

18EEPE12 - ENVIRONMENTAL SYSTEM ANALYSIS

Category: PE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Developed conceptual schematics required for system analysis and an ability to translate pertinent criteria into system requirements

UNIT I ECOLOGICAL SYSTEM (9)

Basic concepts in ecology and ecological modeling, Population Dynamics: Birth and death processes. Single species growth, Prey-predator models: Lotka-Volterra, Rosenzweig-MacArther, Kolmogorov models. Multi-species modeling - Structural analysis and stability of complex ecosystems.

UNIT II CONTINUOUS-FLOW REACTOR MODELING (9)

CSTR, Plug-Flow, Dispersion. A case study of a tubular reactor with axial dispersion, Parameter Calibration: Search algorithms for nonlinear dynamical models, Variance of estimated parameters. Application to Monod and Haldane kinetics.

UNIT III WATER QUALITY MODELING (9)

Rivers and streams water quality modeling -dispersion and mixing- water quality modeling process- model sensitivity-assessing model performance; Models for dissolved oxygen and pathogens- Pollutant and nutrient dynamics -Dissolved Oxygen dynamics -Groundwater quality modeling.

UNIT IV MICROBIAL DYNAMICS AND ENERGETICS (9)

Requirements for carbon and nutrient removal. Activated sludge: Process schemes: completely mixed, plug-flow, SBR, nutrient removal. Anaerobic digestion: process dynamics, Operational control of wastewater treatment processes.

UNIT V COMPUTER BASED SOLUTIONS (9)

Formulation of linear optimization models. Linear programming. Sensitivity testing and duality. Solution techniques and computer programming; Formulation of linear optimization models. Application of models- simulation, parameter estimation and experimental design.

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

REFERENCE BOOKS:

1. Deaton, M.L and Winebrake, J.J., "Dynamic Modeling of Environmental Systems", Springer-Verlag, 2000

2. Orhon, D and Artan, N., "Modeling of Activated Sludge Systems, Technomic" Publ. Co., 1994.

3. Chapra, S.C. "Surface Water-Quality Modeling", McGraw-Hill, 1997.

4.METCALI & EDDY," Waste Water Engineering Treatment,Disposal, Reuse", Tata McGraw hill, New York,2013.
5.Arceivala S.J.,"waste water Treatment and Disposal, McGraw Hill Education(india),pvt Ltd,2007.

COURSE OUTCOMES:

CO1 : Understand the basic concepts involved in ecological system and assess the ecological modeling based on population dynamics.

CO2 : Apply the modeling techniques and algorithms for reactor design

CO3 : Analyze water quality modeling based on dispersion, mixing, the amount of dissolved oxygen presents in water and assessing its performance.

CO4 : Summarize the requirements for carbon and nutrient removal; understand the process dynamicsand operation control for the treatment processes.

CO5 : Formulate the optimization models using computer simulation

COURSE ARTICULATION MATRIX:

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

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

18EEPE13 - REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL ENGINEERING

Category : PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Able to learn fundamentals of remote sensing, aerial photography and satellite remote sensing
2. Able to get knowledge on data analysis and application of GIS
3. Able to use GIS in the laboratory

UNIT I FUNDAMENTALS OF REMOTE SENSING (9)

Introduction to remote sensing – Principles of Electro – Magnetic Radiation – Energy /Matter interaction with Atmosphere and land surface – spectral reflectance of earth materials and vegetation – Data products.

UNIT II AERIAL PHOTOGRAPHY AND SATELLITE REMOTE SENSING (9)

Aerial Photography – Photogrammetry And Visual Image Interpretation. Various satellites in orbit and their sensors – Resolutions – Multispectral Remote Sensing system (MSS) and design – VISIBLE - NIR remote sensing - Thermal IR Radiation properties, systems and application – Microwave and LIDAR remote sensing – Principles and applications.

UNIT III DATA ANALYSIS AND GIS (9)

Data Analysis – Visual interpretation and digital image processing – Classification. Introduction to GIS, concepts and data base structure, various GIS software.

UNIT IV REMOTE SENSING AND GIS APPLICATIONS (9)

Applications of Remote sensing and GIS – Management and Monitoring of Land, air, water and pollution studies – conservation of resources – coastal zone management – Limitations.

