GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

M.E. (THERMAL 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

CURRICULUM FOR CANDIDATES ADMITTED DURING 2018-2019 AND ONWARDS

TWO YEAR M.E PROGRAMME

THERMAL 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	18TEFCZ1	Research Methodology And IPR	FC	50	50	100	3	3	0	0	3
2	18TEPC01	Thermodynamics And Combustion	PC	50	50	100	3	3	0	0	3
3	18TEPC02	Advanced Fluid Dynamics	PC	50	50	100	3	3	0	0	3
4	18TEPC03	Gas Turbines	PC	50	50	100	3	3	0	0	3
5	18TEPEXX	Professional Elective I	PE	50	50	100	3	3	0	0	3
6	18TEPEXX	Professional Elective II	PE	50	50	100	3	3	0	0	3
7	18TEACXX	Audit Course I	AC	50	50	100	2	2*	0	0	0
Practical											
8	18TEPC04	Advanced IC Engines 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	18TEPC05	Advanced Heat And Mass Transfer	PC	50	50	100	3	3	0	0	3
2	18TEPC06	Steam Engineering	PC	50	50	100	3	3	0	0	3
3	18TEPC07	Computational Fluid Dynamics	PC	50	50	100	3	3	0	0	3
4	18TEPEXX	Professional Elective III	PE	50	50	100	3	3	0	0	3
5	18TEPEXX	Professional Elective IV	PE	50	50	100	3	3	0	0	3
6	18TEACXX	Audit Course II	AC	50	50	100	2	2*	0	0	0
Practical											
7	18TEPC08	Advanced Combustion Laboratory	PC	50	50	100	3	0	0	3	1.5
8	18TEEE01	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	18TEPEXX	Professional Elective V	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	18TEEE02	Project Phase I	EEC	100	100	200	20	0	0	20	10
Total				**200**	**200**	**400**	**26**	**6**	**0**	**20**	**16**

FOURTH SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18TEEE03	Project Phase II	EEC	200	200	400	32	0	0	32	16
Total				**200**	**200**	**400**	**32**	**0**	**0**	**32**	**16**

TOTAL CREDITS: 70

CURRICULUM DESIGN

M.E THERMAL ENGINEERING

LIST OF PROFESSIONAL ELECTIVES											
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	18TEPE01	Numerical Methods In Thermal Engineering	PE	50	50	100	3	3	0	0	3
2	18TEPE02	Energy Auditing And Management	PE	50	50	100	3	3	0	0	3
3	18TEPE03	Advanced Thermodynamics	PE	50	50	100	3	3	0	0	3
4	18TEPE04	Design Of Condensers, Evaporators And Cooling Towers	PE	50	50	100	3	3	0	0	3
5	18TEPE05	Instrumentation In Thermal Engineering	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE II											
6	18TEPE06	Finite Element Methods In Thermal Engineering	PE	50	50	100	3	3	0	0	3
7	18TEPE07	Supercharging And Scavenging	PE	50	50	100	3	3	0	0	3
8	18TEPE08	Engine Electronics	PE	50	50	100	3	3	0	0	3
9	18TEPE09	Manufacturing And Testing Of IC Engines And Components	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE III											
10	18TEPE10	Refrigeration And Cryogenics	PE	50	50	100	3	3	0	0	3
11	18TEPE11	Advanced Gas Dynamics And Space Propulsion	PE	50	50	100	3	3	0	0	3
12	18TEPE12	Fuels And Combustion	PE	50	50	100	3	3	0	0	3
13	18TEPE13	Fans, Blowers And Compressors	PE	50	50	100	3	3	0	0	3
14	18TEPE14	Thermal Energy Systems	PE	50	50	100	3	3	0	0	3
15	18TEPE15	Modeling Of CI Engine Processes	PE	50	50	100	3	3	0	0	3
16	18TEPE16	Air Conditioning System Design	PE	50	50	100	3	3	0	0	3
17	18TEPE17	Engine Pollution And Control	PE	50	50	100	3	3	0	0	3
18	18TEPE18	Alternative Fuels For Ic Engines	PE	50	50	100	3	3	0	0	3

PROFESSIONAL ELECTIVE IV											
19	18TEPE19	Nuclear Engineering	PE	50	50	100	3	3	0	0	3
20	18TEPE20	Solar Energy And Wind Energy	PE	50	50	100	3	3	0	0	3
21	18TEPE21	Diesel Emission Characteristics	PE	50	50	100	3	3	0	0	3
22	18TEPE22	Environmental Engineering And Pollution Control	PE	50	50	100	3	3	0	0	3
23	18TEPE23	Bio-Energy Conversion Techniques	PE	50	50	100	3	3	0	0	3

LIST OF OPEN ELECTIVES

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	OE	50	50	100	3	3	0	0	3

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

LIST OF AUDIT COURSES

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18TEACZ1	English for Research Paper Writing	AC	50	50	100	2	2*	0	0	0
2	18TEACZ2	Disaster Management	AC	50	50	100	2	2*	0	0	0
3	18TEACZ3	Value Education	AC	50	50	100	2	2*	0	0	0
4	18TEACZ4	Constitution of India	AC	50	50	100	2	2*	0	0	0
5	18TEACZ5	Pedagogy Studies	AC	50	50	100	2	2*	0	0	0
6	18TEACZ6	Stress Management by Yoga	AC	50	50	100	2	2*	0	0	0
7	18TEACZ7	Personality Development Through Life Enlightenment Skills	AC	50	50	100	2	2*	0	0	0
8	18TEACZ8	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	03	4.29 %
2.	Professional Cores	10.5	10.5	0	0	21	30.00 %
3.	Professional Electives	6	6	3	0	15	21.43 %
4.	Employability Enhancement Courses	0	2	10	16	28	40.00 %
5.	Open Elective Courses	0	0	3	0	03	4.29 %
Total Credits		**19.5**	**18.5**	**16**	**16**	**70**	**100.01%**

18TEFCZ1 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*

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

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.

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.

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.

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

CO/ PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	H	H	H	M	M	L	L	L	L	M
CO 2	H	H	H	H	M	L	H	M	M	L	L
CO 3	H	H	H	H	M	L	H	M	M	L	L
CO 4	H	H	H	H	H	M	H	M	M	L	M
CO 5	H	H	H	H	H	H	M	H	M	L	M

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

18TEPC01 – THERMODYNAMICS AND COMBUSTION
(use of approved tables and charts are permitted)

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the students to learn the advanced concepts like chemical and statistical thermodynamics, combustion principles, energy at micro level, conversion of heat energy in thermodynamic systems.*

AVAILABILITY AND THERMODYNAMIC PROPERTY RELATIONS (9)

Reversible work, Availability, Irreversibility and Second-Law Efficiency for a closed System and Steady-State Control Volume. Thermodynamic Potentials, Maxwell relations, Generalized relations for changes in Entropy, Internal Energy and Enthalpy, C_p and C_v, Clausius Clayperon Equation, Joule-Thomson Coefficient, Bridgmann Tables for Thermodynamic relations.

REAL GAS AND MULTI-COMPONENT SYSTEMS (9)

Different Equations of State, Fugacity, Compressibility, Principle of Corresponding States, Use of generalized charts for enthalpy and entropy departure, fugacity coefficient, Lee-Kessler generalized three parameter tables, Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, Ideal solution of real gases and liquids, Equilibrium in multi - phase systems, Gibbs phase rule for non-reactive components.

CHEMICAL THERMODYNAMICS AND EQUILIBRIUM (9)

Thermo chemistry, First Law analysis of reacting systems, Adiabatic Flame temperature, Entropy change of reacting systems, Second Law analysis of reacting systems, Criterion for reaction equilibrium, Chemical availability, Equilibrium constant for gaseous mixtures, evaluation of equilibrium composition, Availability of reacting systems.

STATISTICAL THERMODYNAMICS (9)

Microstates and Macrostates, Thermodynamic probability, Degeneracy of energy levels, Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein Statistics, Microscopic Interpretation of heat and work, Evaluation of entropy, Calculation of the Macroscopic properties from partition functions, Equilibrium constant statistical thermodynamics approach.

COMBUSTION PRINCIPLES AND CHEMICAL KINETICS (9)

Thermodynamics, concepts of combustion – Combustion equations, heat of combustion Theoretical flame temperature, chemical equilibrium and dissociation, Combustion cycles. Stoichiometry, Theories of Combustion, Pre-flame reactions, Reaction rates, Rankine-Hugoniot relations – detonation branch-Analysis of the deflagration - Chapman- Jouguet waves, Laminar and Turbulent Flame propagation.

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

REFERENCE BOOKS:

1. *Kenneth Wark Jr., **Advanced Thermodynamics for Engineers**, McGraw-Hill Inc., 1995.*
2. *Bejan, A., **Advanced Engineering Thermodynamics**, John Wiley and Sons, 3rd edition,2006.*
3. *Holman, J.P., **Thermodynamics**, Fourth Edition, McGraw-Hill Inc., 1988.*
4. *Smith, J.M. and Van Ness., H.C., **Introduction to Chemical Engineering Thermodynamics**, Fourth Edition, McGraw-Hill Inc., 2005.*
5. *Sonntag, R.E., and Van Wylen, G, **Introduction to Thermodynamics, Classical and Statistical**, Third Edition, John Wiley and Sons, 1991.*
6. *Sears, F.W. and Salinger G.I., **Thermodynamics, Kinetic Theory and Statistical Thermodynamics**, Third Edition, Narosa Publishing House, New Delhi, 1993.*
7. *Rao, Y.V.C., **Postulation and Statistical Thermodynamics**, Allied Publisher Limited, New Delhi, 1994.*
8. *John B.Heywood, **Internal Combustion Engine Fundamentals**, McGraw Hill Book, 1998*
9. *Stephen Turns, **An Introduction to combustion: concepts and applications,** McGraw Hill Book, Third Edition, 2016.*

COURSE OUTCOMES :

On completion of this course, students will be able to

***CO1:** Apply different sources of energy gain and energy loss to operate thermodynamic systems.*

***CO2:** Evaluate equilibrium of thermodynamic systems.*

***CO3:** Calculate appropriate stoichiometry level for perfect combustion.*

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	L	M	M	L	M	L	L	L	L
CO 2	M	H	H	M	H	M	M	J	M	L	L
CO 3	M	M	H	M	M	L	L	L	M	L	L

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

18TEPC02 ADVANCED FLUID DYNAMICS

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the students to learn the advanced concepts and equations of various type of fluid flows and realize the special effects due to turbulence, friction and shock.*

INTRODUCTION **(9)**

Ideal and non-ideal flows, general equations of fluid motion, Navier - stokes equations and their exact solutions. Boundary layer theory, wedge flows, laminar flow over plates and through cylinders.

TWO-DIMENSIONAL FLOW **(9)**

Subsonic flow, physical significance of irrotational motion – Kelvin's theorem – Differential equation in terms of velocity Potential and stream function – Flow with small perturbation – flow past a wave shaped wall – Gothert's rule – Prandtl Glanert rule – Hodograph method.

TURBULENT FLOW **(9)**

Turbulence, models and flow equations: steady and unsteady turbulent boundary layers.

SHOCK WAVE **(9)**

Normal and oblique shocks – Prandtl – Meyer expansion – Rankine Hugnoit relation. Application of method of characteristics applied to two-dimensional case – simple supersonic wind tunnel Design of supersonic wind tunnel and nozzle.

EXPERIMENTAL TECHNIQUES **(9)**

Role of experiments in fluid, layout of fluid flow experiments, sources of error in experiments, data analysis, design of experiments, review of probes and transducers, Introduction to Hot wire Anemometry, Laser Doppler Velocimetry and Particle Image Velocimetry

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

REFERENCE BOOKS:

*1. Mohanty, A. K., **Fluid Mechanics**, Prentice Hall of India, 2nd edition, 1997*

*2. Shapiro, A. F., **The Dynamics of Compressible flow** Vol. I, The Ronald Press Company 1963*

*3. Shames, **Mechanics of Fluids**, Mc Graw Hill L96M Book Company, 4th edition, 2005*

*4. Schlichting, H., **Boundary layer theory**, Mc Graw Hill Book Company,8th edition, 2003*

*5. E. Rathakrishnan, **Gas Dynamics**, Prentice Hall, New Delhi 2013.*

*6. Yunus A Cengel, John M.Cimbala, **Fluid Mechanics: Fundamentals and Applications**, McGraw-Hill, Hrd Edition, 2014.*

*7.K. Muralidhar, **Advanced Engineering Fluid Mechanics**, Alpha Science International Ltd, Second Edition 2005.*

*8. Pijush K. Kundu, Ira M Kohen and David R. Dawaling, **Fluid Mechanics**, Academic Press, Fifth Edition 2011.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: *Apply conservation of energy and momentum principles to various fluid flows.*

CO 2: *Analyze the effects of turbulent boundary layer profile for the given fluid flow conditions.*

CO 3: *Evaluate the concepts of shock waves in the design of wind tunnel and nozzles and layout of fluid flow experiments*

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	M	M	H	M	M	M	L	L	L
CO 2	M	M	L	H	M	M	M	L	L	L	M
CO 3	M	H	H	M	M	M	L	L	M	L	L

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

18TEPC03 - GAS TURBINES

(use of approved tables and charts are permitted)

Category : PC

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn aircraft applications of power plant cycles and turbo machines like compressors, axial and radial flow turbines and combustors.

INTRODUCTION **(9)**

Power plant cycles for stationary and aircraft applications, component behaviors, Industrial applications, Marine and land transportation, Environmental issues, analysis of ramjet, turbojet and turbo-propeller, Inlets and nozzles.

COMPRESSORS **(9)**

Principle and operations of Centrifugal and axial flow compressors momentum and energy transfer in rotors, velocity diagrams, calculation of stage performance, compressibility effects, cascade testing and characteristics.

AXIAL AND RADIAL FLOW TURBINE **(9)**

Elementary theory of axial and radial flow turbine, Vortex theorem, choice of blade profile, Pitch and Chord Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, materials, testing and performance characteristics.

COMBUSTORS **(9)**

Different types and flow pattern, material requirement and cooling systems, air pollution and reduction.

MATCHING **(9)**

Matching procedure of power plant components, engine off-design performance.

