Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Environmental Sciences					
Course Code: EVSC2016					
Contact hrs per week:	L	T	P	Total	Credit points
	2	0	0	2	0

Module 1: [6L]

Socio Environmental Impact:

Basic ideas of environment and its component

Population growth: exponential and logistic; resources; sustainable development. 3L

Concept of green chemistry, green catalyst, green solvents

Environmental disaster and social issue, environmental impact assessment, environmental audit, environmental laws and protection act of India. 3L

Module 2: [6L]

Air Pollution:

Structures of the atmosphere, global temperature models

Green house effect, global warming; acid rain: causes, effects and control. 3L

Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution. 3L

Module 3: [6L]

Water Pollution:

Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts.

Biochemical effects of heavy metals; eutrophication: source, effect and control. 2L

Water quality parameters: DO, BOD, COD.

Water treatment: surface water and waste water. 4L

Module 4: [6L]

Land Pollution

Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal. 3L

Noise Pollution

Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control. 3L

Text/Books

1. Gour Krishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.
2. A. K. De, "Environmental Chemistry", New Age International.
3. A. K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd

References/Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd.

Course Outcome:

The subject code EVSC2016 corresponds to basic environmental chemistry for the 2nd year B.Tech students, which is offered as Environmental Sciences and is mandatory for all branches of engineering. The course provides basic knowledge of various environmental pollutions as well as its impact and ways to curb it. The course outcomes of the subject are

1. Understand the natural environment and its relationships with human activities.
2. Characterize and analyze human impacts on the environment.
3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
4. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
5. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
6. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Human Values and Professional Ethics						
Course Code: HMTS2001						
Contact hrs per week:	**L**	**T**	**P**	**S**	**Total**	**Credit points**
	3	**0**	**0**	**0**	**3**	**3**

Module I (10 L)

Human society and the Value System

Values: Definition, Importance and application.

Formation of Values: The process of Socialization

Self and the integrated personality

Morality, courage, integrity

Types of Values:

Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism

Aesthetic Values: Perception and appreciation of beauty

Organizational Values: Employee: Employer--- rights, relationships, obligations

Psychological Values: Integrated personality and mental health

Spiritual Values &their role in our everyday life

Value Spectrum for a Good Life, meaning of Good Life

Value Crisis in Contemporary Society

Value crisis at----

Individual Level

Societal Level

Cultural Level

Value Crisis management---- Strategies and Case Studies

Module II (10L)

Ethics and Ethical Values

Principles and theories of ethics

Consequential and non-consequential ethics

Egotism,Utilitarianism, Kant's theory and other non-consequential perspectives

Ethics of care, justice and fairness, rights and duties

Ethics-- Standardization
Codification
Acceptance
Application

Types of Ethics--- Ethics of rights and Duties
Ethics of Responsibility
Ethics and Moral judgment
Ethics of care
Ethics of justice and fairness
Work ethics and quality of life at work

Professional Ethics

Ethics in Engineering Profession;

moral issues and dilemmas, moral autonomy(types of inquiry)

Kohlberg's theory, Gilligan'stheory (consensus and controversy)

Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEEInstitute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers

Violation of Code of Ethics---conflict, causes and consequences

Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)

Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership

Conflict between business demands and professional ideals

social and ethical responsibilities of technologies.

Whistle Blowing: Facts, contexts, justifications and case studies

Ethics and Industrial Law

Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III (10L)

Science, Technology and Engineering
Science, Technology and Engineering as knowledge and profession
----Definition, Nature, Social Function and Practical application of science
Rapid Industrial Growth and its Consequences
Renewable and Non- renewable Resources: Definition and varieties
Energy Crisis
Industry and Industrialization
Man and Machine interaction
Impact of assembly line and automation
Technology assessment and Impact analysis
Industrial hazards and safety
Safety regulations and safety engineering
Safety responsibilities and rights
Safety and risk, risk benefit analysis and reducing risk
Technology Transfer: Definition and Types
The Indian Context

Module IV (6L)

Environment and Eco- friendly Technology
Human Development and Environment
Ecological Ethics/Environment ethics
Depletion of Natural Resources: Environmental degradation
Pollution and Pollution Control
Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept
Strategies for sustainable development
Sustainable Development--- The Modern Trends

Appropriate technology movement by Schumacher and later development
Reports of Club of Rome.

Suggested Readings:

1. Tripathi,A.N., Human Values, New Age International, New Delhi,2006

2. Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996.

3. Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008.

4. Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008.

5. Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.

6. Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.

7. Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).

