OPEN ELECTIVES FOR THE YEAR 2018 - 19

1. 15MA8X01 Graph Theory (Except CS & IS)
2. 15MA8X02 Linear Algebra (for all)
3. 15HU8X03 Intellectual Property Rights (for all)
4. 15BT8X05 Nanotechnology (for all,except BT)
5. 15CV8X07 Environmental Impact Assessment (for all,except CV)+ FT
6. 15ME8X08 Industrial Pollution Control (for all, except ME)
7. 15EE8X10 Non-Conventional Energy Systems (for all, except EE)
8. 15EE8X11 Linear Systems Theory (for ME & EC)
9. 15EC8X12 Information and Electronic Communication Technology(for all,except EC)
10. 15EC8X13 Robotics (for all, except EC)
11. 15CS8X14 Object Oriented Programming with C++ (for all, except CS & IS)
12. 15CS8X15 Essentials of Information Technology (for all, except CS & IS)
13. 15EC8X18 Consumer Electronics (for all, except EC)
14. 15PH8X19 Opto Electronic Devices (for EC, EE, CSE & ISE)
15. 15CH8X21 Chemistry of Natural Products (for Bio-Tech)
16. 15HU8X24 Professional & Cognitive Communique (for all)
17. 15IS8X27 Fundamental of Operating Systems (For all except CSE & ISE)
18. 15ME8X28 Operations Management and Entrepreneurship (for all, except ME) +FT
19. 15PH8X29 Physics of Semiconductor Devices (for EE, EC, CSE & ISE)
20. 15CV8X30 Introduction to Geoinformatics (for all, except CV)
21. 15CH8X31 Corrosion Science (for CIV, Mech. & Bio Tech)
22. 15EC8X32 Application of Signal Processing (for all, except EC)
23. 15ME8X33 Human Resource Management (for all, except ME)
24. 15EE8X34 Solid State Lighting (For all, except EE)
25. 15EC8X35 Data Acquisition System Design Using Lab View (for all, except EC)
26. 15ME8X36 Computational Fluid Dynamics (for all, except ME)
27. 15HU8X37 Linguistics and Language Technology (for all)
28. 15IS8X38 Introduction to Python Programming (For all except CSE & ISE)
29. 15EC8X39 Introduction to Artificial Neural Network (for CS, IS &EE)

Mapping of POs & COs:

POs / COs	a	b	c	d	e	f	g	h	i	j	k	l
1	H	H										
2	M	L										
3					M							
4					H						M	
5					H						M	

L : Low M: Medium H : High

TEXT BOOKS:

1. Graph Theory: F.Harary, Narosa Publishing House,1988.
2. Graph Theory with applications to Engineering and computer science: Narsingh Deo, Prentice Hall of India, New Delhi, 2001.

REFERENCE BOOKS:

1. Introduction to Graph Theory: D.B.West, Prentice Hall of India, New Delhi.
2. Applications of Graph Theory: Vinod Chandra, Prabhakar Gore, James Moore, North Holland,1979.

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LINEAR ALGEBRA

Sub Code : 15MA8X02 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. Develop a thorough knowledge about the system of linear equations and obtaining their solutions
2. Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
3. Determine the kernel, range, rank, and nullity of a linear transformation and apply them suitably in their field of study
4. Evaluate the eigenvalues and their corresponding eigenspaces and appraise its importance in various fields.
5. Make use of Gram-Schmidt process to produce an orthonormal basis.

UNIT – I

Linear equations: System of linear equations and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-factorization**.** **7 Hours**

GRAPH THEORY

Sub Code	**: 15MA8X01**	**Credits**	**: 03**
Hrs/Week	**: 3+0+0+0**	**Total Hours**	**: 39**

Course Learning Objectives:

This Course will enable students to

1. Explain subgraphs, bipartite graphs, isomorphic graphs etc..
2. Apply the concept of trees and its properties.
3. Distinguish between planar and nonplanar graphs and apply their properties to solve problems.
4. Represent a graph in terms of adjacency matrix, incidence matrix etc. and vice-versa.
5. Find the shortest path between two vertices in a graph.