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

REFERENCE BOOKS:

1. *L.Cohen, H., Rogers, G.E.C., and Saravanamuttoo, H.I.H., **Gas Turbine Theory**, Longman Group Ltd, 2009.*
2. *M.Gordon C, Dates, **Aero-thermodynamics of Gas Turbine and Rocket Propulsion** – AIAA Education Series, 3rd edition NY 1997.*
3. *Kerrebrock, J.L., **Aircraft engines and gas turbines**, The MIT Press 2nd ed, 1996.*
4. *Yahya, S.H., **Turbines, Compressors and Fans**, Tata McGraw-Hill,4th edition 2013.*
5. *Earl Logan, Jr., **Hand book of Turbo machinery**, Marcel Dekker, Inc., USA, 2nd edition 2003.*
6. *Dixon,S.L., **Fluid Mechanics and Thermodynamics of Turbo machinery**,Pergamon Press,7th edition 2014.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: *Utilize the understanding in designing and assess the performance of compressors and utilize various power plant cycles applications.*

CO 2: *Make the thermal design and analysis for various turbo machines like axial and radial flow turbines and combustors.*

CO 3: *Match various power plant components.*

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	L	M	L	L	L	L	L	L	L
CO 2	H	M	M	M	L	L	L	L	L	L	M
CO 3	M	M	L	L	L	L	L	L	L	L	L

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

18TEPC04 - ADVANCED IC ENGINES LABORATORY

Category : PC

L	T	P	C
0	0	3	1.5

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the students to learn the importance of various types of I.C engines and analyze them using commercial and open source software.*

LIST OF EXPERIMENTS:

1. Performance test on Spark Ignition and Compression Ignition engines using Alternate fuels such as ethanol and Bio-fuels.
2. Emission measurement in Spark Ignition and Compression Ignition Engines using smoke meter and gas analyzer.
3. Performance test using pressure transducers in CI and SI engines.
4. Performance test on variable compression ratio petrol and diesel engines.
5. Performance and heat balance test on I.C. Engines using water dynamometer.
6. Performance test on Computerized Two Stage Air Compressor Test Rig.
7. Determination of temperature distribution using Thermal Imager.
8. Study and evaluation of the effect of Air fuel ratio of the 2 stroke single cylinder petrol engine.
9. Study and drawing of engine components with dimensions, Assembly and Disassembly.
10. Study on Meshing Techniques and Turbulent modeling
11. Convection heat transfer analysis in Laminar flow inside 2D pipe
12. Flow analysis over a Flat Plate for Boundary layer characteristics using CFD

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

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Evaluate the performance of SI and CI engines.*

CO2: *Analyze the emission characteristics of IC engines.*

CO3: *Apply the principles of CFD in fluid flow 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	M	M	H	L	L	L	L	L	L	L	L
CO 2	M	M	H	M	L	L	L	L	L	L	L
CO 3	H	H	H	M	H	L	L	L	L	L	L

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

18TEPC05-ADVANCED HEAT AND MASS TRANSFER

(use of approved tables and charts are permitted)

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

To make the students to learn the concepts of modes of heat transfer, heat exchangers along with numerical formulation of heat equations and to analyze various heat transfer correlations.

CONDUCTION AND RADIATION HEAT TRANSFER (9)

One dimensional energy equations and boundary condition, three-dimensional heat conduction equations, extended surface heat transfer, Conduction with moving boundaries, Porous-media heat transfer, Radiation in Gases and vapor.

TURBULENT FORCED CONVECTIVE HEAT TRANSFER (9)

Momentum and Energy Equations, Turbulent Boundary Layer Heat Transfer, Mixing length concept, Turbulence Model- k- ε Model, Analogy between Heat and Momentum Transfer –Reynolds, Colburn, Von Karman, Turbulent flow in a Tube, High speed flows.

PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER (9)

Condensation with shear edge on bank of tubes, Boiling – pool and flow boiling, Heat exchanger, ε – NTU approach and design procedure, compact heat exchangers.

NUMERICAL METHODS IN HEAT TRANSFER (9)

Finite difference formulation of steady and transient heat condition problems – Discretization schemes – Explicit, Crank Nicolson and Fully implicit schemes, Control volume formulation, Steady one-dimensional convection and Diffusion problems, Calculation of the flow field – Simpler Algorithm.

MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION (9)

Mass Transfer, Vaporization of droplets, combined heat and mass transfer problems, Heat Transfer Correlations in I.C. Engines.

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

REFERENCE BOOKS:

1. *Incropera F.P. and DeWitt.D.P,* ***Fundamentals of Heat & Mass Transfer****, John Wiley & Sons, Seventh edition,2013*
2. *Eckert.E.R.G., and Drake.R.M,* ***Analysis of Heat and Mass Transfer****, McGraw Hill Co., 1987.*
3. *Ozisik.M.N.,* ***Heat Transfer - Basic Approach****, McGraw-Hill Co., 1985.*
4. *Bejan.A.,* ***Convection Heat Transfer****, John Wiley and Sons,4th edition 2013.*

5. *Rohsenow.W.M., Harnett.J.P, and Ganic.E.N, **Handbook of Heat Transfer Applications**, McGraw-Hill, NY 1985.*

6. *Patankar.S.V., **Numerical heat Transfer and Fluid Flow**, Hemisphere Publishing Corporation, 2011.*

7. *Carnahan.B., Luther.H.A, and Wilkes, J.O., **Applied Numerical Methods**, Wiley & Sons, 1990*

8. *Yunus A.Cengal, **Heat and Mass Transfer – A practical Approach**,5 th edition, Tata McGraw - Hill, 2015.*

COURSE OUTCOMES :

On completion of this course, students will be able to

***CO1:** Use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.*

***CO2:** Evaluate the concepts of phase change in heat and mass transfer processes.*

***CO3:** Apply numerical methods for solving heat transfer problems.*

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	L	M	L	M	L	L	L	L	M
CO 2	H	M	M	L	L	L	L	L	L	L	L
CO 3	H	L	M	L	M	L	L	L	L	L	L

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

18TEPC06 – STEAM ENGINEERING

(use of approved tables and charts are permitted)

Category : PC

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn various power generation units, steam generators, heat balance and safety standards of various steam generating units.

INTRODUCTION **(10)**

Parameter of a steam Generator – Thermal calculations of Modern steam Generator – Tube Metal Temperature Calculation and choice of Materials – Steam purity Calculations and Water treatment.

STEAM SYSTEM AND HEAT BALANCE **(10)**

Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system - Heat transfer in Furnace – Furnace Heat Balance –Calculation of Heating Surfaces – Features of Firing systems for solid – Liquid and Gaseous Fuels – Design of Burners.

BOILER DESIGN **(10)**

Design of Boiler Drum – Steam Generator Configurations for Industrial Power and Recovery Boiler – Pressure Loss and circulation in Boilers.

DESIGN OF ACCESSORIES **(8)**

Design of Air Preheaters – Economisers and Super heater for high pressure steam Generators – Design Features of Fuel Firing Systems and Ash Removing Systems.

BOILER CODE **(7)**

IBR and International Regulations – ISI Code's Testing and Inspection of Steam Generator – Safety Methods in Boilers – Factor of safety in the Design of Boiler Drum and Pressure parts-Safety of Fuel Storage and Handling – Safety Methods of Automatic Operation of Steam boilers.

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

REFERENCE BOOKS:

1. ***David Gunn, Robert Horton,*** *Industrial Boilers* ***– Longman Scientific & Technical Publication, 2000.***
2. ***Carl schields,*** *Boilers – Type Characteristics and function****, McGraw Hull Publishers,2002..***
3. *Modern Power Station Practice(8 vol)* ***–Central Electricity Generation Board ,2000.***
4. *Large Boiler Furnaces****, Richard Dolezal Elsevier Company, 2008.***
5. *Boilers: A Practical Reference* ***Kumar Rayaprolu,*** *CRC Press, 2012*
6. ***The Boiler Book*** *(A Complete Guide To Advanced Boiler Technology For the Specifying Engineer) Paperback – 1993.*
7. *Kumar Rayaprolu* ***Boilers for Power and Process*** *April 23, 2009 by CRC Press.*
8. *P. Chatopadhyay;* ***Boiler Operation Engineering****: Questions and Answes; Tata McGrawHill Education Pvt Ltd, New Delhi.*

WEB REFERENCES :

1. *http://www.volund.uk*
2. *http://www.aee.vatech.co.at*
3. *http://www.thermomax.com*
4. *http://www.pages.hotbot.com*

COURSE OUTCOMES:

On completion of this course, students will be able to

***CO 1**: Gain knowledge in different types of boilers used in different industries and problems raised in boiler maintenance and solve them.*

***CO 2:** Economically utilize the heat in industries within the knowledge of Indian boiler regulation act.*

***CO 3:** Know about the kind of boilers being used in various industries and their applicability.*

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	H	H	M	H	L	L	H	H	M	H
CO 2	H	H	M	H	M	H	M	M	H	L	L
CO 3	H	H	H	M	L	H	M	M	L	H	M

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

18TEPC07 - COMPUTATIONAL FLUID DYNAMICS

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

- *To make the students to learn finite difference and finite volume discretized forms of CFD equations and their solutions.*

GOVERNING EQUATIONS AND BOUNDARY CONDITIONS (9)

Basics of CFD, Governing equations of Fluid Dynamics – Continuity, Momentum and Energy Equations, Physical Boundary conditions, Mathematical behavior of PDEs on CFD – Elliptic, Parabolic and Hyperbolic equations.

DISCRETISATION TECHNIQUES AND SOLUTION METHODOLOGIES (9)

Methods of deriving discretization equations – Finite difference & Finite volume methods, Finite difference discretization of wave equation, Laplace equation, Burger's equation, numerical error and stability analysis. Time dependent methods – Explicit, Implicit – Crank – Nicolson methods, time split methods.

CALCULATION OF FLOW-FIELD FOR N-S EQUATIONS (9)

Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes – Discretization equations for two - dimensional convection and diffusion. Representation of the pressure – Gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and velocity corrections – Pressure – Correction equation. SIMPLE algorithm and its variants.

TURBULENCE MODELING (9)

Time – averaged equation for turbulent flow, Turbulence models – Zero equation model, one equation model, two equation K-I models, and advanced models.

GRID GENERATION (9)

Algebraic Methods – Methods – Differential Equation methods – Adaptive grids.

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

REFERENCE BOOKS:

1. *Versteeg, H.K, and Malalasekera, W.,* ***"An Introduction to Computational Fluid Dynamics: The Finite Volume Method"****, Longman, 2008 .*
2. *D. A, Anderson, John C. Tanne hill, Richard H. Pletcher –* ***Computational Fluid Mechanics and Heat Transfer****, Hemisphere publishing corporation, McGraw – Hill book company,2012.*
3. *Muralidhar, K., and Sundararajan, T.,* ***Computational Fluid Flow and Heat Transfer****, Narosa Publishing House, New Delhi, 2011.*
4. *Ghoshdasdidar, P.S.,* ***Computer Simulation of flow and heat transfer*** *Tata McGraw- HillPublishing Company Ltd., 1998.*
5. *Subas, V.Patankar,* ***Numerical heat transfer fluid flow****, Hemisphere Publishing Corporation, 1980.*
6. *Taylor, C and Hughes****, J.B. Finite Element Programming of the Navier Stokes Equation****, Pineridge Press Limited, U.K., 1981.*
7. *Fletcher, C.A.J.,* ***Computational Techniques for Fluid Dynamics I****, Fundamental and General Techniques, Springer – Verlag, 1996.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Appreciate different types of PDEs that arise in fluid flow and heat transfer problems.

CO 2: Design of Numerical Schemes for 1D model equations of flow fluid and implement large scale linear system solvers (iterative and direct)

CO 3: Propose the concepts of numerical schemes for unsteady viscous flows.

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	M	M	L	L	L	L	L	L	L
CO 2	M	H	M	M	L	L	L	L	L	L	L
CO 3	H	M	M	L	L	L	L	L	L	L	L

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

18TEPC08- ADVANCED COMBUSTION LABORATORY

Category : PC

L	T	P	C
0	0	3	1.5

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the students to learn the various advancements in combustion research through experimental and analytical methods.*

LIST OF EXPERIMENTS:

1. Studies on combustion kinetics and chemical dynamics.
2. Studies on low temperature combustion.
3. Experimental investigation on HCCI engine.
4. Emission testing on DISI engine.
5. Particle ignition and char combustion characteristics of a solid fuel.
6. Modeling of Large Eddy Simulation of IC engines.
7. Modeling of exhaust after treatment of IC engines.
8. Soot measurement using laser induced incandescence.
9. Stereoscopic and tomographic Particle imaging velocimetry measurements.
10. Test on Supersonic combustion tunnel.

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

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: Analyze the modern combustion strategies.

CO2: Evaluate the combustion characteristics of various fuels.

CO3: Simulate the in-cylinder flows of IC engines.

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	H	M	H	H	L	L	L	L	L	L
CO 2	M	M	H	M	M	L	L	L	L	L	L
CO 3	M	M	L	H	M	L	L	L	L	L	M

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

18TEEE01- MINI PROJECT

Category : EEC

L T P C

0 0 4 2

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the student to feel/understand the magnitude of numbers being used in the energy sector.*

COURSE CONTENT :

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

COURSE OUTCOMES :

Learners will be able to

CO1 : Students will get an opportunity to work in actual industrial environment if they opt for internship.

CO2 : In case of mini project, they will solve a live problem using software/analytical/computational tools.

CO3 : Students will learn to write technical reports.

CO4 : Students will develop skills to present and defend their work in front of technically.

LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 60 PERIODS TOTAL: 60 PERIODS

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	M	M	M	M	L	L	M	M	H	M
CO 2	M	H	M	H	H	M	L	L	L	L	L
CO 3	M	L	M	M	M	L	L	L	L	L	M
CO 4	M	L	M	M	L	L	L	M	M	M	M

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

18TEEE02 PROJECT PHASE I

Category: EEC

L	T	P	C
0	0	20	10

PREREQUISITES: NIL

COURSE OBJECTIVE:

- *To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature and to develop the methodology to solve the identified problem then publish paper at least in conference.*

COURSE CONTENT:

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

COURSE OUTCOMES:

Learners will be able to

CO1: *Students will be exposed to self-learning various topics.*

CO2: *Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.*

CO3: *Students will learn to write technical reports.*

CO4: *Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.*

LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 300 PERIODS TOTAL: 300 PERIODS

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	M	H	H	M	L	H	H	M	L	L
CO 2	H	M	H	H	M	L	M	H	M	L	M
CO 3	H	M	H	H	M	L	M	H	M	L	L
CO 4	H	M	H	H	H	L	M	H	M	L	M

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

18TEEE03 PROJECT PHASE II

Category: EEC

L	T	P	C
0	0	32	16

PREREQUISITES: NIL

COURSE OBJECTIVE:

To solve the identified problem based on the formulated methodology and to develop skills to analyze and discuss the test results and make conclusions.

COURSE CONTENT:

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

COURSE OUTCOME:

Learners will be able to

CO1: *Students will be able to use different experimental techniques.*

CO2: *Students will be able to use different software/ computational/analytical tools.*

CO3: *Students will be able to design and develop an experimental set up/ equipment/test rig.*

CO4: *Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.*

CO5: *Students will be able to either work in a research environment or in an industrial environment.*

CO6: *Students will be conversant with technical report writing.*

CO7: *Students will be able to present and convince their topic of study to the engineering community.*

LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 480 PERIODS TOTAL: 480 PERIODS

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	M	H	H	M	L	H	H	M	L	M
CO 2	H	M	H	H	M	L	H	H	M	L	M
CO 3	H	M	H	H	M	L	H	H	M	L	M
CO 4	H	M	H	H	M	L	H	H	M	L	M
CO 5	H	M	H	H	M	L	H	H	M	L	M
CO 6	H	M	H	H	H	L	H	H	M	L	M
CO 7	H	M	H	H	H	L	H	H	M	L	M

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

18TEPE01 NUMERICAL METHODS IN THERMAL ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To be familiar with solutions of linear system of equations numerical solution of nonlinear equations.*
- *To acquire knowledge of least square approximations when discrete set of observations known.*
- *To develop the skill of solving single and double variable integration numerically.*
- *To attain the fluency to solve ordinary and partial differential equations numerically.*

NUMERICAL SOLUTIONS OF SYSTEM OF LINEAR AND NON – LINEAR EQUATIONS (9)

System of linear equation: Gauss Elimination Method, Gauss Jordan Method, Choleski Method, Gauss- Seidal Method – System of Non Linear equations: Iteration Method, Newton –Raphson Method for single variable and simultaneous equations with two variables.