UNIT V LABORATORY PRACTICES (9)

Data sources – Visual interpretation - digital image processing – Introduction to ENVI image processing software – GIS / Data Analysis in ARC GIS.

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

REFERENCE BOOKS

1. ***Anji Reddy, "Remote Sensing and Geographical Information system", BS publications 2001.***
2. ***M.G. Srinivas (Edited by) "Remote sensing applications", Narosa publishing house, 2001.***

3. ***A M. Chandra and S.K .Ghosh, "Remote Sensing and Geographical Information System", Narosa Publishing House, 2006.***
4. ***Lintz, J. and Simonet, Remote Sensing of Environment, Addison Wesley Publishing Company, Sidney Ray - 1999.***
5. ***Burroughs P.A, Principles of Geographical Information System, Oxford University Press, 1998.***
6. ***Thomas M Lille sand ,Rupiah W. Kiefer & Jonathan W. Chip man "Remote sensing and Image Interpretation" John Wiley Sons, 2004.***

COURSE OUTCOMES:

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

CO1 : Understand the concepts of GIS techniques and Data input.

CO2 : Identify field applications in Resources management

CO3 : Analyze data using various GIS software

CO4 : Get knowledge on data analysis and application of GIS

CO5 : Use the softwares for the field data.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M		H	H	H	H		H	M	L
CO2	H	H	M	H	H	M	M		M	M	L
CO3	H	H		M	M	M	M		L	M	L
CO4	H	H		M	M	M	M		2	M	L
CO5	H	M		H	M	M	M		2	M	L

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

18EEPE14 - AIR AND NOISE QUALITY MODELING

Category: PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Develop conceptual schematics required for air quality modeling
2. Translate pertinent criteria into air pollution control.

UNIT I MODELING CONCEPT (8)

Overview of different types of models-deterministic and stochastic approach- Steps in model development- numerical and simulations models- calibration and validation of models- Limitations- Transport phenomena- Mass balance analysis-Model development and decision making.

UNIT II AIR POLLUTION MODELING (11)

Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants - Meteorological settling for dispersal of air pollutants – Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

UNIT III AIR QUALITY MODELS (12)

Types modeling technique, modeling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models- diffusion models – Gaussian plume derivation- modifications of Gaussian plume equation- long term average-multiple cell model-receptor oriented and source oriented air pollution models- model performance, accuracy and utilization-air Quality Index -air quality mapping

UNIT IV INDOOR AIR QUALITY MODELS (8)

Indoor Air Pollutants - Volatile Organic Compounds , Inorganic Gaseous Pollutants Respirable Particulates , Bioaerosols, Radon and its decay products-Infectious disease transmission- A/C units in indoor- Odors and sick building syndrome-Indoor Air quality Models.

UNIT V SOFTWARE PACKAGE APPLICATIONS (6)

Commercial air quality models -ADMS, Airviro and USEPA models.

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

REFERENCE BOOKS:

1. Zanneti, P. "Air Pollution Modeling Theories", Computational Methods and Available Software. Van Nostrand Reinhold, New York. 1990

2. Boubel R.W., Fox D.L., Turner D.B & Stern A.C., "Fundamentals of Air Pollution" Academic Press, New York, 1994

3. Schnoor J.L., "Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil", John Wiley & Sons Inc., New York, 1996.

4. Arthur C.Stern Air Pollution (3rd Ed.)Volume I – Air Pollutants, their transformation and Transport, (Ed.), Academic Press, 2006.

5. Deaton and Wine Brake, "Dynamic Modeling of Environmental Systems", Wiley & Sons, 2002.

COURSE OUTCOMES:

At the end of the course the students are able to

CO1: Understand mathematical perspective of modeling

CO2 : Use air pollution modeling parameters in appropriate places

CO3 : To Develop conceptual schematics required for air quality modeling

CO4 : Make air quality models and ability to translate pertinent criteria into air pollution control.