UNIT – I

Introduction to graphs: Graphs, digraphs, paths, cycles, complete graph, bipartite graph, connectivity, cut points, bridges, blocks, sub graphs-spanning and induced. **8 Hours**

UNIT – II

Eulerian &Hamiltonian graphs: Trees, Eulerian graphs, characterizations, Hamiltonian graphs. **7 Hours**

UNIT – III

Planar graphs &Coloring: Planar graphs, outer planar graphs, Euler's polyhedron formula, colorability : chromatic number, five color theorem, four color conjecture, chromatic polynomial. **8 Hours**

UNIT – IV

Representations of graphs: adjacency matrix, incidence matrix,circuit matrix,cutset matrix. Shortest paths in weighted graphs, Dijkstra's algorithm to find shortest paths. **8 Hours**

UNIT – V

Spanning trees: Algorithms to find a spanning tree, minimal spanning tree-Kruskal's & Prims algorithm. **8 Hours**

Course Outcomes:

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

1. Distinguish between bipartite and complete bipartite graphs, identify whether two graphs are isomorphic, find subgraphs of a graph etc.
2. Distinguish between Eulerian and Hamiltonian graphs.
3. Identify whether a graph is planar and to find the chromatic polynomial of a graph.
4. Apply algorithmic methods to find the shortest path between two given vertices.
5. Use a suitable algorithm to find a minimal spanning tree.

UNIT – II

Vector spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces. **7 Hours**

UNIT – III

Linear Transformations: Linear transformations; algebra of linear transformations; isomorphism; representation of transformations by matrices; linear functions; transpose of a linear transformation. Determinants and elementary properties. **9 Hours**

UNIT – IV

Canonical Forms: Characteristic values; similarity of matrices, Cayley Hamilton theorem, annihilating polynomials; invariant subspaces; diagonalization of symmetric matrices, iterative estimates of characteristic values. **8 Hours**

UNIT – V

Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization; least-squares problems; symmetric and unitary operators. **8 Hours**

Course Outcomes:

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

1. Test for consistency of system of linear equations and compute the solution by different methods.
2. Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
3. Analyze the concept of a linear transformation as a mapping from one vector space to another and be able to calculate its matrix representation with respect to standard and nonstandard bases.
4. Evaluate the eigenvalues and their corresponding eigenspaces and explain its importance in various fields.
5. Make use of Gram-Schmidt process to produce an orthonormal basis and also able to use least square approximation method to obtain the solution of ill conditioned system.

Mapping of POs & COs:

POs / COs	a	b	c	d	e	f	g	h	i	j	k	l
1	H	H										
2	M	L										
3					M							
4					H						M	
5					H						M	

L : Low M: Medium H : High

TEXT BOOKS:

1. M. Artin , Algebra Prentice Hall of India.2004.
2. David C.Lay, "Linear Algebra and its Applications",3rd edition, Pearson Education (Asia) Pte. Ltd, 2005.
3. Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Thomson Learning Asia, 2003.
4. Bernard Kolman and David R. Hill, "Introductory Linear Algebra with Applications", Pearson Education (Asia) Pte.Ltd 7th edition ,2003.

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INTELLECTUAL PROPERTY RIGHTS

Sub Code : 15HU8X03 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. Understand creativity component in intellectual property, different types of legal protection of intellectual properties and other basic concepts of Intellectual property.
2. Analyze different types of protection for inventions, different types of agreement and treaties for Intellectual properties.
3. Examine patent types, specifications and patent search and database for 'prior art'.
4. Understand the basic procedure of drafting claims and applying for patents and other legal forms of intellectual property rights.
5. Examine the protocol involved in protection of inventions like patents.

UNIT – I

Introduction to Intellectual Property

Invention and Creativity - Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; History and evaluation of IPR – like Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. **8 Hours**

UNIT – II

Agreements and Treaties

History - General Agreement on Trade and Tariff (GATT). Indian Position vis-a-vis WTO and Strategies; TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities – Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments – Patent (Amendment) Rules, 2017 **8 Hours**

UNIT – III

Basics of Patents and Concept of Prior Art

Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in the context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, WIPO, IPO, etc.) **8 Hours**

UNIT – IV

Patent filing procedures

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies **8 Hours**

UNIT – V

Case Studies:

Patents (Basmati rice, Turmeric, Neem, etc.) non-biological cases – (i) TVS V/S HERO, (ii) Samsung V/S Nokia – Copyright and related rights – Trade Marks – Trade secrets - Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition; Technology transfer and license agreements (US anti-HIV drug license to Africa) **7 Hours**

Course Outcomes:

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

1. General understanding of the intellectual property rights and Awareness about different forms of intellectual property rights
2. Awareness about national aand international intellectual property right related legislations
3. Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights
4. General understanding of patenting procedures and licensing and ability to evaluate different forms of intellectual property rights
5. General understanding about the provisions, privileges and limitations of intellectual property right holders with an understanding of the legal aspects (civil or criminal) of the use of intellectual property rights.