EIGEN VALUE PROBLEMS, CURVE FITTING AND INTERPOLATION. (9)

Eigen value problem: Power Method – Curve fitting: Least Square approximations – Fitting a straight line – Regression lines – Non-linear curve fitting. Interpolation: Cubic spline interpolation and Hermite's Polynomials.

NUMERICAL INTEGRATION (9)

Trapezoidal Rule – Simpson's one third and three eighth rule – Gaussian two and three - point quadrature formula – Double integrals using Trapezoidal Rule – Simpson's Rule.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS (9)

Taylor's series Method – Euler's Method – Modified Euler's Method – Runge-Kutta Method of fourth order – Milne's and Adams Basforth Predictor and Corrector Methods. Numerical solution of Ordinary Differential Equation by Finite Difference Method.

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (9)

Finite difference solution for Laplace equations: Gauss Jacobi and Gauss Seidal methods – Poisson equation – Parabolic equation: Bender Schmidt and Crank Nicholson Methods – Hyperbolic equation: Explicit Method.

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

REFERENCE BOOKS:

1. *P. Kandasamy, K. Thilagavathy and K. Gunavathy, **"Numerical Methods"**, S. Chand & Co Ltd., New Delhi 2010.*
2. *James.G* **"Advanced Modern Engineering Mathematics"**, *Fourth edition, Pearson Education* Asia, 2011.
3. *Grewal.B.S.*, **"Numerical Methods in Engineering and Science"**, *Khanna Publishers* New Delhi, 2014.
4. *S.R.K.Iyengar, R.K Jain*, **"Numerical Methods"**, New Age International Publishers, New Delhi, 2009.
5. *Veerarajan.T and* Ramachandran.T **"Numerical Methods with Programming C"**, *Tata Mc Graw Hill Publishing Company Ltd*., New Delhi 2011.
6. *Grewal.B.S.*, **"Numerical Methods in Engineering and Science"**, *Khanna Publishers* New Delhi, 2014.

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Understanding methods for solving linear system of equations.*

CO2: *Developing skill of least square approximations leading to fitting a curve and interpolation.*

CO3: *Evaluating numerical quadrature and numerical cubature using standard methods.*

CO4*: Understanding numerical solution to first order ordinary differential equations and second order partial differential equations.*

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	M	M	M	L	L	L	L	L	L	L
CO 2	H	H	M	M	L	L	L	L	L	L	L
CO 3	M	H	H	M	L	L	L	L	L	L	L
CO 4	H	M	M	M	L	L	L	L	L	L	L

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

18TEPE02 – ENERGY AUDITING AND MANAGEMENT

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn concepts of energy scenario, energy auditing identifying the ways of energy conservation and management.

INTRODUCTION **(8)**

Global energy requirements – Depletion of conventional energy sources -Energy Scenario – Principles and Imperatives of Energy Conservation – Energy Consumption Pattern – Resource – Availability – Role of Energy Managers in Industries.

THERMAL ENERGY AUDITING **(12)**

Energy Audit -Purpose, Methodology with respect to process Industries –Power plants, Boilers, Characteristic method Employed in Certain Energy Intensive Industries – Various Energy Conservation Measures in Steam System – Losses in Boiler, Methodology of Upgrading Boiler Performance – Energy Conservation in pumps, Fans and Compressors, Air Conditioning and Refrigerating systems, Steam Traps – Types, Function, Necessity.

ROLE OF INSTRUMENTATION IN ENERGY CONSERVATION **(10)**

Total Energy Systems – Concept of Total Energy – Advantages and Limitations – Total Energy System and Application– Various Possible Schemes Employing Steam Turbines Movers Used in Total Energy Systems – Potential and Economical of Total Energy Systems- Energy conservation in transportation.

ELECTRICAL ENERGY AUDITING **(10)**

Potential Areas for Electrical Energy Conservation in various Industries – Energy Management Opportunities in Electrical Heating, Lighting system, Cable Selection – Energy Efficient Motors – Factors involved in Determination of Motor Efficiency Adjustable AC Drives, Applications and its use variable speed Drives/Belt Drives.

ENERGY MANAGEMENT **(5)**

Importance of Energy Management- Energy pricing- Energy Economics – Discount Rate, Payback period, Internal rate of Return, Life Cycle Costing.

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

REFERENCE BOOKS:

1. *Amlan Chakrabarthi,* ***Energy Engineering and Management,*** *PHI Learning Pvt. Ltd, New Delhi, 2011.*
2. *Roy L. Nersesian,* ***Energy for the 21st Century****, Yes Dee Publishing Pvt Ltd, 2011.*
3. *Craig B Smith,* ***Energy Management Principles****, Pergamon Press, NewYork, 2nd edition 2015.*
4. *Hamies,* ***Energy Auditing and Conservation; Methods, Measurements, Management & Case study****, Hemisphere, Washington, 2010.*
5. *Trivedi, PR, Jolka KR,* ***Energy Management****, Commonwealth Publication, New Delhi, 2000.*
6. *Witte, Larry C,* ***Industrial Energy Management & Utilization****, Hemisphere Publishers, Washington, 2000.*
7. *Diamant, RME,* ***Total Energy, Pergamon****, Oxford, 1970.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1*: Appreciate the energy auditing techniques and use them accordingly.*

CO 2: *Apply the methodology to find out boiler performance.*

CO 3: *Design suitable types of auditing methods for various applications.*

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	M	L	L	L	L	M	L	L	L	M
CO 2	H	M	M	L	L	L	M	L	L	L	M
CO 3	H	M	M	L	L	L	M	L	L	L	M

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

18TEPE03 - ADVANCED THERMODYNAMICS
(use of approved tables and charts are permitted)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the students to learn the advanced concepts like maximum energy and minimum energy, combustion principles, energy at micro level, conversion of heat energy into electrical flux of a thermodynamic systems.*

AVAILABILITY AND THERMODYNAMIC PROPERTY RELATIONS (9)

Reversible work, Availability, Irreversibility and Second-Law Efficiency for a closed System and Steady-State Control Volume. Thermodynamic Potentials, Maxwell relations, Generalized relations for changes in Entropy, Internal Energy and Enthalpy, C_p and C_v, Clausius Clayperon Equation, Joule-Thomson Coefficient, Bridgmann Tables for Thermodynamic relations.

REAL GAS AND MULTI-COMPONENT SYSTEMS (9)

Different Equations of State, Fugacity, Compressibility, Principle of Corresponding States, Use of generalized charts for enthalpy and entropy departure, fugacity coefficient, Lee-Kessler generalized three parameter tables, Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, Ideal solution of real gases and liquids, Equilibrium in multi phase systems, Gibbs phase rule for non-reactive components.

CHEMICAL THERMODYNAMICS AND EQUILIBRIUM (9)

Thermo chemistry, First Law analysis of reacting systems, Adiabatic Flame temperature, Entropy change of reacting systems, Second Law analysis of reacting systems, Criterion for reaction equilibrium, Chemical availability, Equilibrium constant for gaseous mixtures, evaluation of equilibrium composition, Availability of reacting systems.

STATISTICAL THERMODYNAMICS (9)

Microstates and Macrostates, Thermodynamic probability, Degeneracy of energy levels, Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein Statistics, Microscopic Interpretation of heat and work, Evaluation of entropy, Calculation of the Macroscopic properties from partition functions, Equilibrium constant statistical thermodynamics approach.

IRREVERSIBLE THERMODYNAMICS (9)

Conjugate Fluxes and Forces, Entropy Production Onsager's Reciprocity relations, thermoelectric phenomena, formulations, Power Generation, Refrigeration.

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

REFERENCE BOOKS:

1. *Kenneth Wark Jr., **Advanced Thermodynamics for Engineers**, McGraw-Hill Inc., 1995.*
2. *Bejan, A., **Advanced Engineering Thermodynamics**, John Wiley and Sons, 3rd edition,2006.*
3. *Holman, J.P., **Thermodynamics**, Fourth Edition, McGraw-Hill Inc., 1988.*
4. *Smith, J.M. and Van Ness., H.C., **Introduction to Chemical Engineering Thermodynamics**, Fourth Edition, McGraw-Hill Inc., 2005.*
5. *Sonntag, R.E., and Van Wylen, G, **Introduction to Thermodynamics, Classical and Statistical**, Third Edition, John Wiley and Sons, 1991.*
6. *Sears, F.W. and Salinger G.I., **Thermodynamics, Kinetic Theory and Statistical Thermodynamics**, Third Edition, Narosa Publishing House, New Delhi, 1993.*
7. *DeHotf, R.T., **Thermodynamics in Materials Science**, McGraw-Hill Inc., 2006.*
8. *Rao, Y.V.C., **Postulation and Statistical Thermodynamics**, Allied Publisher Limited, New Delhi, 1994*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Apply different sources of energy gain and energy loss to operate thermodynamic systems.*

CO2: *Evaluate equilibrium of thermodynamic systems.*

CO3: *Analyze energy of particles at micro-level and conversion of energy into electrical flux.*

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	M	L	L	L	L	L	L	L	L
CO 2	H	H	M	L	L	L	L	L	L	L	L
CO 3	M	H	M	L	L	L	L	L	L	L	L

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

18TEPE04 - DESIGN OF CONDENSERS, EVAPORATORS AND COOLING TOWERS

(Use of approved tables and charts are permitted)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the students to learn the heat transfer processes and design of heat transfer equipments.*

INTRODUCTION **(9)**

Principles of heat transfer, Types of heat exchangers, Standard Representation, Parts description, TEMA classifications, Applications.

CONDENSERS **(9)**

Estimation of heat transfer coefficient, Fouling factor, Friction factor- Design procedures, Wilson plots, Design of different types of condensers, BIS Standards.

EVAPORATORS **(9)**

Different types of evaporators, Design procedure, Factors affecting the evaporator capacity, Thermal Stress calculations, matching of components, Design of evaporative condensers.

COOLING TOWERS **(9)**

Types of Cooling towers, Analytical and graphical design procedures, Tower Characteristics Parametric analysis, Range of cooling tower, Tower efficiency, cooling tower load, Energy conservation.

SELECTION OF CONDENSERS, EVAPORATORS AND COOLING TOWER **(9)**

Condenser selection – Water cooled – Air cooled, Selection of evaporators, Selection of cooling tower, Selection of Pumps and Fans.

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

REFERENCE BOOKS:

1. *Ozisik, M.N.,* ***Design of Heat exchangers , condensers and evaporators*** *, John Wiley , New York , 1985.*
2. *Kern K.H.,* ***Process heat transfer****, McGraw-Hill, 2002.*
3. *Ozisik M.N.,* ***Heat transfer****, McGraw-Hill, 1993.*
4. *Nicholas Cheremisioff ,* ***Cooling tower*** *, Ann Arbor Science pub. 1981.*
5. *TEMA Hand book,* ***Tubular Exchanger Manufacturer Association****, New York, 9th edition, 2007.*
6. *Andrew.D.Althouse, Carl.H.Turnquist,* ***Modern Refrigeration and Air Conditioning****, GoodHeard-Wilcox Company, Inc, Publishers, 2000.*
7. *Ramesh K Shah, Dusan P. Sekulic* ***Fundamentals of Heat Exchanger Design*** *John Wiley & Sons,2003.*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Utilize the principles of heat transfer for industrial applications.*

CO2: *Design condensers, evaporators and cooling towers.*

CO3: *Select suitable heat transfer equipment.*

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	M	L	L	L	L	L	L	M
CO 2	H	M	H	M	L	L	L	L	L	L	L
CO 3	H	L	M	L	L	L	L	L	L	L	L

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

18TEPE05 -INSTRUMENTATION IN THERMAL ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

- *To make the students to learn different techniques of instrumentation involved in thermal quantity measurement and the concept of microprocessors in measurement, different kind of errors involved and the transducers for different types of thermo-physical quantities.*

MEASUREMENT CHARACTERSTICS (9)

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

MICROPROCESSORS AND COMPUTERS IN MEASUREMENT (9)

Data logging and acquisition, use of intelligent instruments for error reduction, elements of micro-computer interfacing, intelligent instruments in use.

MEASUREMENT OF PHYSICAL QUANTITIES (9)

Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of intelligent instruments for the physical variables.

FLOW VISUALISATION (9)

Techniques, shadow graph, Schlieren, interferometer, Laser Doppler anemometer, heat flux measurement, Telemetry in engines.

MEASUREMENT ANALYSIS (9)

Chemical, thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.

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

REFERENCE BOOKS:

1. *Holman, J.P., **Experimental methods for engineers**, McGraw-Hill, 8th edition 2011.*
2. *Barney, **Intelligent Instrumentation**, Prentice Hall of India, 1988.*
3. *Prebrashensky, V., **Measurements and Instrumentation in Heat Engineering**, Vol.1 and 2, MIR Publishers, 1980.*
4. *Rangan, C.S., Sharma, G.R., Mani, V.S.V. , **Instrumentation Devices and Systems**, Tata McGraw Hill, 2nd edition New Delhi, 1997.*
5. *Doeblin, **Measurement System Application and Design**, McGraw Hill, 2012.*
6. *Morris.A.S, **Principles of Measurements and Instrumentation**, Prentice Hall of India, 1998.*
7. *D Patranabis **Transducers, Mechanical Measurement and Industrial Instrumentation,** Tata McGraw - Hill Education (2010).*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Gain knowledge on various measuring instruments and advance measurement techniques.*

CO2: *Evaluate various steps involved in error analysis and uncertainty analysis.*

CO3: *Analyze various thermal and flow systems and their behavior.*

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	M	M	L	L	L	L	L	L	L	M
CO 2	M	M	H	L	L	L	L	L	L	L	L
CO 3	M	H	L	M	L	L	L	L	L	L	L

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

18TEPE06 - FINITE ELEMENT METHODS IN THERMAL ENGINEERING

Category : PE

L	T	P	C
3	**0**	**0**	**3**

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the students to learn different discretization methods for solving heat transfer and fluid flow problems.*

INTRODUCTION **(5)**

Overview of numerical methods - Discretized representation of physical systems - thermal resistance – Governing equations and Boundary conditions for thermal and flow systems.

ONE DIMENSIONAL HEAT CONDUCTION **(6)**

Principles of variations calculus - applications of variational approach to one dimensional heat conduction – element matrix contribution and assembly.

HEAT FUNCTIONS AND ANALYSIS **(10)**

Weighted residual methods - Galerkin's approach - Shape functions. Application of Galerkin's weighted residual approach to one dimensional heat conduction - Three nodded triangular elements- M-D steady state conduction using triangular elements - Radiation and natural convective boundary conditions –incorporation of variations in thermal properties.

CONVECTIVE HEAT TRANSFER **(12)**

Higher order elements and numerical integration solution of heat conduction and creeping flow using higher order element - Solution of convective heat transfer.

HEAT EXCHANGER APPLICATIONS **(12)**

Incompressible laminar flow simulation - Stream function / Vorticity methods, Velocity Pressure formulation, mixed order interpolation for incompressible flow modifications for turbulent flow. Application to heat exchanger.