CO5 : Use software in air quality modeling

COURSE ARTICULATION MATRIX:

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

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

18EEPE15 - ENVIRONMENTAL AUDITING AND NEW PRODUCT MANAGEMENT

Category : PE

PREREQUISITES : Nil

L	T	P	C
3	0	0	3

UNIT I ENVIRONMENTAL AUDITING (6)

Environmental Policies and Legislations - Industrial activities and Environment – Prevention versus Control of Industrial Pollution – – Regulation to Encourage Pollution Prevention and Cleaner Production – Environmental Auditing – Types-Environmental Reporting Environmental statement- Role of Industry, Government and Institutions – Environmental Management Hierarchy - Regulatory versus Market Based Approaches.

UNIT II EA TOOLS (10)

Environmental Impact Assessment - Life Cycle Assessment - Elements of LCA – Life Cycle Costing – Eco Labeling – Environmental Management Systems- Standards – ISO 14001,19000 – Environmental audit –Environmental Risk Assessment – Technology Assessment - Tools with case studies

UNIT III CLEANER PRODUCTION (10)

Definition – methodology – Historical evolution – Benefits – Promotion – Barriers Overview of CP - Assessment Steps and Skills - Preparing for the Site, Visit, Information gathering, and Process Flow Diagram - Material Balance - CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis– CP Financing – Establishing a Program – Organizing a Program – Preparing a Program Plan – Measuring Progress – Pollution Prevention and Cleaner Production Awareness Plan.

UNIT IV ENVIRONMENTAL ASPECTS OF NEW PRODUCT,DEVELOPMENT (10)

New Product Development Process(NPDP) –Objectives- opportunities in Product Design – Product Life cycle Management – PRO launch –basics, benefits, Phase gate, Design for Environment, Design for Six Sigma(DFSS), Best Available Technology concept (BAT) - Project Management - goals and Life cycle

UNIT V SUSTAINABLE DEVELOPMENT (9)

Sustainable development – Indicators of Sustainability – Sustainability Strategies - Barriers to Sustainability – – Industrialization and sustainable development – Industrial Ecology – SHE – Six-Age Model- Cleaner Production (CP) in Achieving Sustainability – Business opportunities and Success for sustainable future

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

REFERENCE BOOKS:

1. ***World Bank Group 'Pollution Prevention and Abatement Handbook – Towards Cleaner Production', WorldBank and UNEP, Washington D. C., 1998.***
2. ***Prasad modak C. Visvanathan and Mandarparasnis , 'Cleaner Production Audit', Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 1995.***
3. ***Robert.G.Cooper,'Winning at NewProducts' Third Edition, Basic Books, A member of the Perseus Books Group,2001***
4. ***Richard Welford and Richard Starkey , Business and the Environment, University Press 2010***
5. ***www.environmentalexpert.com.***
6. ***www.Cleaner production.com.***

COURSE OUTCOMES:

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

CO1: Recognize the relationship between the organizations and the environment and assess critically the benefits of environmental auditing

CO2: Understand the application of environmental management tools and able to do the assessment on Environmental impact

CO3: Perform the strategies of cleaner production

CO4: Analyze the environmental responsibility while developing a new product and thereby by achieving the sustainability

CO5: Use the incatorstratagies for achieving sustainable development.

COURSE ARTICULATION MATRIX:

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

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

18EEPE16 - ADVANCED WASTEWATER TREATMENT AND REUSE

Category : PE

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 air sripping
2. Able to learn about various nutrient processes
3. Able to learn about reclamation and reuse of wastewater

UNIT I GENERAL AND STRIPPING (9)

Need for advanced wastewater treatment – technologies used for advanced treatment – conventional reactor modifications in advanced treatment-oxidation processes – regulations in removal of NBOD and other nutrients- Selection of unit operation in advanced treatment Gas stripping – Analysis of gas stripping – Design of stripping towers – applications. – Air stripping of ammonia – Breakpoint chlorination – Ion exchange.

UNIT II NITROGEN REMOVAL AND OXIDATION PROCESSES (9)

Nutrient removal – Nitrogen removal – forms and sources of nitrogen – Biological nitrogen removal – Nitrification kinetics – Denitrification kinetics – Design parameters – Nitrogen removal by – physical and chemical processes Oxidation processes-advanced oxidation process in removal of nitrogen and phosphorus derivatives-use of peroxy, Cl- and oxy radicals in reducing COD.