Course Outcome:

After the completion of the course, the students will:

1. be aware of the value system and the importance of following such values at workplace
2. learn to apply ethical theories in the decision making process
3. follow the ethical code of conduct as formulated by institutions and organizations
4. Implement the principles governing work ethics
5. Develop strategies to implement the principles of sustainable model of development
6. Implement ecological ethics wherever relevant and also develop eco-friendly technology

Text/ Reference Book:

1. Montgomary, Douglas C. Design and Analysis of Experiments, WileyIndia, 5/e, 2007.
2. Kothari C.K. Research Methodology – Methods and Techniques, NewAge International, 2/e, 2004.
3. Krishnswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M., Management Research Methodology; Integration of Principles, Methods and Techniques, Pearson Education, 2006.
4. Stephan L. Nelson, Gujulia Kelly, The Complete reference Office Xp, TMH, 2001.
5. University of Chicago Press, Chicago Manual of Style, University of Chicago Press, 2003.
6. Udpa, S. R., Quality Circles in India: Participation for Progress, TMH, 1988.
7. Chopra, S., A Book on Indian Patenting System, Notion Press, 2018
8. Ramakrishna, B. and Kumar, Anil, H. S., Fundamentals of IPR for Students, Notion Press, 2017

Subject Name: Material for Renewable Energy Application					
Paper Code: REEN5141					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

1. To get familiarized with the properties of different materials- metals and nonmetals.
2. To learn about the manufacturing process of nano-material and its characterizations techniques.
3. Ability to design photovoltaic material and its electronic properties for the solar energy application.
4. Ability to understand the role of selection for the wind turbine material and it required properties.
5. To acquire knowledge on the characterization of materials by modern tools.

Module 1: [10L]

Nanomaterial for renewable energy: Classification of nanomaterials – zero-dimensional, one-dimensional, two-dimensional, three- dimensional; Synthesis of nanomaterials: Bottom up and top down approaches, colloidal method, chemical vapor deposition (CVD) methods, wet chemical methods, sol-gel synthesis, and mechanical exfoliation methods, physical vapor deposition (PVD), sputtering, plasma enhanced CVD (PECVD), hot wire CVD (HWCVD), Nano-structured materials with applications - quantum dots, nano-tubes, nano-wires, nano- crystals.

Module 2: [10L]

Materials for photovoltaic conversions, Si and non-Si materials, crystalline, semi crystalline, polycrystalline and amorphous materials; Nano, micro, and poly-crystalline Si for solar cells, mono-micro silicon composite structure; Technology for Si extraction, purification; Method of doping and junction fabrication; Cell fabrication and metallization techniques; Networking the PV cell; P-N junction, sources of losses and prevention, Concepts on high efficiency solar cells, tandem and multi-junction solar cells, photo-voltaic materials and photo-voltaic modules and their applications; Solar PV concentrator cells and systems, III-V, II-IV compound materials thin film solar cells.

Module 3: [10L]

Materials for wind turbines- blades, nacelles, and tower; Important properties of the blade, Metal and polymer-composite material for blade and tower; Rotor blade – properties and application; Erecting of the tower material, Support materials for wind tower, Corrosion issues; importance of nacelles in wind turbine and its component.

Mechanical properties: flexural strength, bending moment, strength of material- yield strength, ultimate strength, Young's modulus, Poisson's ratio, and fatigue; Universal testing machine (UTM); shear webs for wind turbine blades.

Module 4: [10L]

Electronic and atomic structures of solar cell material; Atomic bonding in solids, crystal structure, microstructure, solidification, alloys; Description of optical and thermal materials for solar cell application.

Material characterization: Scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), Single crystal X-Ray diffraction, Ultraviolet visible spectroscopy, Raman spectroscopy, atomic force microscopy (AFM), and X-ray photoelectron spectroscopy (XPS); Pulse layer deposition (PLD), PV cell diode properties, PV cell series resistance, PV cell shunt resistance.

Text/Reference Books:

1. Rosa A. Fundamentals of Renewable Energy Processes, 3rd ed., 2012.
2. Martin A.G., Solar cells: Operating principles, technology and system applications, Prentice-Hall Inc, Englewood Cliffs, NJ, USA, 1981.
3. Rao C.N.R., Muller A. & Cheetham A.K. Nanomaterials Chemistry - Recent Developments and New Directions, Wiley VCH, 2007.
4. Moller H.J. Semiconductor for solar cells, Artech House Inc, MA, USA, 1993.
5. Barbec C., Dyakonov V., Parisi J., Saricittci N.S. Organic photovoltaics: Concepts and realization, Springer-Verlag 2003.
6. Nijssen R.P.L. & Brondsted P. Advances in wind turbine blade design and materials, Elsevier, 2013..