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

REFERENCE BOOKS:

1. *S.S.Rao,* ***"The Finite Element Method in Engg."****, Pergamon Press, 5th ed., 2011.*

2. *Larry Segerlind* ***"Applied Finite Element Analysis"****, John Wiley & Sons, 2nd ed, 2005.*

3. *C.S.Krishnamoorthy,* ***"Finite Element Analysis Theory and Programming",*** *Tata McGraw-Hill, 2nd ed, 2011.*

4. *J.N.Reddy,* ***"An Introduction to Finite Elements Methods"****,McGraw-Hill,2005.*

5. *O.C.Zienkiewiez,* ***"Finite Element Methods",*** *McGraw-Hill, 2002.*

6. *T.R.Chandrapatla and Belegundu,* ***"Introduction to Finite Elements in Engg."****, Prentice Hall of India, 2002.*

7. *A.J.Baker,* ***"Finite Element Computational Fluid Mechanics",*** *McGraw-Hill, 2003.*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO 1:*Understand the basic numerical methods and governing equations of heat transfer and fluid flow conditions.*

CO 2: *Evaluate temperature distribution in one and two-dimensional conduction problems numerically.*

CO 3: *Analyse the laminar and turbulent flow problems to evaluate the performance of heat exchangers.*

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	M	H	M	L	L	L	L	M	L	L
CO 2	M	H	H	M	L	L	L	L	L	L	L
CO 3	M	H	M	L	L	L	L	L	L	L	L

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

18TEPE07 - SUPERCHARGING AND SCAVENGING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn effects of supercharging and scavenging in I.C engines and design of exhaust systems

SUPERCHARGING **(8)**

Objectives - Effects on engine performance – engine modification required - Thermo-dynamics of Mechanical supercharging and Turbo charging - Turbo charging methods - Engine exhaust manifolds arrangements.

SUPERCHARGERS **(10)**

Types of compressors - Positive displacement blowers - Centrifugal compressors - Performance characteristic curves - Suitability for engine application - Surging - Matching of supercharger compressor and Engine – Matching of compressor, Turbine Engine.

SCAVENGING OF TWO STROKE ENGINES **(12)**

Peculiarities of two stroke cycle engines - Classification of scavenging systems - Mixture control through Reed valve induction - Charging Processes in two stroke cycle engine - Terminologies - Shankey diagram – Relation between scavenging terms - scavenging modeling - perfect displacement, Perfect mixing Complex scavenging models.

PORTS AND MUFFLER DESIGN **(8)**

Porting - Design considerations - Design of intake and Exhaust Systems - Tuning.

EXPERIMENTAL METHODS **(7)**

Experimental techniques for evaluating scavenging - Firing engine tests - Non firing engine tests – Port flow characteristics - Kadenacy system - Orbital engine combustion system, Sonic system.

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

REFERENCE BOOKS:

1. *Obert, E.F., **Internal Combustion Engines and Air Pollution,** Intext Education Publishers,1980.*
2. *Richard Stone, **Internal Combustion Engines**, SAE,2012.*
3. *Vincent,E.T., **Supercharging the I.C.Engines,** McGraw-Hill,2002.*
4. *Watson,N. and Janota, M.S., **Turbocharging the I.C. Engine,** MacMillan Co.,2000.*
5. *Schweitzer, P.H., **Scavenging of Two Stroke Cycle Diesel Engine**, MacMillan Co.1996.*
6. *John B.Heywood, **Two Stroke Cycle Engine**, SAE Publications,1999.*

COURSE OUTCOMES:

On successful completion of this course students will be able to:

CO 1: *Design and make thermal analysis of the supercharging system and scavenging processes*

CO 2: *Design and tune Intake and Exhaust Systems to achieve desired performance Results.*

CO 3: *Address specific issues arising in laboratory testing of modified Engines.*

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	M	M	M	L	L	L	L	L	L	L
CO 2	M	M	M	M	L	L	L	L	L	L	L
CO 3	M	M	M	M	L	L	L	L	L	L	L

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

18TEPE08 - ENGINE ELECTRONICS

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn concepts of Automotive Electronics and its evolution and trends of sensor monitoring mechanisms to design and model various automotive ignition and injection systems control for different vehicle.

SENSORS **(9)**

Types – Air flow, Pressure, Temperature, Speed Oxygen, Detonation, Position – Principle of Operation, Arrangement and material.

GASOLINE INJECTION SYSTEM **(9)**

Open loop and closed loop systems, Mono point, Multi point and direct injection systems –Principles and Features, Bosch injection systems.

DIESEL INJECTION SYSTEM **(9)**

Inline injection pump, Rotary pump and injector – Construction and principle of operation, Common rail and unit injector system – Construction and principle of operation.

IGNITION SYSTEMS **(9)**

Ignition fundamentals, Types of solid -state ignition systems, high energy ignition distributors, Electronic spark timing and control.

ENGINE MAPPING **(9)**

Combined ignition and fuel management systems. Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation, Hybrid vehicles and fuel cells.

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

.

REFERENCE BOOKS:

1. ***Bosch Technical Instruction Booklets,*** *1999.*
2. *Tom Denton,* ***Automotive Electrical and Electronic Systems****, Edward Amold, 2016*
3. *Robert N.Brady,* ***Automotive Computers and Digital Instrumentation****, Prentice Hall, 1988.*
4. *Duffy Smith.,* ***Auto Fuel Systems****, The god Heart Willcox Company Inc., Publishers, 1992.*
5. *Heinz Heisler.,* ***Advanced Engine Technology****. SAE Publications, 1995*
6. *Boltzharol, A., Materials Handling Handbook, Elsevier butter worthheinemenn Company, 2005.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1*: Obtain an overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry.*

CO 2: *Interface automotive sensors and actuators with microcontrollers.*

CO 3: *Develop, simulate and integrate digital control techniques.*

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	M	M	L	L	L	L	L	L	L	L
CO 2	M	L	L	L	L	L	L	L	L	L	L
CO 3	H	M	L	L	L	L	L	L	L	L	L

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

18TEPE09 - MANUFACTURING AND TESTING OF IC ENGINES AND COMPONENTS

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn a comprehensive module on the aspects of materials, manufacture and testing of piston engine assemblies, components, subsystems and Engine Standards.

CYLINDER BLOCK AND CYLINDER HEAD (9)

Casting practice and special requirements, materials, machining, methods of testing, Cylinder liners – Mat, Types and Manufacture.

PISTON ASSEMBLY (9)

Types, requirements, casting, forging, squeeze casting, materials, machining, testing, manufacture piston rings – material, types and manufacture – surface treatment, bimetallic pistons, articulated pistons.

DRIVE SYSTEMS (9)

Requirements, materials, forging practice, machining, balancing of crankshaft, testing, CR, CS, CAS, VT.

COMPUTER INTEGRATED MANUFACTURING (9)

Integration of CAD, CAM and Business functions CIM- Networking, CNC programming for machining of I.C.Engines Components.

QUALITY AND TESTING (9)

SPC - Introduction to ISO 9000, ISO L4000, TS L6949, its importance, BIS codes for testing various types of engines, equipments required, instrumentation, computer aided engine testing, metrology for manufacturing I.C.Engine Components, In site measurement – Telemetry and sensors.

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

REFERENCE BOOKS:

1. *Grover, M.P., **CAD/CAM**, Prentice Hall of India Ltd., 1985.*
2. *Heldt, P.M**., High speed internal combustion engines**, Oxford & IBH Publishing Co., 1965.*
3. *Judge, A.W., **Testing of high speed internal combustion engines**, Chapman & Hall.,2016.*
4. *Richard, W., Heine Carl R. Loper Jr. and Philip, C., Rosenthal, **Principles of Metal Casting**, McGraw-Hill Book Co., 2001.*
5. ***IS: 1602 – 1960 Code for testing of variable speed internal Combustion engines for Automobile Purposes , 1998.***
6. ***SAE Handbook, 2011.***
7. *P.Radhakrishnan and S.Subramaniayn, **CAD/CAM/CIM**, New Age International (P) Limited, Publishers, 2013.*
8. *Mikett P.Groover**, Automation, production Systems and Computer – Integrated Manufacturing** Prentice Hall of India Private Limited, 1999.*

COURSE OUTCOMES:

On successful completion of this course students will be able to:

CO 1: *Specify the component material and manufacturing method for a particular I.C.Engine.*

CO 2: *Implement advanced Computer integrated Techniques in Manufacturing I.C.Engine components.*

CO 3: *Relate and Quality Check a Component with International Standards.*

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	M	L	L	L	L	L	L	L	L	L
CO 2	M	M	M	M	L	L	L	L	L	L	L
CO 3	M	M	L	L	L	L	L	L	L	M	L

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

18TEPE10 – REFRIGERATION AND CRYOGENICS

(use of approved tables and charts are permitted)

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn different processes in cryogenic systems and to conduct activities related to design and the experimental study of low-temperature plant facilities and related industries.

INTRODUCTION **(9)**

Insight on Cryogenics, Methods of producing cold - thermodynamic basis, first and second law analysis, Vapour compression systems, Properties of Cryogenic fluids, and Material properties at Cryogenic temperatures.

LIQUEFACTION CYCLES **(9)**

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles, Inversion Curve-Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle, Dual Cycle, Helium Refrigerated Hydrogen Liquefaction Systems. Critical components in Liquefaction Systems.

CRYOGENIC REFRIGERATORS **(9)**

Binary Mixtures, T-C and H- C Diagrams, Principle of Rectification, Rectification Column Analysis – McCabe Thiele Method. Adsorption Systems for purification.

SEPARATION OF CRYOGENIC GASES **(9)**

J.T.Cryocoolers, Stirling Cycle Refrigerators, G.M.Cryocoolers, Pulse Tube Refrigerators, Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators.

HANDLING OF CRYOGENS AND APPLICATIONS **(9)**

Cryogenic Dewar Construction and Design, Cryogenic Transfer Lines. Insulations used in Cryogenic Systems, Different Types of Vacuum Pumps, Instrumentation to measure Flow, Level and Temperature. Applications of Cryogenics in Space Programmes, Superconductivity, Cryo Metallurgy, Medical applications

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

REFERENCE BOOKS:

1. *Thomas M.Flynn, **Cryogenic Engineering**, Marcel Dekker, New York 2nd edition, 2005.*
2. *Klaus D.Timmerhaus and Thomas M.Flynn, **Cryogenic Process Engineering**, Plenum Press, New York, 2013.*
3. *Randall F.Barron, **Cryogenic Systems**, McGraw Hill, 2002.*
4. *Scott R.B., **Cryogenic Engineering**, Van Nostrand and Co., 2002.*
5. *Robert W. Vance, **Cryogenic Technology**, Johnwiley & Sons, Inc.2010, New York, London*
6. *G.Venkatarathnam, **Cryogenic Mixed Refrigerant Processes**, Springer Publication, 2010.*

WEB REFERENCES:

1. *http://www.wiley-vch.de/contents/ullmann/ull_10211.html.*
2. *http://www.onecro.com*
3. *http://www.caddet-ee.org/search/produce.cfm?ID=R072*
4. *http://www.sumkasons.20m.com/In2.html*
5. *http://www.thtcryogenics.freeserve.co.uk/crogenics.html*

COURSE OUTCOMES:

On successful completion of this course students will be able to:

CO1: *Understand basic concepts of cryogenic systems and processes of liquefaction techniques.*

CO2: *Perform Necessary Calculations for a Selecting particular Refrigerator.*

CO3: *Assess storage systems and insulation techniques used in cryogenic applications.*

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	M	L	M	L	L	L	L	L	L	L
CO 2	H	H	M	M	L	L	L	L	L	L	L
CO 3	M	M	L	L	L	L	L	L	L	L	L

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

18TEPE11 – ADVANCED GAS DYNAMICS AND SPACE PROPULSION

(use of approved tables and charts are permitted)

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn the compressible flow through different systems and propulsion systems for jet and space vehicle.

BASIC CONCEPTS AND ISENTROPIC FLOWS (9)

Energy and momentum equations of compressible fluid flows – isentropic flow - Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

FLOW THROUGH DUCTS (9)

The Shock Tube: Propagating Expansion Fan - Flows through constant area ducts with heat transfer and Friction - variation of flow properties Use of tables and charts - Unsteady Shock Waves: The Shock Tube - Application of The Method of Characteristics: Flow through a diverging channel.

NORMAL AND OBLIQUE SHOCKS (10)

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks - Supersonic Flow over a Wavy wall - Finite Wave Theory: An introduction to the Method of Characteristics. Prandtl – Meyer expansion and relation. Supersonic Flow past a HD Cone at an angle of attack - Bluff Body at an angle of attack - Supersonic Flow past a HD Cone at an angle of attack: Flow Visualization-Use of table and charts.

JET PROPULSION (8)

Theory of jet propulsion – thrust equation – thrust power and propulsive efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan and turbo prop engines.

SPACE PROPULSION (9)

Types of rocket engines and propellants. Characteristic velocity.Theory of single and multistage rocket propulsion.Liquid fuel feeding systems.Solid propellant geometries.Space flights – orbital and escape velocity.Rocket performance calculations – nuclear and electrical rocket propulsion.

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

REFERENCE BOOKS:

1. *L. Anderson, J.D., **Modern Compressible flow**, McGraw Hill, 2013.*
2. *M. S.M. Yahya, **Fundamentals of Compressible Flow with Aircraft and Rocket propulsion**, New Age International (P) Limited, 4th Edition, 2010.*
3. *H. Saravanamutto HIH, Cohen H., Rogers CEC.&Straznicky PV, **Gas Turbine Theory**, 6th Edition, Printice Hall, 2009..*
4. *Sutton, G.P. **Rocket Propulsion Elements**, John wiley, 2010, New York*
5. *Radhakrishnan, E., **Gas Dynamics**, Printice Hall of India, 8th edition, 2010*
6. *Shapiro, **Dynamics and Thermodynamics of Compressible fluid Flow,** , prentice hall, 6th edition, 2009.*
7. *Hill and Peterson, **Mechanics and Thermodynamics of Propulsion**, Addison – Wesley, 1992.*
8. *Zucrow, N.J., **Aircraft and Missile Propulsion**, vol.I & II, John Wiley, 1975*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: *Understand the basic concepts of compressible flow and isentropic flow.*

CO2: *Analyze the steady and unsteady shock waves by considering friction effect.*

CO3: *Evaluate the thrust power, propulsion efficiency, performance of jet engines and space propulsion engines.*

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	H	H	M	L	L	L	L	L	L	L
CO 2	H	H	H	M	L	L	L	L	M	L	M
CO 3	H	H	H	M	L	L	L	L	M	L	M

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

18TEPE12- FUELS AND COMBUSTION

(use of approved tables and charts are permitted)

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn various types of fuels and their combustion Stoichiometry to design the burner.

INTRODUCTION **(9)**

General, Conventional Energy Sources, Solar Energy, Nuclear Power, Energy from Biomass, Wind Power, Tidal Power, Geothermal Energy, Energy Survey of India , Rocket Fuels.

SOLID, LIQUID AND GASEOUS FUELS **(9)**

Coal - Analysis and Properties of Coal, Classification of Coal, Oxidation of Coal, Hydrogenation of Coal, Efficient use of Solid Fuels, Manufactured Fuels, Agro Fuels, Solid Fuel Handling, Properties Related to Combustion, Handling Storage, Origin and Classification of Petroleum, Refining and Other Conversion Processes, Composition of Petroleum Various Petroleum Products, Storage and Handling of Liquid Fuels, Liquid Fuel Combustion Equipment, Gaseous Fuels, Through Non-Thermal Route-Biogas, Refinery Gas, LPG, Cleaning and Purification of Gaseous Fuels.

THEORY OF COMBUSTION PROCESS **(9)**

Stoichiometry and Thermodynamics, Combustion Stoichiometry General, Rapid Methods of Combustion Stoichiometry, Combustion Thermodynamics, Problem, Combustion Problems with Chemical reactions burners.