UNIT III MEMBRANE SEPARTION PROCESSES AND ELECTRO DIALYSIS (9)

Membrane separation processes – process classification – membrane materials-Symmetric and asymmetric membranes – membrane configuration – membrane fouling- Molecular weight cutoff – Reverse osmosis – theory – membrane structure and rejection mechanism – osmotic pressure – Transport models and flux equations – ultra filtration – Electrdialysis – theory – power requirement.

UNIT IV PHOSPHOROUS REMOVAL (9)

Phosphorous removal – By biological methods – Phosphorous removal by chemical addition – chemistry of precipitation with Aluminium, calcium and Iron – Comparison of processes – Estimation of sludge produced from chemical precipitation of phosphorous with lime in PST.

UNIT V WASTEWATER RECLAIMATION AND REUSE (9)

Merits and demerits of advanced treatment-applications of treated wastewater- Wastewater reclamation and reuse – The role of water recycling in the hydrologic cycle – wastewater reuse applications – public health and environmental issues in water reuse – Level of treatment – Risk Assessment – Ground water recharge with reclaimed water.

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

REFERENCE BOOKS

1. ***METCALF & EDDY, "Wastewater Engineering Treatment Disposal Reuse", Tata McGraw-Hill, New York, 2013.***
2. ***Arceivala S. J.' "Wastewater treatment and Disposal" Marcelderdekker Publishers,1981.***
3. ***HOWARD S. PEAVY, DONALD R. ROWE & GEORGE TCHOBANOGLOUS, "Environmental Engineering", McGraw-Hill, 2013.***
4. ***QASIM S. R., "Wastewater Treatment Plant – Planning, Design and operation, Holt Rinchart and Winston, New York, 2002.***
5. ***Larry D. Benefield and Clifford W. Randall, "Biological Process Design for Wastewater Treatment" , Prentice - Hall Series in Environmental sciences, 1985.***

COURSE OUTCOMES:

At the end of these course student will be able to

CO1 : Learn the appropriate advanced treatment methods to remove critical pollutants from the wastewater.

CO2: Understand kinetics involved in nitrogen removal from wastewater.

CO3 : Apply the mechanism involved in the membrane processes.

CO4 : Analyze the various methods used for the removal of phosphorous and determine sludge production rate.

CO5 : Analyze the various wastewater reclamation and reuse techniques.

COURSE ARTICULATION MATRIX:

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

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 Vastu Purusha Mandala and its significance in creation of patterns, and lay-outs, extension of this to aural and visual fields -Types of Lay-Outs

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

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

UNIT V - MEASUREMENTS & MATERIALS (9)

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

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

REFERENCE BOOKS:

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

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

COURSE OUTCOMES:

The students are able to

CO 1: Obtain exposure on various concepts of vastu

CO 2: Understand the theories in Vastu.

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

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

CO 5: Plan a structure considering various vastu techniques.

COURSE ARTICULATION MATRIX:

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

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*		

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*	

18EEOE04 - ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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), H3-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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

CO1: Understand solid waste management techniques

CO2: Know what is biomass

CO3 : Study Methods and factors considered for biomass gasification

CO4 : Know equipment meant for biomass combustion

CO5 : Understand about biogas and its development in India

COURSE ARTICULATION MATRIX:

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

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

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 (9)

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 (9)

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

UNIT III ENERGY REQUIREMENTS IN BUILDING (9)

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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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 (9)

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*			

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

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVE

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

UNIT I-EARTHQUAKES (09)

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

UNIT II- SLOPE STABILITY (09)

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

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.

UNITV-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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.s

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

REFERENCE BOOKS:

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

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

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

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

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

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understanding methods concepts of cost management.

CO2: Developing the skills for project planning.

CO3: Evaluating the cost behavior and profit.

COURSE ARTICULATION MATRIX

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

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

18EDOE12-INTRODUCTION TO INDUSTRIAL ENGINEERING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

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

INTRODUCTION (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.

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.

WORK SYSTEM DESIGN (9)

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

STATISTICAL QUALITY CONTROL (9)

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

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 the functioning of various kinds of Industries.

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

CO3: Evaluating the cost optimization in industries.