REFERENCE BOOKS:

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
3. Subbaram N.R. " Handbook of Indian Patent Law and Practice ", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
4. Eli Whitney, United States Patent Number : 72X, Cotton Gin, March 14, 1794.
5. Intellectual Property Today : Volume 8, No. 5, May 2001,

6. WTO and International Trade by M B Rao. Vikas Publishing House Pvt. Ltd.
7. Correa, Carlos M. Intellectual property rights, the WTO and developing countries : the TRIPS agreement and policy options, Zed Books, New York 2000
8. Wadehra, B.L.Law relating to patents, trade marks, copyright designs & geographical indications 2 ed. Universal Law Publishing 2000
9. Sinha, Prabhas Chandra Encyclopaedia of Intellectual Property Rights, 3 Vols. Eastern book corporation, 2006.
10. "Practical Approach to Intellectual Property Rights"; Rachna Singh Puri and Arvind Vishwanathan
11. I.K. International Publishing House Pvt. Ltd.,

Important Links:

http://www.w3.org/IPR/
http://www.wipo.int/portal/index.html.en
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/

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NANOTECHNOLOGY

Sub Code : 15BT8X05 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

The objective of this course is

1. To learn fundamental concepts of nanoscience and nanotechnology
2. To appreciate the application of nanoscience to various fields of engineering.

UNIT - I

INTRODUCTION

Introduction to nanoscience, A Brief History of the Super Small, Definition of nanotechnology, Bottom-Up versus Top-Down; Discussions on nanofabrication, Nanolithography(Dip pen, photo, X-ray, Electron beam, nanosphere lithography), Structure-property relationships in materials, Fabrication of Hard Materials. **6 Hours**

UNIT – II

NANOMATERIAL AND NANO TOOLS

Zero dimensional : Nano particle, 1-D: Nano wires, nano rods, 2-D: Thin films, Special nanomaterials: Buckyballs (Fullerenes), Nanotubes, nanowire, Dendrimers, Nanoshells, magnetic nanoparticle, Quantum Dot (Nanocrystals), self assembled monolayers, Scanning probe microscopy (Scanning tunneling microscopy, Atomic force microscopy). Characterization of nanomaterials: Physical, chemical and structural. Applications of nanomaterial. **8 Hours**

UNIT - III

MICROFLUIDICS

Microflows (Laminar flow), Hagen-Pouiselle equation, micromixing, microvalves & micropumps, Need for the microfluidics, Fabrication of Soft Materials, application of microfluidics. Microfluidics and their applications to lab on chip. **8 Hours**

UNIT - IV

MEMS

Introduction and Overview, Design of MEMS, Sensors, Material aspect of MEMS, Electromagnetic Transducers, Mechanical Transducers, Chemical Transducers, Optical Transducers – Applications of optical and chemical transducers. Recent Developments in MEMS and Nanochips. application of MEMS. **8 Hours**

UNIT – V

APPLICATIONS

Chemistry, structure, mechanism of action, structure activity relationship and therapeutic applications of the following:

Sporting goods equipment, Apparel industry, Cosmetics, Appliances, Automobile/vehicle industry, Paint and Other water resistance coatings, Removing windshield fog, Medical bandages, Organic light-emitting displays, Medical applications, Food and Agriculture. Nanotechnology for data storage. Risk assessment, management, ethical aspects. **9 Hours**

Course Outcomes:

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

1. Choose the terminologies of nanotechnology and structure-property relationship of materials.
2. Outline the synthesis of nanomaterials, structure and their methods of characterization.
3. Apply nanotechnology concepts in the field of microfluidics.
4. Summarize the applications of MEMS in Engineering field.
5. Utilize nanotechnology for various engineering disciplines.