STOICHIOMETRY **(9)**

Stoichiometry Relations, Theoretical Air Required for Complete Combustion, Calculation of Minimum Amount of Air Required for a Fuel of Known Composition, Calculation of Dry Flue Gases If Fuel Combustion is Known, Calculation of the Composition of Fuel and Excess Air Supplied from Exhaust Gas Analysis, Dew Point of Products, Flue Gas Analysis(O_M, CO_M, CO, NOx, SOx).

BURNER DESIGN **(9)**

Ignition, Concept of Ignition, Auto Ignition, Ignition Temperature, Flame Propagation, Various Methods of Flame Stabilization, Incorporation in Burner Design, Basic Features and Types of Solids, Liquid and Gaseous Fuel Burner, Design Consideration of Different Types of Coal-Oil and Gas Burners, Recuperative and Regenerative Burners.

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

REFERENCE BOOKS:

1. *Samir Sarkar**, Fuels & Combustion**, Hrd Edition, Orient Logman,latest Edition 2009.*
2. *Bhatt, Vora **Stoichiometry**,5th Edition, tata Mcgraw Hill, 2010.*
3. *Blokh AG, **Heat Transfer in Steam Boiler Furance**, Hemisphere Publishing Corpn,2000.*
4. *Civil Davies, **Calculations in Furance Technology**, Pergamon Press,Oxford,2000*
5. *Sharma SP,Mohan Chander,**Fuels & Combustion**, Tata Mcgraw Hill,1987.*

WEB REFERENCES :

1. *http://Shop.ieee.org.*
2. *http://opus.utah.edu.*
3. *http://www.creada.org.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: *Understand the various sources of energy and fuels.*

CO 2: *Distinguish between various types of fuels and combustion methods and balancing the combustion equation.*

CO3: *Choose correct stoichiometric ratio for combustion process and design burners for industrial applications.*

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	M	L	L	L	L	L	L	L	L	L
CO 2	M	H	M	M	L	L	L	M	M	L	L
CO 3	M	H	M	L	L	L	L	L	M	L	M

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

18TEPE13 - FANS, BLOWERS AND COMPRESSORS
(use of approved tables and charts are permitted)

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:
To make the students to learn different applications, types and design of Pumps, Fans, blowers & Compressors.

PRINCIPLES OF TURBO MACHINERY **(10)**

Introduction to turbo machines- Transfer of energy to fluids- performance characteristics- fan laws- dimensionless parameters- specific speed- selection of centrifugal, axial, mixed flow, Axial flow machines.

ANALYSIS OF CENTRIFUGAL BLOWERS **(10)**

Centrifugal blowers: Theoretical characteristic curves, Eulers characteristics and Eulers velocity triangles, losses and hydraulic efficiency, flow through impeller casing inlet nozzle. Volute, diffusers, leakage disc friction mechanical losses, multivane impellers of impulse type, cross flow fans.

ANALYSIS OF AXIAL FLOW **(10)**

Axial flow fans: rotor design airfoil theory, vortex theory, cascade effects, degree of reaction, blade twist stage design, surge and stall, stator and casing, mixed flow impellers.

TESTING AND CONTROL OF FANS **(05)**

Fan testing, noise control, material and components blower regulation, speed control, throttling control at discharge and inlet.

DESIGN AND APPLICATIONS OF BLOWERS **(10)**

Special design and applications of blower, induced and forced draft fans for air-conditioning plants, cooling towers, ventilation systems, booster systems.

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

REFERENCE BOOKS:

1. *Stepanoff A.J.* ***Turboblowers****, John Wiley & sons, 2000*
2. *Bruno E C K,* ***Fans****, Pergamon Press, 1973.*
3. *Austin H. Chruch,* ***Centrifugal pumps and blowers****, John Wiley and sons, 1989.*
4. *Dixon, Fluid mechanics,* ***Thermodynamics of turbomachinery*** *,Elsevier, 7th edition,1984.*
5. *Dixon.* ***Worked examples in turbomachinery****, Pergamon press, 1984.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: *Apply the principles of turbo machinery to fans, blowers, and compressors.*

CO 2: *Analyze different type of flow arrangements in turbo machinery.*

CO 3: *Design and testing of Pump, Blower, fan and compressor for a given application.*

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	L	M	L	L	L	L	L	L	M	L	L
CO 2	M	H	M	L	L	L	L	L	M	L	M
CO 3	M	H	M	L	L	L	L	L	M	L	M

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

18TEPE14 - THERMAL ENERGY SYSTEMS

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn design, modeling and optimization of thermal energy systems used in various energy production applications and ensuring the dynamic behavior of the thermal system.

DESIGN OF THERMAL SYSTEM **(6)**

Design systems, Workable Systems, Optimal Systems, Matching of system Components, Economic analysis, Depreciation, gradient present worth factor.

MATHEMATICAL MODELLING **(8)**

Equation fitting – Nomography, Empirical equation, Regression analysis, Different modes of mathematical models, selection, computer programmes for models.

MODELLING THERMAL EQUIPMENTS **(8)**

Modelling heat exchangers. Evaporators, condensers, absorption and rectification columns, compressor, pumps, simulation studies, information flow diagram, solution procedures.

SYSTEMS OPTIMIZATION **(15)**

Objective function formulation, Constraint equations, Mathematical formulation, Calculus method, Dynamic programming, programming, Linear programming methods, solution procedures.

DYNAMIC BEHAVIOUR OF THERMAL SYSTEM **(8)**

Steady state simulation, Laplace transformation, Feedback control loops, Stability analysis, Non linearities.

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

REFERENCE BOOKS:

1. *J.N.Kapur, **Mathematical Modelling**, Willey Eastern Ltd., New York, 2015.*
2. *W.F.Stoecker, **Design of Thermal Systems**. McGraw Hill, 2002.*
3. *W.F.Stoecker, **Refrigeration and Airconditioning**, TMH, 2nd edition 2014.*
4. *Fanger P.O., **Thermal Comfort**, McGraw Hill, USA, 1982.*
5. *McQuiston FC & Parker TD, **Heating, Ventilating and Air conditioning, Analysis and Design**, John Wiley & Sons, USA,6th edition 2005.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: *Use the techniques, skills and modern engineering tools necessary for engineering practice.*

CO 2: *Develop model equations for the given system.*

CO 3: *To impart the knowledge of the linear programming methods and apply concepts, laws and principles of thermal systems to operate and maintain them for efficient use of energy and its conservation as per industrial norms.*

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	M	M	L	L	L	L	M	L	L
CO 2	H	M	H	M	L	L	L	L	M	L	M
CO 3	H	H	M	M	L	L	L	L	M	L	M

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

18TEPE15 - MODELING OF CI ENGINE PROCESSES

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to understand the concepts of combustion and flow modeling of CI engines.

GENERAL CONSIDERATIONS OF MODELING **(9)**

Governing equations, conservation of mass, conservation of energy, second law Analysis, Numerical methodology, computing mesh, Discretisation, Grid Formation.

SPRAY MODELING **(9)**

Spray equation Models, Thin spray models, Thick Spray Models, Droplet turbulence inter- actions, Droplet impingement on walls.

IN-CYLINDER FLOW MODELING **(9)**

Full Field Model, K-e Model, laminar flow modeling, probability density functions, Ekman layers roll-up vortex, vortex structures. Compression generated turbulence, effective viscosity turbulent diffusivity.

INTRODUCTION TO COMBUSTION MODELING **(9)**

Classification, zero-dimensional modeling, quasi-dimensional modeling, multidimensional modeling, comparison of of different combustion systems, combustion efficiency, applications

COMBUSTION MODELS **(9)**

Multi zone Models, Kono's model, Cummins engine model, Hiroyasu's model,. Single zone models, Premixed diffusive models, Heat Transfer Cp-relations Weibe's function analysis, Whitehouse-way model, Two zone models, Mathematical modeling of Catalytic converters one dimensional model- MD axi-symmetric model of monolithic reactor, Computation of chemical reactions, two dimensional transient temperature field.

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

REFERENCE BOOKS:

1. *J.I.Ramos **"Internal Combustion Engine Modeling"** Hemisphere Publishing Corporation, 1989.*
2. *James N.Mattavi and Charles A.Amann **"Combustion Modeling in Reciprocating Engines"**. Plenum Press – 1980.*
3. *John.B.Heywood, **"Internal Combustion Engine Fundamentals"** McGraw-Hill International Editions, Automotive technology Series, 2012.*
4. *I.kandylas,G.Koltsakis and A.Stamatelos **"Mathematical Modeling of Precious Metals Catalytic Converters for Diesel Nox Reduction"**. Journal of automobiles engineering, 213, no. D3(1993): 279-292.*
5. *Sandeep Maju, Robert I.Sager.Jr., and Benny J.Srider, **"Predicting Durability"** Mechanical engineering Vol. 64, March 1999.*
6. *.J.Baxendale **"Computational Fluid Dynamics in Exhaust System Design and Development"** SAE Paper.No.931072,1993.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1*: Develop flow modeling equation and analyze the effects of it.*

CO 2: *Develop in-cylinder flow modeling of CI engines.*

CO 3: *Develop combustion models based on practical applications.*

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	L	L	M	H	M	L	L	L	L	L	L
CO 2	H	M	M	L	L	L	L	L	L	L	L
CO 3	M	M	L	L	L	L	L	L	L	M	L

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

18TEPE16- AIR CONDITIONING SYSTEM DESIGN

(Use of approved tables and charts are permitted)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn different air conditioning system components, equipments and their testing methods.

COMPONENTS TESTING AS PER (BIS CODES) (9)

Testing of Condensers and Evaporators, Testing of Cold Storages – Code of Practice for Fire Safety ,Storage, Specification and Testing of all type of Air conditioners – Enthalpy deviation curve – psychrometry.

AIR CONDITIONING EQUIPMENTS AND ACCESSORIES (9)

Construction Details of Room Air Conditioner – Window Type, Package Type, Split type, VRF , Central Units – Air Distribution Devices – Air Circuits – Air handling System – Air conditioning processes.

AIR CONDITIONING SYSTEM DESIGN AND LOAD CALCULATION (9)

Design conditions - load calculations - air distribution - pressure drop - duct design - fans and blowers.

APPLICATIONS OF AIR CONDITIONING (9)

Air Conditioning in Automobiles, Railway Wagons, Marine Vessels, Aircraft and Other Commercial Applications.

AIR CONDITIONING ACCESSORIES AND CONTROL (9)

Performance and selection, noise control, Piping System, Valves, Receivers, Oil Trap, Oil Regenerators, Driers and Strainers. Control System of Temperature, Pressure, Oil Flow, Compressor Motor – Protection Devices.

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

REFERENCE BOOKS:

1. ***ASHRAE Hand book (Fundamentals &Equipments) 2012***
2. *Dossat, R. J.* ***"Principles of Refrigeration and Air Conditioning"****, John Wiley & Sons,4th edition, 2010.*
3. *Hains, J.B.* ***"Automatic Control of Heating & Air conditioning"*** *McGraw-Hill, 1981.*
4. *H. Althouse, A.D. &Turnquist, C.H.* ***"Modern Refrigeration and Air conditioning"*** *Heart – Wilcox Co. Inc.,1985.*
5. ***Recent release of BIS Code for relevant testing practice.***
6. *Manohar Prasad, "Refrigeration & Air Conditioning", New Age Publishers.*
7. *Stoecker, "Refrigeration & Air Conditioning", Mc Graw Hill, 1992.*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Student should understand construction and design features Air-conditioning system.*

CO2: *Student should understand various types and its adoptability in the various environment and application areas.*

CO3: *Student should understand various health issues*

CO4: *Student should design seasonal energy efficient system*

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	M	L	L	L	L	L	L	M	L
CO 2	M	M	L	L	L	L	L	L	M	L	L
CO 3	M	L	M	M	M	L	L	L	L	L	L
CO 4	H	M	L	M	L	L	L	L	L	M	L

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

18TEPE17 - ENGINE POLLUTION AND CONTROL

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn engine pollution formation, control, Measurement techniques and impact of them in the society to match pre-requisite course specialized studies and research.

POLLUTION – ENGINES AND TURBINES **(5)**

Atmospheric Pollution from piston engines and gas turbines, global warming.

POLLUTANT FORMATION **(10)**

Formation of Oxides of Nitrogen, Carbon monoxide, hydrocarbon, aldehydes and Smoke Particulate emission, effects of pollutions on environment.

POLLUTION MEASUREMENT **(10)**

Non dispersive infrared gas analyzer, gas chromatography, chemi-luminescent analyzer and flame ionization detector, smoke measurement, noise pollution, measurement and control.

CONTROL OF ENGINE POLLUTION **(10)**

Engine component, fuel modification, evaporative emission control, EGR, air injection in thermal reactors, In cylinders control of pollution, catalytic converters, application of microprocessors in emission control.

DRIVING CYCLES AND EMISSION STANDARDS **(10)**

Use of driving cycles for emission measurement, chassis dynamometer, CVS system, National and International emission standards.

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

REFERENCE BOOKS:

1. *Crouse William,* ***Automotive Emission Control****, Gregg Division / McGraw-Hill 2000.*
2. *Ernest, S.,Starkman,* ***Combustion Generalized Air Pollutions****, Plenum Press, 1993.*
3. *George, Springer and Donald J.Patterson,* ***Engine emissions, pollutant Formation and Measurement****, Plenum Press, 2012.*
4. *Obert,E.F.,* ***Internal Combustion Engines and air Pollution****, Intext Educational Publishers, 2000.*

COURSE OUTCOMES:

On successful completion of this course students will be able to:

CO 1: *Identify the emission and its effect on human health and environment.*

CO 2: *Outline the formation of pollutant in SI engine and C.I engine*

CO 3: *Develop knowledge on Emission control, measurement and standardization techniques.*

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	M	L	L	L	L	L	L	L	L	L
CO 2	M	M	M	L	L	L	L	L	L	L	L
CO 3	M	M	M	L	L	L	L	L	L	L	L

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

18TEPE18 - ALTERNATIVE FUELS FOR IC ENGINES

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

To make the students to learn various types properties, availability of alternate fuels to identify the physical significance of alternate fuel.

INTRODUCTION **(9)**

Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources.

ALCOHOLS **(9)**

Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI and CI Engines.

NATURAL GAS, LPG, HYDROGEN AND BIOGAS **(9)**

Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI and CI engines, performance and emission of LPG. Hydrogen- storage and handling, performance and safety aspects.

VEGETABLE OILS **(9)**

Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics.

ELECTRIC, HYBRID, FUEL CELL AND SOLAR CARS **(9)**

Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, Hybrid vehicles, fuel cell vehicles, solar powered vehicles.

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

REFERENCE BOOKS:

1. *Richard.L.Bechfold – **Alternative Fuels Guide Book** - SAE International Warrendale, 2007.*
2. *Maheswar Dayal - "**Energy today a tomorrow**"- I and B Horishr India, 1982.*
3. *Nagpal - "**Power Plant Engineering**" - Khanna Publishers, 1991.*
4. *"**Alcohols as motor fuels progress in technology**" - Series No.19 - SAE Publication USE, 1980.*
5. *SAE paper nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA.*
6. *Hybrid and alternative fuel vehicles , **Jack R. merad** 2007*
7. *Groover M.P **CAD/CAM** 2004*

WEB REFERENCES :

1. *http://aimforhigh.blogspot.com/2011/12/at2022-alternate-fuels-and-energy.html#ixzzLuBElr9rW*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Understand the various types of fuel options available for the conventional fuels.*

CO 2:*Analyze the performance and emission characteristics of alternate fuels.*

CO 3:*Understand the recent development in the I.C engines using alternate fuels.*

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	L	L	L	L	L
CO 2	M	M	L	L	L	L	L	L	L	L	L
CO 3	M	L	L	L	L	L	L	L	L	L	M

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

18TEPE19 – NUCLEAR ENGINEERING

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE :

To make the students to learn various types properties, availability of alternate fuels to identify the physical significance of alternate fuel.