Subject Name: Bio Energy					
Paper Code: REEN 5142					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. The students will be able to identify different technologies for biomass conversion to energy.
2. The students will be able to justify the unit operations necessary to generate bioenergy.
3. The students will be able to identify different bio-resources to produce energy.
4. The students will be able to describe technologies required for bio-gas.
5. The students will be able to design processes for biofuel production.
6. The students will be able to solve problems with the application of bioreactors to generate bio-energy.

Module 1: [10L]

Introduction to biomass; Basic photosynthesis process for C3 and C4 plants on biomass production; classification of biomass; brief overview on the conversion of biomass into fuels; physicochemical characteristics of biomass as fuel; CO_2 fixation potential of biomass, Biomass resource assessment, application of remote sensing for resource assessment; biomass productivity study, energy plantation; basis of selection of plants for energy plantation; potential of biomass as energy sources: Worldwide and India.

Energy from waste: characterization and classification of waste as fuel – agro based, forest residues, industrial waste, Municipal solid waste. Waste to energy options: combustion (unprocessed and processed fuel), gasification, anaerobic digestion, fermentation, and pyrolysis.

Module 2: [10L]

Anaerobic digestion, biogas production mechanism and technology, types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas slurry utilization and management, biogas applications, cost benefit analysis of biogas for cooking, lighting, power generation applications, Feedstock for biogas, Microbial and biochemical aspects, operating parameters for biogas production. Kinetics and mechanism, Bio-hydrogen production: hydrolysis, fermentation.

Landfills: Gas generation and collection in landfills, Introduction to transfer stations. Comparison with non-energy options like Vermiculture, Composting, and case studies.

Module 3: [10L]

Bio-fuels different processes of production;

Different generation of bio-fuel: based on raw material used. Biodiesel production, different types of raw materials, non-edible oil-seeds, Pyrolysis, mechanism of transesterification, fuel characteristics of biodiesel;

Alcohol production: types of raw materials, lignocellulosic biomass for alcohol production, process description (fermentation), distillation / pervaporation.

Module 4: [10L]
Introduction to bioreactor, anaerobic digesters, fluidized bed, airlift reactor;
Conversion devices: combustors (Spreader Stokes, Moving grate type, fluidized bed), gasifier, digesters.
Briquetting technology: Production of refuse derived fuel (RDF) and briquetted fuel. High rate digesters for industrial wastewater treatment, Photo-bioreactors: raceway pond, tubular, flat panel, helical etc. numerical problems.

Text Books:

1. Mahaeswari R.C. Bio Energy for Rural Energisation, Concepts Publishing Co., 1997.
2. Khandelwal K.C. & Mahdi S.S. Biogas Technology – A Practical Handbook, Tata McGrawHill, 1986.

Reference Books:

1. Reed T.B. Biomass Gasification – Principles and Technology, Noyce Data Corporation,1981
2. Boyles D.T. Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.
3. Eriksson S. & Prior M. The briquetting of Agricultural wastes for fuel (FAO Energy and Environment paper), Food & Agriculture Org, 1990.

Subject Name: Thermal and Electrical Energy Fundamentals					
Paper Code: REEN5144					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

1. Applying the knowledge of different modes of heat transfer to design equipments for harnessing renewable energy.
2. Understanding the basics of characteristics and behaviour of laws of thermodynamics and its applications to process.
3. Solving the problems related power generation from renewable resorses.
4. Understanding the basics of DC and AC sources along with their applications on electrical circuits.
5. Solving the problems related to applications of network theorems and solving complex DC circuits.
6. Solving the problems related to R-L-C circuits connected to single phase and three phase AC.

Module 1: [10L]

Introduction on conduction, convection& radiation heat transfer; The electromagnetic spectrum, The Black body radiation, Plank's law & Wien's displacement law, Stefan-Boltzman law, Sky radiation, Radiation heat transfer coefficient, Absorbance & Emittance. Natural convection between flat plate & between concentric cylinders, Heat transfer relations for internal flow, Wind convection coefficient.

Module 2: [10L]

Introduction to first and second laws of thermodynamics; importance of thermodynamics laws to Renewable energy systems, Energy balance of open system and closed system process. Work done in adiabatic and isothermal process. Steady flow energy equation for pump, compressor, turbine, heat exchangers etc. Concept of Reversibility, Irreversibility; Carnotcycle. Concept of entropy. Clausius inequality. Power cycle and its efficiencies. Chemical reaction equilibrium. Energy and mass balance calculation of fuel combustion.