Course Articulation Matrix:

	PO											
CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M					L						
CO2	M					L			M			
CO3	M		M			M			H			
CO4	M		L			L			M			
CO5	L		M			M			H			

TEXT BOOKS:

1. Lindsay, S.M. *Introduction to Nanoscience*, Oxford University Press, 2009.
2. Robert Kelsall and Hamley, I. (Ed.). *Nanoscale Science and Technology*, Wiley, 2005.
3. Bharat Bhushan (Ed.), *Springer Handbook of Nanotechnology*, 3rd Ed., Springer, 2010.

REFERENCE BOOKS:

1. Booker, R. and Earl Boysen (Eds), *Nanotechnology*, Wiley Dreamtech, 2005.
2. Murthy, D.V.S. *Transducers and instrumentation*, Prentice Hall of India, 2010.
3. Schmidt, G. *Nanotechnology Assessment and perspectives*, Springer, 2006.
4. Ratner M. and Ratner, D. *Nanotechnology – A gentle Introduction to the Next Big Idea*, Pearson Education, 2005.
5. Silberzan, J.B.P. *Microfluidics for Biotechnology*, ARTECH house, 2010.
6. Cao, G. *Nanostructure and nanomaterial*, World scientific, 2011.

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ENVIRONMENTAL IMPACT ASSESSMENT

Sub Code	**:**	**15CV8X07**	**Credits**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This Course will enable students to

1. Learn the importance of conducting EIA studies
2. Understand the key elements of EIA
3. Discuss the environmental acts and legislations
4. Understand the importance of public participation in EIA
5. Discuss case studies on EIA for various projects

UNIT – I

INTRODUCTION

Development activities and ecological factors; EIA, EIS, FONSI. Need for EIA studies, Baseline information, Procedure for conducting EIA, Limitation of EIA, Environmental Acts/ policies.

8 Hours

UNIT - II

CONTENT OF EIA

Framework of impact assessment in developmental projects, environmental setting, EIA – objectives, contents, methodologies, techniques; Rapid and comprehensive EIA.

10 Hours

UNIT – III

ENVIRONMENTAL ATTRIBUTES

Assessment and prediction of attributes – Air, Water, Noise, Land, Ecology, Soil, Socio-economic environment **8 Hours**

UNIT - IV

PUBLIC PARTICIPATION IN EIA

Public participation in environmental decision making, practical consideration in preparing EIA and EIS, salient features of project activity, environment parameter – activity relationship matrices **10 Hours**

UNIT – V

EIA CASE STUDIES

EIA for construction project, power projects, mining projects. **8 Hours**

Course Outcomes:

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

1. Carry out screening and scoping for developmental projects.
2. Implement different methodologies for environmental impact assessment
3. Measure quantitatively environmental impact on major environments
4. Carry out Public participation in environmental decision making
5. Prepare environmental impact assessment reports.

Course Articulation Matrix :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		L					L								L
CO2			M						M						
CO3		M				M								L	
CO4				L		M	M	H							
CO5	M									H					L

Note : Enter correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

L : Low M: Medium H : High

TEXT BOOKS:

1. 1 Jain R. K., Henry C. Perkins, "Environmental Impact Analysis", McGraw Hill Ltd., 2006.
2. Y Anjeneyulu, Valli Manickam., "Environmental Impact Assessment Methodologies", BS Publications, 2012
3. Canter, R.L., "Environmental Impact Assessment", McGraw-Hill Inc., New Delhi, 2011

REFERENCE BOOKS:

1. Jain R. K., Henry C. Perkins, "Environmental Impact Analysis", McGraw Hill Ltd, 2006
2. Shukla, S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
3. John G. Rau and David C Hooten (Ed)., "Environmental Impact Analysis Handbook", McGraw-Hill Book Company, 1990.
4. "Guidelines for EIA of development projects", Ministry of Environment and Forests, GOI
5. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Science, 1999.

NPTEL SOURCES

1. http://nptel.ac.in/courses/120108004/
2. http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

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INDUSTRIAL POLLUTION CONTROL

Sub Code : 15ME8X08 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to:

1. Know the Consequences of pollution, relationship between man and environment over the last few decades, necessity of modern awareness on pollution and how carbon audit can help in developing a carbon strategy.
2. Identify the Importance of Meteorology in pollution control and global warming, various types of plume dispersions and its effect; analyze various levels of plume height for different pollutants.
3. Distinguish Particulates and fly ash separation techniques such as cyclone separator, electrostatic precipitator efficiency calculations etc.
4. Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants.
5. Summarize the Effects of water, soil, plastics and odor pollution their control techniques, Different Pollution Control Acts, Legal aspects of pollution control and how these acts can help in bringing down the pollution rate.