COURSE ARTICULATION MATRIX

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

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

18MFOE13 INDUSTRIAL SAFETY
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVES:

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

UNIT –I INDUSTRIAL SAFETY (9)

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

UNIT –II FUNDAMENTALS OF MAINTENANCE ENGINEERING (9)

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

UNIT –III WEAR AND CORROSION (9)

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

UNIT –IV FAULT TRACING (9)

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

UNIT –V PERIODIC AND PREVENTIVE MAINTENANCE (9)

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

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

REFERENCE BOOKS:

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

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

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

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

COURSE OUTCOMES :

On completion of this course, students will be able to

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

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

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

COURSE ARTICULATION MATRIX

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

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

18MFOE14 OPERATIONS RESEARCH
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

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

UNIT- I INTRODUCTION **(9)**

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

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

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

(9)

UNIT-III NON LINEAR PROGRAMMING PROBLEM

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

(9)

UNIT -IV SEQUENCING AND INVENTORY MODEL

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

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

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

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

REFERENCE BOOKS:

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

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

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

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

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

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

COURSE OUTCOMES :

On completion of this course, students will be able to

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

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

CO3: Implement optimization techniques in engineering problems.

COURSE ARTICULATION MATRIX

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

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

18MFOE15 COMPOSITE MATERIALS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVES :

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

UNIT- I INTRODUCTION (9)

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

UNIT- II REINFORCEMENT (9)

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

UNIT- III MANUFACTURING OF METAL MATRIX COMPOSITES (9)

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

UNIT-IV MANUFACTURING OF POLYMER MATRIX COMPOSITE (9)

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

UNIT-V STRENGTH ANALYSIS OF COMPOSITES (9)

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

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

REFERENCE BOOKS:

1. ***Lubin****, George,* ***"Hand Book of Composite Materials",*** *Springer, 1982.*

*2. K.K.Chawla, "****Composite Materials****", Springer, 2011*

3. Deborah D.L. Chung ***, "Composite Materials Science and Applications"*** *, Springer, 2010.*

*4. Danial Gay, Suong V. Hoa, and Stephen W.Tasi, "****Composite Materials Design and Applications****", CRC Press,2002.*

*5. R.W.Cahn, "****Material Science and Technology – Vol 13– Composites",*** *VCH, West Germany, 1996.*

*6. WD Callister, Jr., Adapted by R. Balasubramaniam, "****Materials Science and Engineering, An introduction****", John Wiley & Sons, NY, Indian edition, 2007.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the nature of composite materials and composite reinforcements.

CO2: Develop the skills for manufacturing of composites.

CO3: Evaluate the strength of composite materials.

COURSE ARTICULATION MATRIX

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

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

18TEOE16 – GLOBAL WARMING SCIENCE
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make the students to learn about the material consequences of climate change, sea level change due to increase in the emission of greenhouse gases and to examine the science behind mitigation and adaptation proposals.

INTRODUCTION **(9)**

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

CLIMATE MODELS **(9)**

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

EARTH CARBON CYCLE AND FORECAST **(9)**

Carbon cycle-process, importance, advantages. Carbon on Earth, Global carbon reservoirs, Interactions between human activities and Carbon cycle. Geologic time scales, Fossil fuels and energy, Perturbed

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.

GEO ENGINEERING **(9)**

Solar mitigation, Strategies – Carbon dioxide removal, solar radiation management, Recent observed trends in global warming for sea level rise, drought, glacier extent.

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

REFERENCE BOOKS:

1 *Archer, David.* ***GlobalWarming: Understanding the Forecast****, Wiley, 2011*

2 *Budyko,* ***Climate Changes, American Geophysical Society****, Washington, D.C.,244 pp.*

3 *Bodansky,* ***May we engineer the climate?****Clim. Change 33, 309-321.*

4 *Dickinson,* ***Climate Engineering-A review of aerosol approaches to changing the global energy*** *balance, Clim. Change 33, 279-290.*

5 *Climate Change 2007-****The Physical Science Basis: Working Group I Contribution to the Fourth Assessment Report of the IPCC****. Cambridge University Press,2007.*

COURSE OUTCOMES:

On completion of this course, the students will be able to:

CO1: Understand the current warming in relation to climate changes throughout the Earth.