Module 3: [10L]

Resistance (R), Inductance (L) and Capacitance (C). Ohm’s law. DC and AC sources – voltage and current, ideal and practical, dependent and independent. KCL & KVL, loop or mesh analysis, nodal analysis, star-delta transformation, Thevenin’s and Norton’s theorem, superposition theorem, maximum power transfer theorem.

Module 4: [10L]

Representationofsinusoidalquantities,steadystateanalysisofR-L-Cseriesand parallel circuits, resonance in electrical circuits, energy and power, complex power – apparent, active and reactive power, three phase ac circuits – phase & line voltages and currents. Magnetic flux and mmf, analogy between electrical and magnetic circuits, magnetic materials, eddy current & hysteresis losses.

Text Books:

1. Cengel Y.A. and Boles M.A., Thermodynamics: An Engineering Approach, Sixth Edition (Tata McGraw-Hill, 2008).
2. Duffie J.A. & Beckman W.A.; Solar Engineering of Thermal Processes; John Wiley & Sons Inc., 2013
3. Theraja B. L., Theraja A.K., "A text book of Electrical Technology", S. Chand Publication

Reference Books:

1. Nag P.K., Engineering Thermodynamics, Third Edition (Tata McGraw-Hill,2005).
2. Arora C.P., Thermodynamics, Tata McGraw-Hill, New Delhi,2003.
3. Kothari D.P, Nagrath I.J., "Fundamentals of electrical engineering", Tata McGraw-Hill Publication,2016.
4. Prasad R., Fundamentals of Electrical Engineering, PHI publication.

Subject Name: Modeling and Analysis of Renewable Energy System					
Paper Code: REEN5145					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

1. Given an unconstrained optimization problem, students will be able to apply the correct optimization method to solve the problem.
2. Given a constrained optimization problem, students will be able to set up the objective function correctly and apply appropriate methods to solve the problem.
3. Given a power generation system, students will be able to apply appropriate optimization methods to determine the optimal scheduling of power generation and also will be able to find out the most economic load dispatch scheduling for power generating units.
4. Given a physical process, students will be able to identify the appropriate method to mathematically model the system to predict relevant variables.
5. Given a multivariable physical system, students will be able to apply regression methods to develop a statistical model for it.

Module 1: [10 L]

Essential features of optimization problems, General methods to solve optimization problems, continuity of functions, unimodal, multimodal, convex and concave functions; Concept of Hessian matrices; Unconstrained- Optimality conditions, Newton and quasi-newton methods of unidimensional search; multivariate search; Introduction to simple Constrained Optimization: Lagrange multipliers – Necessary and sufficient conditions for optimality; sensitivity analysis

Module 2: [10 L]

Least square method for linear regression; Levenberg Marquardt algorithm for non-linear regression; Multivariate first order regression**.** Introduction to Response Surface Methodology, the Method of Steepest Ascent, analysis of a second order model, location of the stationery point, characterizing the response surface, experimental designs for fitting response surfaces, applications and numerical problems.

Module 3: [10 L]

Initial value problems solution by Runge-Kutta Method. Concept of partial differential equation (PDE); Discretization in space and time; Implicit and explicit scheme; Finite difference: Crank-Nicholson method to solve parabolic PDE;

Module 4: [10 L]

Optimal power generation scheduling, economic load dispatch of power generating units; Multiobject stochastic power dispatch-stochastic problem formulation; algorithm; application of the method.
Case studies of optimisation in Energy systems – problems.

Text/Reference Books:

1. Himmelblau D.M. & T.F. Edgar T.F., Optimization of Chemical Processes:, McGraw-Hill, 2001.
2. Kothari D. P. & Dhillon J.S. Power System Optimization, PHI, 2nd Edition, 2004.
3. Soliman S.A.H., Mantawy A.A.H., Modern Optimization Techniques with Applicationsin Electric Power Systems, Springer, 2011.
4. Chung K L, Elementary probability theory with stochastic processes, Springer, 4/e, 2013.
5. Montgomery, Douglas C., Design and Analysis of Experiments, Wiley International Student Version 8/e, 2012.
6. Chapra S., Canale R., Numerical Methods for Engineers, McGraw Hill Education India Private Limited, 7th Edition, 1985.
7. Gilat A., Subramaniam V., Numerical Methods for Engineers and Scientists, John Wiley and Sons, 3rd Edition, 2017.