BASICS OF NUCLEAR FISSION AND POWER FROM FISSION **(9)**

Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding

NEUTRON TRANSPORT AND DIFFUSION AND EQUATIONS **(9)**

Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions, neutron slowing down - Solution of multigroup diffusion equations in one region and multiregion reactors, concept of criticality of thermal reactors

REACTOR KINETICS AND CONTROL **(9)**

Derivation of point kinetics equations, in hour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients

HEAT REMOVAL FROM REACTOR CORE **(9)**

Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux

REACTOR SAFETY, RADIATION PROTECTION **(9)**

Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standards

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

REFERENCE BOOKS:

1. *John R. Lamarsh, Anthony J.Barrata* ***Introduction to Nuclear Engineering****, third Edition, Prentice Hall, (2001)*
2. *John R. Lamarsh* ***Introduction to Nuclear Reactor Theory****, Addison-Wesley, 1966)*
3. *James J. Duderstadt and Lewis J. Hamilton,* ***Nuclear Reactor Analysis,*** *John Wiley (1976)*
4. *Manson Benedict, Thomas H Pigford,* ***Nuclear Chemical Engineering****, Mc-Gram Hill 2nd edition-1981*
5. *J.Kenneth Shultis, Richard E. Faul,* ***Fundamentals of Nuclear Science and Engineering****, CRC Press 1st edition-2002*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Student will understand the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing down and absorption.*

CO2: *The student will also be familiar with concepts of reactor criticality, the relationship between the dimension and fissile material concentration in a critical geometry.*

CO3: *The student will also be familiar with Time dependent (transient) behaviour of power reactor in non-steady state operation and the means to control the reactor.*

CO4: *The student will also be familiar with concepts of heat removal from reactor core, reactor safety and radiation protection.*

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	M	L	L	L	L	L	L	L	L
CO 2	H	H	M	L	L	L	L	L	L	L	L
CO 3	H	H	M	M	L	L	L	L	L	L	L
CO 4	H	H	M	M	L	L	L	L	L	L	L

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

18TEPE20 -SOLAR ENERGY AND WIND ENERGY

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn properties, types, energy conversion techniques of solar and wind energy systems

SOLAR RADIATION (9)

Availability - Measurement and Estimation - Isotropic and an isotropic model - Introduction to solar collectors flat - plate collectors, Air heater and Concentrating collectors and Thermal storage - Steady state transient analysis - Solar Pond - Solar Refrigeration.

MODELLING OF SOLAR THERMAL SYSTEMS AND SIMULATIONS IN PROCESS DESIGN (9)

Design of active systems by f-chart and utilizability methods - water heating systems – Active and passive - Passive heating and cooling of buildings - Solar distillation - Solar Drying.

PHOTOVOLTAIC SOLAR CELL (9)

P-N Junction – Metal – Schottky junction, Electrolyte – Semiconductor Junction, Types of solar cell - their Applications- Experimental Techniques to determine the characteristics of Solar cells Photovoltaic Hybrid Systems Photovoltaic Thermal Systems – Storage Battery – Solar Array Characteristics, Evaluation – Solar Chargeable Battery.

WIND TURBINE (9)

Structure – Statistics – Measurements and Data Presentation – Wind Turbine Aerodynamics – Momentum Theories – Basics Aerodynamics – Airfoils Characteristics – HAWT – Blade Element Theory – Prandt'ls Lifting Line Theory (prescribed wake analysis) – VAWT Aerodynamic Loads in Steady Operation – Wind Turbulence – Yawed Operation and Tower Shadow.

WIND ENERGY CONVERSION SYSTEM (WECS) (9)

Sitting – Rotor Selection – Annual Energy Output – Horizontal Axis Wind Turbine (HAWT) Vertical Axis Wind Turbine– Rotor Design Considerations – Number of Blades – Blade Profile – M/H Blades and Teetering – Coning – Upwind/ Downwind – Power Regulation – Yaw system – Tower – Synchronous and Asynchronous Generators and Loads – Integration of Wind Energy Converters to Electrical Networks – Inverters – Testing of WECS – WECS Control System-Requirements and Strategies – Miscellaneous Topics – Noise – Other Applications.

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

REFERENCE BOOKS:

1. *L.L.Freis,* ***Wind Energy Conversion Systems****, Prentice Hall, 1990.*
2. *D.A.Spera,* ***Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering****, ASME Press, 2nd edition, 2009*
3. *S.P.Sukhatme,J.K.Nayak-****Solar Energy: Principles of Thermal Collection and Storage****, Tata McGraw-Hill, 3rd edition, 6th reprint,2010..*
4. *F.A.Duffie and W.A.Beckman-****Solar Engineering of Thermal Processes****-John Wiley (2013).*
5. *J.F.Krider and F.Kreith-****Solar Energy Handbook*** *McGraw-Hill (1986).*

WEB REFERENCES :

1. *http://www.ises.ors*
2. *http://www.windpower-monthly.com*
3. *http://www.solarpv.com*

COURSE OUTCOMES:

On completion of this course, students will be able to

***CO 1**: Find the availability of solar radiation for different places.*

***CO 2:** Identify the designing procedure of solar thermal system using simulation process.*

***CO 3:** Acquire the knowledge of wind turbine systems and its conservation.*

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	M	L	L	L	L	L	L	M	L	L
CO 2	M	M	M	L	L	L	L	L	L	M	M
CO 3	H	M	L	L	L	L	L	L	L	M	M

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

18TEPE21- DIESEL EMISSION CHARACTERISTICS

Category : PE

L	T	P	C
3	**0**	**0**	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn combustion in diesel engines and extent of the problem of pollutant formation and control in internal combustion engines and testing measures.

DIESEL EMISSION CHARACTERISTICS (9)

Vehicle emission Test Programme - Effect of ambient Temperature on "HC", "OC" and emission - Different fuel system.

EFFECT OF HIGH- PRESSURE INJECTION ON SOOT FORMATION PROCESS (9)

High Pressure Injection - Experimental apparatus and measuring principles - Measurement of Non-Evaporating spray – Measurement of Evaporating spray and flame.

DIESEL SOOT SUPPRESSION (9)

Soot Suppression by kind and content of fuel additives - Under various operating conditions - Effect of combustion chamber type and swirl ratio.

SIMULTANEOUS REDUCTION OF SOOT AND NOx (9)

Experimental procedure - Steady state and test cycle - Transient test cycle.

EFFECTS OF DIESEL FUEL PROPERTY ON EXHAUST VALVE STICKING (9)

Test engine bench - Test fuel engine - Ignition limit test - Investigation of white smoke - Measurement of valve sticking force - Valve Train fracture test.

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

REFERENCE BOOKS:

1. *Satora, Yasuhiro Iton Gutaka Higuchi and Tateo Nagai,* ***NIIGATA Ultra Lean Burn SI Gas Engines -Achieving High Efficiency and Low NOx Emission; SAE – 901608, 1990.***
2. *SW Cootes and G.G.Lassanska,* ***Measurement and Analysis of Gaseous Exhaust Emissions from Recreational and Small Commercial Marine Craft; SAE – 901597, 1990.***
3. *G.Greeves and CHT Wang,* ***Origins of Diesel Particulate Mass Emission; SAE – 810260, 1981.***
4. *Yuzo.Aoyagi, Takeyuki Kamimoto Yokio Matsui and Shim Matsuoka,* ***A Gas Sampling Study on the Formation Processes of Soot and NO in a DI Diesel Engine; SAE – 800254.*** *1980.*
5. *Kenneth Carpenter and John H.Johnson,* ***Analysis of the Physical Characteristics of Diesel Particulate Matter Using Transmission Electron Microscope Techniques; SAE – 790815.*** *1979.*
6. *Harvet A. Bybket and Thoedore L.Rjosebrock,* ***Automotive Diesel Engines-Fuel Composition vs Particulates SAE – 790923.1****979.*
7. *Charles M.Urban and Robert D.Waner,* ***Evaluation of Heavy-Duty Engine Exhaust Particulate Traps; SAE – 850147.*** *1985*

COURSE OUTCOMES:

On successful completion of this course the student will be able to

CO 1*: Understand the concepts of the Emission in engines.*

CO 2: *Analyse the formation of emission and its control in engines.*

CO 3: *Test the emission characteristics of I.C engines.*

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	M	L	L	L	L	L	L	L
CO 2	M	L	L	M	L	L	L	L	M	L	M
CO 3	L	L	L	L	L	L	L	L	L	L	L

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

18TEPE22 – ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn sources and effects of air pollution, water pollution and soil contamination

AIR POLLUTION **(10)**

Definition - sources and effect - air sampling and measurements – dispersion of air pollutants – diurnal effects on the air pollutants dispersion – meteorological aspects – analysis of air pollutants - control methods and equipments - issues in air pollution control

SOLID WASTE MANAGEMENT **(10)**

Sources and Classification - Characteristics of solid waste-Potential methods of solid waste Disposal – Process and Equipments for Energy Recovery from Municipal Solid Waste and Industrial Solid Waste – Hazardous waste disposal – Secure landfill.

WATER POLLUTION AND TREATMENT **(10)**

Water and wastewater – standards of potable water for various purposes - Sources and Classification of Water Pollutants - Characteristics wastewater - WasteWater Sampling techniques – types of treatment and choice of wastewater treatment – utilization and Disposal of Sludge.

OTHER TYPES OF POLLUTION AND LEGISLATIONS **(7)**

Sources, health impact on humans, animals and plants, control strategies – for noise pollution Oil Pollution – Pesticides pollution - Radioactivity Pollution – laws governing air, water and soil pollution

CASE STUDIES **(8)**

Industrial process description – pollution sources – methods available in abatement of pollution – treatment technologies – for thermal power, nuclear power, automobile, aeronautical and mining plants

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

REFERENCE BOOKS:

1. ***Environmental Considerations in Energy Development, Asian Development Bank (ADB), Manilla(1991)***
2. *G.Masters (1991):* ***Introduction to Environmental Engineering and Science,*** *Prentice -Hall International Editions.*
3. *H.S.Peavy, D.R..Rowe, G.Tchobanoglous (1985):* ***Environmental Engineering*** *- McGraw-Hill Book Company, NewYork.*
4. *H.Ludwig, W.Evans (2006):* ***Manual of Environmental Technology in Developing Countries,*** *W.Y. Brockelman and B.N.Lohani, International Book Company, Absecon Highlands, N.J.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: *Identify and value the effect of the pollutants on the environment: atmosphere, water and soil.*

CO 2: *Analyze an industrial activity and identify the environmental problems.*

CO 3: *Plan strategies to control, reduce and monitor pollution with the application of environment management system(EMS).*

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	L	L	L	L	L
CO 2	M	M	M	L	L	L	L	L	M	L	L
CO 3	M	M	L	M	L	L	L	L	M	L	M

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

18TEPE23 - BIO-ENERGY CONVERSION TECHNIQUES

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To make the students to learn types of biomass, its surplus availability and characterizing the conversion techniques of biomass to energy and do economic analysis.

INTRODUCTION **(9)**

Bio Energy - Bio Conversion Mechanism - Utilization of Photosynthate.

THERMAL BIOMASS CONVERSION **(9)**

Combustion, Pyrolysis, Gasification and Liquefaction - Biological Conversion - Methanol, Ethanol Production - Fermentation - Anaerobic Digestion Biodegradation and Biodegradability of Substrate - Hydrogen Generation from Algae – Biological Pathways.

POWER GENERATION TECHNIQUES **(9)**

Through Fermentation and Gasification - Biomass Production from different Organic Wastes - Effect of Additives on Biogas Yield - Biogas production from Dry Dung Cakes.

INDUSTRIAL APPLICATIONS **(9)**

Industrial Applications - Viability of Energy Production - Wood Gasifier System, Operation of Spark Ignition and Compression Ignition with Wood Gas. Operation and Maintenance.

ECONOMICS AND ENVIRONMENTAL ASPECTS **(9)**

Energy Effectives and Cost Effectiveness - History of Energy Consumption and Cost - Environmental Aspects of Bio-energy Conversion.

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

REFERENCE BOOKS:

1. *David Boyles,* ***Bio Energy Technology Thermodynamics and costs****, John wiley, 1984*
2. *Khandelwal KC, Mahdi SS,* ***Biogas Technology - A Practical Handbook****, Tata McGraw Hill, 1986*
3. *R.C.Maheswari,* ***Bio Energy for Rural Energisation*** *, Concepts Publication, 1997*
4. *Anthony San Pietro,* ***Biochemical and Photosynthetic aspects of Energy Production****, Academic Press, New York, 1980*
5. *EL - Halwagi MM,* ***Biogas Technology : Transfer and Diffusion****, Elsevier Applied SC, London 1986*

WEB REFERENCES :

1. *http://www.bio-energy.at*
2. *http://www.abchansen.dk.*
3. *www.soest.hawaii.edu/csf*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: *A practical understanding on the various biomass energy conversion technologies and its relevance towards solving the present energy crisis.*

CO2: *Provide a thorough understanding of basic principles and system constructions of biomass energy conversion technology and utilization.*

CO3: ***A****nalyze economic optimality and environmental aspects of bio energy conversion techniques.*

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	M	L	L	L	L	L	L	L	L	L
CO 2	M	M	M	L	L	L	L	L	L	M	L
CO 3	M	M	M	L	L	L	L	L	L	L	L

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

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

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

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

UNIT I - INTRODUCTION (9)

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

UNIT II - SPACE THEORY IN VASTU (9)

Features of good building site -good building shapes -macro, micro, enclosed and material spaces - relationship between built space, living organism and universe -impact of built space on human psyche. Flow of energy within built space and outside -

zoning of functional areas -fitting of components in the building -significance of water bodies and energy -The cube as the basic structure.

UNIT III - COSMOGRAM & SETTLEMENT CONCEPTS (9)

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

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

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

UNIT V - MEASUREMENTS & MATERIALS (9)

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

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

REFERENCE BOOKS:

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

*2. K.S.Subramanya Sastri –"**Maya Matam**" -Thanjavur Maharaja Sarjoji saraswathil Mahal Library -Thanjavur-1966.*

*3. Stella Kramresh –"**The Hindu Temple**" Vol.1 & II Motital Banarsidass Publishers Pvt. Ltd., Delhi -1994.*

*4. Bruno Dagens –"**Mayamatam**", Vol.1 & IIIGNCA and Motilal Bamarsidars, .Publishers Pvt. Ltd-s Delhi -1994.*

*5. George Birdsall –"**Feng Shui: The Key Concepts**" -January 2011*

COURSE OUTCOMES:

The students are able to

***CO 1:** Obtain exposure on various concepts of vastu*
***CO 2:** Understand the theories in Vastu.*
***CO 3:** familiarize with the Cosmogram and settlement concepts of vastu*
***CO 4:** Understand the role of vasthu in energy flow manifestation in living beings.*
***CO 5:** Plan a structure considering various vastu techniques.*

COURSE ARTICULATION MATRIX:

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

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

18SEOE02 - PLANNING OF SMART CITIES

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

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
CO1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	***M***	***M***	-
CO4	-	-	-	-	-	***M***	-	-	-	-	-
CO5	***L***	***H***	-	-	-	***L***	-	-	-	-	-

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

18SEOE03 - GREEN BUILDING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

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

UNIT I - INTRODUCTION (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
CO1	***L***	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	***M***	***M***	-	-	-	-	-
CO3	-	-	-	-	-	***M***	-	-	-	-	-
CO4	-	-	-	-	-	***M***	-	-	-	-	-
CO5	***M***	-	-	-	-	-	-	-	***L***	***M***	***M***

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

18EEOE19 - 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

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

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*
4.