CO2: Assess the best predictions of current climate models.

CO3: Able to know about current issues, including impact from society, environment, economy as well as ecology related to greenhouse gases.

COURSE ARTICULATION MATRIX

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

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

18TEOE17 – INTRODUCTION TO NANO ELECTRONICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

- To make the students to provide strong, essential, important methods and foundations of quantum mechanics and apply quantum mechanics on engineering fields.

INTRODUCTION **(9)**

Particles and Waves, Operators in quantum mechanics, The Postulates of Quantum Mechanics, The Schrodinger Equation Values and Wave Packet Solutions, Ehrenfest's Theorem.

ELECTRONIC STRUCTURE AND MOTION **(9)**

Atoms- The Hydrogen Atom, Many-Electron Atoms, Many-Electron Atoms. 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.

SCATTERING THEORY **(9)**

The formulation of scattering events- scattering cross section, stationary scattering state. Partial wave stationary scattering events, Multi-channel scattering, Solution for Schrodinger Equation- radial and wave equation, Greens' function.

CLASSICAL STATISTICS

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

QUANTUM 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.

INTRODUCTION **(9)**

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

ESSENTIALS OF SUPPLY CHAIN MANAGEMENT **(9)**

Basic concepts of supply chain management, Supply chain operations – Planning and sourcing, Making and delivering. Supply chain coordination and use of Technology. Developing supply chain systems.

PLANNING THE SUPPLY CHAIN **(9)**

Types of decisions – strategic, tactical, operational. Logistics strategies, implementing the strategy. Planning resources – types, capacity, schedule, controlling material flow, measuring and improving performance.

ACTIVITIES IN THE SUPPLY CHAIN

Procurement – cycle, types of purchase. Inventory management – EOQ, uncertain demand and safety stock, stock control. Material handling – purpose of warehouse and ownership, layout, packaging. Transport – mode, ownership, routing vehicles.

SUPPLY CHAIN MANAGEMENT STRATEGIES

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, cable TV, 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.

(09)

UNIT-V : ANALYSIS AND CONVENTIONAL MITIGATION METHODS

Analysis of power outages, Analysis of unbalance condition: Symmetrical components inphasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers - Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

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

REFERENCE BOOKS:

1. M. H. J. Bollen, "Understanding Power Quality Problems, Voltage Sag and Interruptions", IEEE Press, series on Power Engineering, 2000.

2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., "Electrical Power SystemQuality", Second Edition, McGraw Hill Publication Co., 2008.

3. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition).

4. Enrique Acha, Manuel Madrigal, "Power System Harmonics: Computer Modeling and Analysis", John Wiley and Sons, 2001.

5. Arrillaga J. and Watson N."Power System Harmonics"2nd edition on; John Willey&sons, 2003

6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

COURSE OUTCOMES:

CO1: Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.

CO2: Recognize the practical issues in the power system

CO3: Analyze the impact of power electronic devices and techniques in power system

CO4: Develop trouble shooting skills and innovative remedies for various power quality problems in power system

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

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

18PSOE21 MODERN AUTOMOTIVE SYSTEMS **Category : OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To expose the students with theory and applications of Automotive Electrical and Electronic Systems.

UNIT-I : INTRODUCTION TO MODERN AUTOMOTIVE ELECTRONICS **(08)**

Introduction to modern automotive systems and need for electronics in automobiles- Role of electronics and microcontrollers- Sensors and actuators- Possibilities and challenges in automotive industry- Enabling technologies and industry trends.

UNIT-II : SENSORS AND ACTUATORS **(09)**

Introduction- basic sensor arrangement- Types of sensors- Oxygen sensor, engine crankshaft angular position sensor – Engine cooling water temperature sensor- Engine oil pressure sensor- Fuel metering- vehicle speed sensor and detonation sensor- Pressure Sensor- Linear and angle sensors- Flow sensor- Temperature and humidity sensors- Gas sensor- Speed and Acceleration sensors- Knock sensor- Torque sensor- Yaw rate sensor- Tyre Pressure sensor- Actuators - Stepper motors – Relays.

UNIT-III : POWER TRAIN CONTROL SYSTEMS IN AUTOMOBILE **(09)**

Electronic Transmission Control - Digital engine control system: Open loop and close loop control systems- Engine cooling and warm up control- Acceleration- Detonation and idle speed control - Exhaust emission control engineering- Onboard diagnostics- Future automotive power train systems.

UNIT-IV : SAFETY, COMFORT AND CONVENIENCE SYSTEMS **(10)**

Cruise Control- Anti-lock Braking Control- Traction and Stability control- Airbag control system- Suspension control- Steering control- HVAC Control.

UNIT-V : ELECTRONIC CONTROL UNITS (ECU) **(09)**

Need for ECUs- Advances in ECUs for automotives - Design complexities of ECUs- V-Model for Automotive ECU‘s- Architecture of an advanced microcontroller (XC166 Family, 32-bit Tricore) used in the design of automobile ECUs- On chip peripherals, protocol interfaces, analog and digital interfaces.

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

REFERENCE BOOKS:

1. M. H. J. Bollen, "Understanding Power Quality Problems, Voltage Sag and Interruptions", IEEE Press, series on Power Engineering, 2000.

2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., "Electrical Power SystemQuality", Second Edition, McGraw Hill Publication Co., 2008.

3. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition).

4. Enrique Acha, Manuel Madrigal, "Power System Harmonics: Computer Modeling and Analysis", John Wiley and Sons, 2001.

5. Arrillaga J. and Watson N."Power System Harmonics"2nd edition on; John Willey&sons, 2003

COURSE OUTCOMES:

CO1: Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.

CO2: Recognize the practical issues in the power system

CO3: Analyze the impact of power electronic devices and techniques in power system

CO4: Develop trouble shooting skills and innovative remedies for various power quality problems in power system

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

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

18PEOE22 VIRTUAL INSTRUMENTATION **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 Lab VIEW 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
(Common to All Branches)

Category: OE

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-MEDIUM H-HIGH

18AEOE26 ADVANCED PROCESSORS
(Common to all Branches)

Category : OE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

***COURSE OBJECTIVES*:**

- To introduce the basics of CISC and RISC
- Describe the architectural features of Pentium processors
- Describe ARM and Special processors

MICROPROCESSOR ARCHITECTURE **(9)**

Instruction set – Data formats – Instruction formats – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – The instruction pipeline – pipeline hazards – Instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation.

HIGH PERFORMANCE CISC ARCHITECTURE –PENTIUM **(9)**

The software model – functional description – CPU pin descriptions – Addressing modes – Processor flags – Instruction set – Bus operations – Super scalar architecture – Pipe lining – Branch prediction – The instruction and caches – Floating point unit– Programming the Pentium processor.

HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM INTERFACE **(9)**

Protected mode operation – Segmentation – paging – Protection – multitasking – Exception and interrupts - Input /Output – Virtual 8086 model – Interrupt processing.

HIGH PERFORMANCE RISC ARCHITECTURE: ARM **(9)**

ARM architecture – ARM assembly language program – ARM organization and implementation – ARM instruction set - Thumb instruction set.

SPECIAL PURPOSE PROCESSORS **(9)**

Altera Cyclone Processor – Audio codec – Video codec design – Platforms – General purpose processor – Digital signal processor – Embedded processor – Media Processor – Video signal Processor – Custom Hardware – Co-Processor.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 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-MEDIUM H-HIGH

18AEOE27 PATTERN RECOGNITION
(Common to all Branches)

Category : OE

	L	T	P	C
PREREQUISITES: Nil	**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-MEDIUM H-HIGH

18VLOE28 VLSI DESIGN

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

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-MEDIUM H-HIGH

18VLOE29 ANALOG & MIXED MODE VLSI CIRCUITS

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-MEDIUM H-HIGH

18VLOE30 HARDWARE DESCRIPTION LANGUAGES

Category : OE

PREREQUISITES: Nil

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To gain knowledge on HDLs and Modeling styles
- To understand the VHDL and Verilog HDL.
- To design sub-systems USING VHDL/VERILOG

BASIC CONCEPTS OF HARDWARE DESCRIPTION LANGUAGES (9)

VLSI Design flow, Features of VHDL, Capabilities, Hierarchy, Syntax and Semantics of VHDL; Basic Language Elements - Data objects - Variable signal, and constant, Data types, Operators and signal assignments, Design Suits - Entities, architecture declaration, configurations, Packages.