UNIT I EARTH'S CLIMATE SYSTEM (09)

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

UNIT II OBSERVED CHANGES AND ITS CAUSES (09)

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

UNIT III IMPACTS OF CLIMATE CHANGE (09)

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

UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES (09)

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

UNIT V CLEAN TECHNOLOGY AND ENERGY (09)

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

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

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

CO2: *To assess the uncertainty and impact of climatic changes*

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

CO4 : *To identify clean technologies for sustainable growth*

CO5: *To identify clean technologies for sustainable growth*

COURSE ARTICULATION MATRIX:

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

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

18EEOE06 - WASTE TO ENERGY

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

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

UNIT I INTRODUCTION (09)

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

UNIT II BIOMASS PYROLYSIS (09)

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

UNIT III BIOMASS GASIFICATION (09)

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

UNIT IV BIOMASS COMBUSTION (09)

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

UNIT V BIOGAS (09)

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

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

CO1: *Understand solid waste management techniques.*

CO2: *Know what is biomass.*

CO3 : *Study Methods and factors considered for biomass gasification.*

CO4 : *Know equipmentmeant for biomass combustion.*

CO5 : *Understand about biogas and its development in India.*

COURSE ARTICULATION MATRIX:

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

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

18GEOE07 - ENERGY IN BUILT ENVIRONMENT

(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course students are able to:

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

UNIT I INTRODUCTION (09)

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

UNIT II LIGHTING REQUIREMENTS IN BUILDING (09)

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

UNIT III ENERGY REQUIREMENTS IN BUILDING (09)

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

UNIT IV ENERGY AUDIT (09)

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

UNIT V COOLING IN BUILT ENVIRONMENT (09)

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

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

CO1: *Understand energy and its usage.*

CO2: *To know lighting to be given to a building.*

CO3 : *To study energy requirements in a building.*

CO4 : *Understand energy audit.*

CO5 : *To study architectural specifications of a building.*

COURSE ARTICULATION MATRIX:

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

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

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

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

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

UNIT I - EVOLUTION OF EARTH (09)
Evolution of earth as habitable planet - Evolution of continents - oceans and landforms - evolution of life through geological times - Exploring the earth's interior - thermal and chemical structure - origin of gravitational and magnetic fields.

UNIT II - GEOSYSTEMS (09)
Plate tectonics - working and shaping the earth - Internal Geosystems – earthquakes – volcanoes - climatic excursions through time - Basic Geological processes - igneous, sedimentation - metamorphic processes.

UNIT III - GROUND WATER GEOLOGY (09)
Geology of groundwater occurrence - recharge process - Groundwater movement - Groundwater discharge and catchment hydrology - Groundwater as a resource - Natural groundwater quality and contamination - Modeling and managing groundwater systems.

UNIT IV- ENVIRONMENTAL ASSESMENT AND SUSTAINABILITY (09)
Engineering and sustainable development - population and urbanization - toxic chemicals and finite resources - water scarcity and conflict - Environmental risk - risk assessment and characterization - hazard assessment - exposure assessment.

UNIT V- AIR AND SOLIDWASTE (09)
Air resources engineering - introduction to atmospheric composition – behaviour - atmospheric photochemistry - Solid waste management – characterization - management concepts.

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

REFERENCE BOOKS:

1. John Grotzinger and Thomas H. Jordan, ***Understanding Earth****, Sixth Edition, W. H. Freeman, 2010.*

2. Younger, P. L., ***Groundwater in the Environment: An introduction****, Blackwell Publishing, 2007.*

3. Mihelcic, J. R., Zimmerman, J. B., ***Environmental Engineering: Fundamentals, Sustainability and Design****, Wiley, NJ, 2010.*

COURSE OUTCOMES

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

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

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

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

CO4: Assess the Environmental risks and the sustainability developments.

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

COURSE ARTICULATION MATRIX:

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

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

18GEOE09 - NATURAL HAZARDS AND MITIGATION

(Common to All Branches)

Category: OE

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

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

18EDOE10 - BUSINESS ANALYTICS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE:

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

BUSINESS ANALYTICS AND PROCESS (9)

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

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 Businessanalytics, problem solving, Visualizing andExploring Data, Business AnalyticsTechnology.

STRUCTURE OF BUSINESS ANALYTICS (9)

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

FORECASTING TECHNIQUES (9)

Forecasting Techniques: Qualitative and Judgmental Forecasting, StatisticalForecasting Models, Forecasting Models for Stationary Time Series, ForecastingModels for Time Series with a Linear Trend, Forecasting Time Series withSeasonality, Regression Forecasting with Casual Variables, Selecting AppropriateForecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation UsingAnalytic 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 thewithout Outcome Probabilities, Decision Trees, The Value of Information, Utilityand Decision Making.

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

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

REFERENCE:

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.

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

REFERENCES:

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 ofIndustrial Engineer – Applications of Industrial Engineering – Production Management VsIndustrial Engineering – Operations Management – Production System – Input Output Model –Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds ofProductivity measures.

PLANT LOCATION AND LAYOUT (9)

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

WORK SYSTEM DESIGN (9)

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

STATISTICAL QUALITY CONTROL (9)

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

PRODUCTION PLANNING AND CONTROL (9)

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

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

REFERENCES:

*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

PREREQUISITES: NIL

L	*T*	*P*	*C*
3	*0*	*0*	*3*

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**

REFERENCES:

*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

PREREQUISITES: NIL

L	*T*	*P*	*C*
3	*0*	*0*	*3*

COURSE OBJECTIVE :

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

UNIT- I INTRODUCTION **(9)**

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

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

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

(9)

UNIT-III NON LINEAR PROGRAMMING PROBLEM

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

(9)

UNIT -IV SEQUENCING AND INVENTORY MODEL

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

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

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

Contact Periods:

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

References:

*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

PREREQUISITES: NIL

L	*T*	*P*	*C*
3	*0*	*0*	*3*

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**

References:

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 model concept, Paleo-climate, Weather prediction by Numerical process. Impacts of climate change, Climate Sensitivity, Forcings and feedbacks.

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

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

GREEN HOUSE GASES

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 **L(9)**

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

ELECTRONIC STRUCTURE AND MOTION **(9)**

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

SCATTERING THEORY **(9)**

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

CLASSICAL STATISTICS **(9)**

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

QUANTUM STATISTICS **(9)**

Statistical mechanics- Basic Concepts, Statistical models applied to metals and semiconductors. The thermal properties of solids- The electrical properties of materials. Black body radiation, Low temperatures and degenerate systems.

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

REFERENCE BOOKS:

1 *Peter L. Hagelstein, Stephen D. Senturia, and Terry P. Orlando,* ***Introductory Applilied Quantum Statistical Mechanics****, Wiley (2004).*

2 *A. F. J. Levi,* ***Applied Quantum Mechanics*** *(2nd Edition), Cambridge (2006).*

3 *Walter A Harrison,* ***Applied Quantum Mechanics****, Stanfor University (2008).*

4 *Richard Liboff,* ***Introductory Quantum Mechanics****, 4th edition, Addison Wesley (2003).*

5 *P.W. Atkins and R.S. Friedman,* ***Molecular Quantum Mechanics*** *Oxford University Press, 3rd edition 1997.*

COURSE OUTCOMES:

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

CO1: *The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, hetero structures.*

CO2: *The student should be able to set up and solve the Scfrödinger equation for different types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.*

CO3: *Potentially be able to join a research group in nanoscience / nanotechnology as a student researcher.*

COURSE ARTICULATION MATRIX:

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

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

18TEOE18 – GREEN SUPPLY CHAIN MANAGEMENT

(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- *To make the students to learn and focus on the fundamental strategies, tools and techniques required to analyze and design environmentally sustainable supply chain systems.*

INTRODUCTION **(9)**

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

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

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

PLANNING THE SUPPLY CHAIN **(9)**

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

ACTIVITIES IN THE SUPPLY CHAIN **(9)**

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

SUPPLY CHAIN MANAGEMENT STRATEGIES **(9)**

Five key configuration components, Four criteria of a good supply chain strategies, Next generation strategies- New roles for end to end supply chain management. Evolution of supply chain organization.

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

REFERENCE BOOKS:

1 *Rogers,Dale., and Ronald Tibben-Lembke."**An Examination of Reverse Logistics Practices."** Journal of Business Logistics 22, no. 2 (2001) : 129-48.*

2 *Guide, V., Kumar Neeraj, et al. "**cellular Telephone Reuse: The ReCellular Inc. Case."** Managing Closed-Loop Supply Chains. Case: Part 6, (2005): 151-156.*

3 *Mark, K. "**Whirlpool Corrporation: Reverse Logistics."** Richard Ivey School of Business. Case: 9B11D001, August 8, 2011.*

4 *Porter, Michael E., and Mark R. Kramer. "**Strategy and Society: The Link between Competitive Advantage and Corporate Social Responsibility."** Harvard Business Revies 84, no. 12 (2006): 78-92.*

5 *Shoshnah Cohen, Josep Roussel, "**Strategic Supply Chain Management",** the five disciplines for top performance, McGraw-Hill, (2005.)*

COURSE OUTCOMES:

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

***CO1:** Evaluate complex qualitative and quantitative data to support strategic and operational decisions.*

***CO2:** Develop self-leadership strategies to enhance personal and professional effectiveness.*

***CO3:** The importance of the design and redesign of a supply chain as key components of an organization's strategic plan.*

COURSE ARTICULATION MATRIX

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

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

18PSOE19 DISTRIBUTION AUTOMATION SYSTEM

(Common to all Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To study about the distributed automation and economic evaluation schemes of power network.

UNIT-I INTRODUCTION (09)

Introduction to Distribution Automation (DA) - Control system interfaces- Control and data requirements- Centralized (vs) decentralized control- DA system-DA hardware-DAS software.

UNIT-II DISTRIBUTION AUTOMATION FUNCTIONS (09)

DA capabilities - Automation system computer facilities- Management processes- Information management- System reliability management- System efficiency management- Voltage management-Load management.

UNIT-III COMMUNICATION SYSTEMS (09)

Communication requirements - reliability- Cost effectiveness- Data requirements- Two way capability-Communication during outages and faults - Ease of operation and maintenance- Conforming to the architecture of flow. Distribution line carrier- Ripple control-Zero crossing technique- Telephone, cableTV, radio, AM broadcast, FM SCA,VHF radio, microwave satellite, fiber optics-Hybrid communication systems used in field tests.

UNIT-IV ECONOMIC EVALUATION METHODS (09)

Development and evaluation of alternate plans- select study area – Select study period- Project load growth-Develop alternatives- Calculate operating and maintenance costs-Evaluate alternatives.

UNIT-V ECONOMIC COMPARISON (09)

Economic comparison of alternate plans-Classification of expenses - capital expenditures-Comparison of revenue requirements of alternative plans-Book life and continuing plant analysis- Year by year revenue requirement analysis, Short term analysis- End of study adjustment-Break even analysis, sensitivity analysis - Computational aids.

CONTACT PERIODS:

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 Category : OE

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To identify, analyze and create solutions for the power quality problems in power system networks.

UNIT-I : INTRODUCTION (09)

Importance of power quality - Terms and definitions as per IEEE std.1159 for transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers - Symptoms of poor power quality- Definitions and terminology of grounding- Purpose of groundings- Good grounding practices - problems due to poor grounding.

UNIT-II : FLICKERS AND TRANSIENT VOLTAGES (09)

RMS voltage variations in power system, complex power, voltage regulation and per unit system - Basic power flow and voltage drop - Devices for voltage regulation and impact of reactive power management - Causes and effects of voltage flicker - Short term and long term flickers -Methods to reduce flickers- Transient over voltages, impulsive transients, switching transients - Effect of surge impedance and line termination - control of transient voltages.

UNIT-III : VOLTAGE INTERRUPTIONS (09)

Definitions -Voltage sags versus interruptions - Economic impact, Major causes and consequences - characteristics, assessment, Influence of fault location and fault level on voltage sag - Areas of vulnerability, Assessment of equipment sensitivity, Voltage sag limits for computer equipment-CBEMA, ITIC, SEMI F 42curves, Report of voltage sag analysis, Voltage sag indices, Mitigation measures for voltage sag- DSTATCOM, UPQC,UPS, DVR, SMEs, CVT, utility solutions and end user solutions.

UNIT-IV : WAVEFORM DISTORTION (09)

Definition of harmonics, inter-harmonics, sub-harmonics- Causes and effects - Voltage versus current distortion, Fourier analysis, Harmonic indices, A.C. quantities under non-sinusoidal conditions, Triplet harmonics, characteristic and non characteristic harmonics- Series and Parallel resonances- Consequence - Principles for controlling and Reducing harmonic currents in loads, K-rated transformer -Computer tools for harmonic analysis- Locating sources of harmonics, Harmonic filtering- Passive and active filters - Modifying the system frequency response- IEEE Harmonic standard 519-1992.

UNIT-V : ANALYSIS AND CONVENTIONAL MITIGATION METHODS (09)

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

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

REFERENCE BOOKS:

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

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

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

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

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

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

COURSE OUTCOMES:

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

CO2: *Recognize the practical issues in the power system.*

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

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

COURSE ARTICULATION MATRIX:

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

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

18PSOE21 **MODERN AUTOMOTIVE SYSTEMS** **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.

CONTACT PERIODS:

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.*

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 ACQUISITION AND SIGNAL CONDITIONING (09)

Components of a DAQ system, Bus, Signal and accuracy consideration when choosing DAQ hardware – Measurement of analog signal with Finite and continuous buffered acquisition- analog output generation – Signal conditioning systems – Synchronizing measurements in single & multiple devices – Power quality analysis using Electrical Power Measurement tool kit.

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

REFERENCE BOOKS:

*1. Jeffrey Travis, Jim Kring, '**LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition),** Prentice Hall, 2006.*

*2. Sanjeev Gupta, **'Virtual Instrumentation using LabVIEW'** TMH, 2004*

*3. Gary W. Johnson, Richard Jennings, **'Lab-view Graphical Programming'**, McGraw Hill Professional Publishing, 2001*

*4. Robert H. Bishop, **'Learning with Lab-view'**, Prentice Hall, 2003.*

*5. Kevin James, '**PC Interfacing and Data Acquisition: Techniques for Measurement**, Instrumentation and Control', Newness, 2000*

COURSE OUTCOMES:

CO1: *Gain Knowledge of graphical programming techniques using LabVIEW software.*

CO2: *Explore the basics of programming and interfacing using related hardware.*

CO3: *Outline the aspects and utilization of PC based data acquisition and Instrument interfaces.*

CO4: *Create programs and Select proper instrument interface for a specific application.*

COURSE ARTICULATION MATRIX

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

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

18PEOE23 **ENERGY AUDITING** **Category: OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To Comprehend energy management schemes and perform economic analysis and load management in electrical systems.