MODELING STYLES (VHDL) (9)

Behavioral Modeling - Process statement, Sequential assignment statements, Loops, wait statement, assertion statement, Delay Model – Inertial delay Model, Transport delay model; Gate Level Modeling – Component instantiation statements; Data flow Modeling - Concurrent assignment statement, Conditional assignment statements, Procedures, functions, Generics, attributes, Model simulation - Writing a test bench, Logic Synthesis.

INTRODUCTION TO VERILOG HARDWARE DESCRIPTION LANGUAGE (9)

Key features, Capabilities, Language Constructs and Conventions in Verilog, Syntax and Semantics of Verilog; Basic Language Elements: Operators, nets, registers, vectors, arrays, parameters, system tasks, complier directives, Module, port connection rules.

MODELING STYLES (VERILOG) (9)

Gate Level Modeling - Gate types, Gate delays; Dataflow Modeling – continuous assignment, Behavioral Modeling - Initial & Always Construct, Assignments with Delays, wait construct, Multiple always blocks, If and if - else, assign, Loop Construct, Sequential and Parallel blocks, Switch level modeling - MOS switches, CMOS switches.

DESIGN SUB-SYSTEMS USING VHDL/VERILOG (9)

Combinational logics – Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter; Flip flop, state machines – Mealy type FSM, Moore type FSM, Counters and Shift register. Synthesis of digital logic circuits.

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. **J. Bhaskar, "A VHDL Primer, 3rd Edition, Pearson Education, 2015.**
2. **Douglas Perry, "VHDL", McGraw Hill International, New York, 1998.**
3. **S. Brown & Z. Vransesic, "Fundamental of digital Logic with Verilog design", Tata McGraw Hill, 2002.**
4. **S. Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall (NJ, USA), 2003.**
5. **Frank Vahid, "Digital Design", Wiley, 2006.**
6. **Peter J Ashenden, "The Designer's Guide to VHDL", Morgan Kaufmann Publishers, 2008.**
7. **Navabi, "VHDL Analysis & Modeling of digital systems", McGraw Hill, 1998.**

***COURSE OUTCOMES*:**

After completing this course, the students will have:

- CO1: knowledge on HDLs and Modeling styles
- CO2: to write the VHDL and Verilog HDL codes
- CO3: to design sub-systems USING VHDL/VERILOG

COURSE ARTICULATION MATRIX:

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

L-LOW M-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

H = 3 ; M = 2 ; L = 1

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

H = 3 ; M = 2 ; L = 1

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

H = 3 ; M = 2 ; L = 1

18EEACZ1 - 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

18EEACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

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

- Key concepts in disaster risk reduction.
- Types of disasters and hazards.
- Disaster prone areas in India.
- Strengths and weaknesses of disaster management approaches.
- Risk assessment methods.

UNIT I INTRODUCTION L(6)

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT 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

18EEACZ3 - 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

18EEACZ4 - 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: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: 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

18EEACZ5 - PEDAGOGY STUDIES
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

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

- Understanding of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies.
- Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology.

UNIT I - INTRODUCTION **L(6)**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT II - PEDAGOGICAL PRACTICES **L(6)**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the

UNIT III - PEDAGOGICAL APPROACHES **L(6)**

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teacher's attitudes and beliefs and Pedagogic strategies.

UNIT IV - PROFESSIONAL DEVELOPMENT **L(6)**

Professional development: alignment with classroom practices and follow-up support. Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes.

UNIT V - CURRICULUM AND ASSESSMENT **L(6)**

Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools,Compare, 31 (2): 245-261.

2 Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3 Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4 Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5 Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6 Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

7 www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES:

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

CO1: Explain the concept of curriculum, formal and informal education systems and teacher education.

CO2: Explain the present pedagogical practices and the changes occurring in pedagogical approaches.

CO3: Understand the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class.

CO4: Perform research in design a problem in pedagogy and curriculum development.

COURSE ARTICULATION MATRIX:

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

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

18EEACZ6 - 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

18EEACZ7 - 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

18EEACZ8 - 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