UNIT-I : BASICS OF ENERGY MANAGEMENT (09)

Energy Scenario – Energy Sector Reforms – Impact on environment – Strategy for future and conservation – Basics of Energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and Methodology - Audit Report – Energy Cost, Benchmarking and Energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, Material and energy balance diagrams.

UNIT-II : ACTION PLANNING AND MONITORING (09)

Energy Management System – Performance assessment – Goal setting by Manager – Action plan implementation – Financial Management: Investment - Financial analysis techniques, ROI, Risk and sensitivity analysis, role of Energy Service Companies. Project management: Steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.

UNIT-III : STUDY OF THERMAL UTILITIES (09)

Combustion of Oil, Coal and Gas – Performance Evaluation of Boilers – Boiler blow down – Boiler water treatment – Energy Conservation Opportunity – Cogeneration: Principal – Options - Classification – Influencing Factors and technical parameters. Waste heat recovery: Classification – application – benefits - Different heat recovery devices.

UNIT-IV : STUDY OF ELECTRICAL UTILITIES (09)

Electricity Billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – recommended luminance levels – Lighting system energy efficiency study – Energy Efficient Technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, Light controllers and Electronic ballasts.

UNIT-V : ENERGY ASSESSMENT IN UTILITY SYSTEMS (09)

Performing Financial analysis: Fixed and variable costs – Payback period – methods – factors affecting analysis – Waste Minimization Techniques: Classification – Methodology. Performance assessment of HVAC Systems: Measurements, Procedure – Evaluation. Assessment of Pumps: Measurements, Procedure – Evaluation.

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

REFERENCE BOOKS:

1. *Murphy W.R. and G.Mckay Butter worth , "**Energy Management**", Heinemann Publications.*

2. *Paul o' Callaghan, **"Energy Management",**Mc-Graw Hill Book Company – 1st edition; 1998.*

3. *John.C.Andreas, **"Energy Efficient Electric Motors",** Marcel Dekker Inc Ltd – 2nd edition; 1995.*

4. *W.C.Turner, **"Energy Management Handbook",** John Wiley and Sons, Fifth edition, 2009.*

5. ***"Energy Management and Good Lighting Practice: fuel efficiency**" – booklet 12 – EEO.*

6. *www.em-ea.org/gbook1.asp*

COURSE OUTCOMES:

***CO1:** Possess knowledge on energy management.*

***CO2:** Analyze the feature of energy audit methodology and documentation of report.*

***CO3:** Able to plan energy management action and develop the understanding of implementation.*

***CO4:** Familiarize with thermal utilities.*

***CO5:** Familiarize with electrical utilities.*

***CO6:** Perform assessment of different systems.*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	M	L	L	-	M	M	L	-	M
CO2	-	-	M	L	L	-	M	M	L	-	M
CO3	-	-	M	L	-	-	M	M	L	-	M
CO4	-	-	M	-	-	-	M	-	L	-	M
CO5	-	-	M	-	-	-	M	-	L	-	M
CO6	-	-	M	-	-	-	M	-	L	-	M

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

18PEOE24 **ADVANCED ENERGY STORAGE TECHNOLOGY** **Category : OE**
(Common to All Branches)

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 **Category : OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

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

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

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

Category : OE

18AEOE27 PATTERN RECOGNITION	L	T	P	C
(Common to all Branches)	3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

- *To get knowledge in pattern recognition in computer vision techniques*
- *To get knowledge in structural pattern methods*
- *To get knowledge on neural networks and fuzzy systems.*

PATTERN CLASSIFIER **(9)**

Overview of pattern recognition -Discriminant functions-Supervised learning –Parametric estimation- Maximum likelihood estimation –Bayesian parameter estimation- Perceptron algorithm-LMSE algorithm – Problems with Bayes approach –Pattern classification by distance functions-Minimum distance pattern classifier.

UNSUPERVISED CLASSIFICATION **(9)**

Clustering for unsupervised learning and classification - Clustering concept-C-means algorithm-Hierarchical clustering procedures- Graph theoretic approach to pattern clustering - Validity of clustering solutions.

STRUCTURAL PATTERN RECOGNITION **(9)**

Elements of formal grammars-String generation as pattern description - recognition of syntactic description- Parsing-Stochastic grammars and applications - Graph based structural representation.

FEATURE EXTRACTION AND SELECTION **(9)**

Entropy minimization – Karhunen - Loeve transformation-feature selection through functions approximation- Binary feature selection.

NEURAL NETWORKS **(9)**

Neural network structures for Pattern Recognition –Neural network based Pattern associators-Unsupervised learning in neural Pattern Recognition-Self organizing networks-Fuzzy logic-Fuzzy classifiers-Pattern classification using Genetic Algorithms.

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

Category : OE

18VLOE28 VLSI DESIGN
(Common to all Branches)

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

Category : OE

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

L	T	P	C
3	0	0	3

PREREQUISITES:Nil

COURSE OBJECTIVES:

- *To acquire knowledge on MOS circuit configuration and CMOS amplifier*
- *To analyze and design Operational amplifier*
- *To understand mixed signal circuits*

MOS CIRCUIT CONFIGURATION (9)

Basic CMOS Circuits - Basic Gain Stage - Gain Boosting Techniques - Super MOS Transistor - Primitive Analog Cells, Current Source, Sinks and References MOS Diode/Active resistor, Simple current sinks and mirror, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.

CMOS AMPLIFIER (9)

CMOS Amplifier Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier.

CMOS DIFFERENTIAL AMPLIFIER (9)

CMOS Differential Amplifier Differential signalling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load, Differential to single ended conversion. Linear Voltage - Current Converters - CMOS, Bipolar and Low – Voltage BiCMOS Op - Amp Design - Instrumentation Amplifier Design.

BICMOS CIRCUIT TECHNIQUES AND CURRENT-MODE SIGNAL PROCESSING (9)

Basic BiCMOS Circuit Techniques, Current - Mode Signal Processing: Continuous - Time Signal Processing – Sampled - Data Signal Processing – Switched - Current Data Converters.

ANALOG FILTERS AND A/D CONVERTERS (9)

Sampled - Data Analog Filters, Over Sampled A/D Converters and Analog Integrated Sensors: First - order and Second SC Circuits - Bilinear Transformation – Cascade Design – Switched - Capacitor Ladder Filter

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

REFERENCE BOOKS:

1. *Behzad Razavi,* ***Design of Analog CMOS Integrated circuits****, Tata McGraw Hill Education, 2002.*
2. *Mohammed Ismail, Terri Fiez,* ***Analog VLSI signal and Information Processing****, McGraw- Hill International Editons, 1994.*
3. *R. Jacob Baker, Harry W. Li, and David E. Boyce,* ***CMOS: Circuit Design , Layout and Simulation****, Prentice Hall of India, 1997.*
4. *David A. Johns and Ken Martin,* ***Analog Integrated circuit Design****, John Wiley & Son, 2013*
5. *Greogorian and Tames,* ***Analog Integrated Circuit for Switched Capacitor Circuits****, John Wiley & Sons Inc., 4th Edition, 1986.*

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

Category : OE

18VLOE30 HARDWARE DESCRIPTION LANGUAGES

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES:Nil

COURSE OBJECTIVES

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

BASIC CONCEPTS OF HARDWARE DESCRIPTION LANGUAGES (9)

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

MODELING STYLES (VHDL) (9)

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

INTRODUCTION TO VERILOG HARDWARE DESCRIPTION LANGUAGE (9)

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

MODELING STYLES (VERILOG) (9)

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

DESIGN SUB-SYSTEMS USING VHDL/VERILOG

(9)

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

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

After completing this course, the students will have:

- *CO1: To 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]***

COURSE ARTICULATION MATRIX:

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

L-LOW M-MEDIUM H-HIGH

18CSOE32 COMPUTER NETWORK ENGINEERING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

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

- *The hardware and software architecture of Computer Networks*
- *The concepts of internetworking*
- *Issues in resource allocation*
- *End-to-end protocols and data transmission*
- *Network management models*

UNIT I FOUNDATION L(9)

Applications – Requirements – Network Architecture – Implementing Network software – Performance – Perspectives on connecting – Encoding – Framing – Error detection – Reliable transmission – Ethernet and Multiple Access Networks – Wireless.

UNIT II INTERNETWORKING L(9)

Switching and bridging – IP – Routing – Implementation and Performance – Advanced Internetworking – The Global Internet – Multicast – Multiprotocol and Label Switching – Routing among Mobile devices.

UNIT III CONGESTION CONTROL AND RESOURCE ALLOCATION L(9)

Issues in Resource allocation – Queuing disciplines – Congestion Control – Congestion avoidance mechanism – Quality of Service.

UNIT IV END-TO-END PROTCOLS AND DATA L(9)

Simple Demultiplexer – Reliable Byte Stream –Remote Procedure Call – RTP – Presentation formatting - Multimedia data.

UNIT V NETWORK MANAGEMENT L(9)

SNMPv1 and v2 Organization and information model - Communication model – Functional model - SNMP proxy server- Remote monitoring- RMON1 and RMON2.

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]***

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	M	-	-	M	-	M
CO2	H	H	M	H	M	H	-	-	M	-	M
CO3	H	H	M	H	M	H	-	-	M	-	M
CO4	H	H	H	M	H	M	-	-	M	-	M
CO5	H	H	M	H	M	H	L	-	M	-	M
CO6	H	H	H	M	H	M	L	-	M	-	M

L-LOW M-MEDIUM H-HIGH

18CSOE33 BIG DATA ANALYTICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

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

- *Statistical methods*
- *Bayesian, Support Vector and Kernel Methods*
- *Time Series Analysis and Rule Induction*
- *Neural networks and Fuzzy Logic*
- *Visualization Techniques*

UNIT I STATISTICAL CONCEPTS AND METHODS L(9)

Statistical Concepts: Probability, Sampling and Sampling Distributions, Statistical Inference, Prediction and Prediction Errors–Resampling- Statistical Method: Linear Models, Regression Modeling, Multivariate Analysis.

UNIT II BAYESIAN METHODS AND SUPPORT VECTOR AND KERNEL METHODS L(9)

Bayesian Methods: Bayesian Paradigm, modeling, inference and networks – Support Vector and Kernel Methods: Kernel Perceptron, Overfitting and Generalization Bounds, Support Vector Machines, Kernel PCA and CCA.

UNIT III TIME SERIES ANALYSIS AND RULE INDUCTION L(9)

Analysis of time series: linear systems analysis, nonlinear dynamics, Delay Coordinate Embedding - Rule induction: Propositional Rule Learning, Rule Learning as search, Evaluating quality of rules, Propositional rule induction, First order rules-ILP systems.

UNIT IV NEURAL NETWORKS AND FUZZY LOGIC L(9)

Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees.

UNIT V STOCHASTIC SEARCH METHODS AND VISUALIZATION L(9)

Stochastic Search Methods: Stochastic Search by Simulated Annealing, Adaptive Search by Evolution-Evolution Strategies- Genetic Algorithms & Programming- Visualization : Classification of Visual Data Analysis Techniques, Data Type to be Visualized, Visualization Techniques, Interaction Techniques and Specific Visual Data Analysis Techniques.

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

Reference Books

1. *Michael Berthold, David J. Hand,* ***"Intelligent Data Analysis-An Introduction"****, Second Edition, Springer, 2007.*
2. *Bill Franks,* ***"Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics"****, John Wiley & sons, 2012.*
3. *Jimmy Lin and Chris Dyer,* ***"Data Intensive Text Processing using Map Reduce"****, Morgan and Claypool Publishers, 2010.*
4. *Tom White,* ***"Hadoop: The Definitive Guide"****, O`Reilly Publishers, 2012*
5. *David Loshin, "****Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph****", Morgan Kaufmann, 2013.*
6. *Paul Zikopoulos, Chris Eaton, "****Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data****", McGraw-Hill Education, 2011.*

COURSE OUTCOMES:

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

CO1: *Explain the statistical concepts and methods.* ***[Familiarity]***

CO2: *Use Bayesian, support vector and kernel Methods.* ***[Usage]***

CO3: *Perform Time series analysis.* ***[Usage]***

CO4: *Use Rule induction.* ***[Usage]***

CO5: *Apply Neural network and Fuzzy logic.* ***[Usage]***

CO6: *Use Stochastic search methods.* ***[Usage]***

CO7: *Explain Visualization Techniques.* ***[Familiarity]***

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	M	-	-	M	-	M
CO2	H	H	H	M	H	M	-	-	M	-	M
CO3	H	H	H	M	H	M	L	-	M	L	M
CO4	H	H	H	M	H	M	-	-	M	-	M
CO5	H	H	H	M	H	M	-	-	M	-	M
CO6	H	H	H	M	H	M	L	-	M	-	M
CO7	H	M	M	M	M	M	-	-	M	L	M

L-LOW M-MEDIUM H-HIGH

18TEACZ1 - 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

18TEACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

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

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

UNIT I INTRODUCTION L(6)

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS L(6)

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA L(6)

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT L(6)

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V RISK ASSESSMENT L(6)

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

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

REFERENCE BOOKS:

1 *R. Nishith, Singh AK, "**Disaster Management in India: Perspectives, issues and strategies**" New Royal book Company.*

2 *Sahni, Pardeep Et.Al. (Eds.)," **Disaster Mitigation Experiences And Reflections**", Prentice Hall Of India, New Delhi.*

3 *Goel S. L. , "**Disaster Administration And Management Text And Case Studies**" ,Deep & Deep Publication Pvt. Ltd., New Delhi.*

4 *Jagbir Singh,* ***"Disaster Management: Future Challenges and Opportunities",*** *I.K. International Publishing House Pvt. Ltd. , New Delhi, 2007.*

COURSE OUTCOMES:

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

CO1: *Differentiate hazard and disaster and types of disasters.*

CO2: *Identify the causes and types of manmade and natural disaster.*

CO3: *Describe the disaster prone areas in India.*

CO4: *To predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences*

CO5: *Provide survival strategies based on risk assessment.*

COURSE ARTICULATION MATRIX

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

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

18TEACZ3 - 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

18TEACZ4 - CONSTITUTION OF INDIA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

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

- *Indian constitution*
- *Constitutional rights & duties*
- *Organs of governance*
- *Local administration*
- *Roles and functions of Election commission*

UNIT I - INDIAN CONSTITUTION **L(6)**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features

UNIT II - CONSTITUTIONAL RIGHTS & DUTIES **L(6)**

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III - ORGANS OF GOVERNANCE **L(6)**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT IV - LOCAL ADMINISTRATION **L(6)**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V - ELECTION COMMISSION **L(6)**

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

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

REFERENCE BOOKS:

1 ***The Constitution of India, 1950 (Bare Act)**, Government Publication.*

2 *Dr. S. N. Busi, **Dr. B. R. Ambedkar framing of Indian Constitution**, 1st Edition, 2015.*

3 *M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.*

4 *D.D. Basu**, Introduction to the Constitution of India**, Lexis Nexis, 2015.*

COURSE OUTCOMES

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

CO1: *Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*

CO2: *Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*

CO3: *Understand the various organs of Indian governance.*

CO4: *Familiarize with the various levels of local administration.*

CO5: *Gain knowledge on election commission of India.*

COURSE ARTICULATION MATRIX

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

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

18TEACZ5 - 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

18TEACZ6 - 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.**K.N Udupa, "Stress and its management by Yoga", Motilal Banarsidass Publ,New Delhi.***

4

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

18TEACZ7 - 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

18TEACZ8 - 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