UNIT - I

Introduction to Pollution, Man and the environment, environmental degradation due to energy generation, consequences of pollution, sustainable industrial growth, air water and soil pollution, carbon audit. Ill effects of different pollutants, permissible concentrations.

6 Hours

UNIT - II

Meteorology: Meteorology, Wind rose, Functions of Atmosphere, Lapse rate & Temperature Variation in the Atmosphere, plume dispersion studies & Numerical problems.

6 Hours

UNIT - III

Separation techniques: Principal of working of thermal power station , Particulates and fly ash separation techniques, Sources of Particulates Matter, Fly ash, Electrostatic precipitator **(Problems),** Theory of settling processes **(Design Problems),** Bag House fabric filter, Cyclone separator,vSpray Tower, Scrubbers & Venturi Scrubber

8 Hours

UNIT - IV

Smoke and gaseous pollutants: Sources of smoke, T, T, T-O Principle of smoke, Measurement of stack smoke intensity (Ringlemann Chart and Smokescope), Bosch Smoke meter, Domestic and Industrial Incinerators- Design factors, Pollutant gaseous-Their sources, measurement and control (So2, Co, UBHC, Nox) **10 Hours**

UNIT - V

Water Pollution, Soil pollution, Noise Pollution, Plastic and odor pollution, Solid waste management, problems associated with nuclear reactors. Their control methods & Legal aspects of pollution

9 Hours

Course Outcomes:

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

1. List different pollutants, define Environmental pollution, know about sustainable industrial growth.
2. Outline the instruments for various Meteorological measurements, distinguish types of plume dispersions and its effect; analyze the concentration of various gaseous pollutants.
3. Recall about Particulates and fly ash separation techniques, compare and interpret their efficiency.
4. Identify Formation, measurement and control techniques for Smoke and gaseous pollutants
5. Identify Effects of water, soil, plastics and odor pollution on environmental pollution; know about Legal aspects of pollution control.

Course Articulation Matrix:

Course Code / Name : 15ME8X08/ Industrial Pollution Control														
Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	2	1	1	2	3	3	1	2	1	1	1	2
CO 2	1	2	2	1	1	2	3	3	1	2	2	2	1	2
CO 3	1	2	3	1	1	2	3	3	1	2	1	1	1	2
CO 4	1	2	2	1	1	2	3	3	1	2	2	2	1	2
CO 5	1	3	3	1	3	2	3	2	1	2	1	1	1	3

TEXT BOOKS:

1. "Environmental Pollution Control Engineering, *Wiley Eastern Ltd.,*
2. "Introduction to Environmental Engineering & Science", Gilbert M Masters, PHI,1995
3. "Environmental Pollution Control Engineering, *C. S RAO New Age Int.*

REFERENCE BOOKS:

1. *"Air Pollution"*, Henry C. Perkins, Mc-Graw Hill, 1974.
2. *"Air Pollution control"*, W. L. Faith, *John Wiley*

MOOC/NPTEL Resources:

http://nptel.ac.in/courses/105106119/36

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NON-CONVENTIONAL ENERGY SYSTEMS

Sub Code : 15EE8X10 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

1. To illustrate the principle of extraction of energy from conventional, nonconventional sources.
2. To demonstrate the working principle and applications of solar based thermal, electrical and PV systems
3. To justify the usage of energy storage techniques and Understand the process of design and implement of wind based energy conversion systems
4. To understand the process of design and implement of biomass based energy conversion systems.

UNIT – I

Energy Sources: Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario. **5 Hours**

Solar Energy Basics: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems); Measurement of Solar Radiation Data – Pyrometer and Pyrheliometer. **3 Hours**

UNIT - II

Solar Thermal Systems: Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green Houses. **4 Hours**

Solar Electric Systems: Solar Thermal Electric Power Generation – Solar Pond and Concentrating Solar Collector (parabolic trough, parabolic dish, Central Tower Collector). Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array.
Solar PV Systems – stand-alone and grid connected; Applications – Street lighting, Domestic lighting and Solar Water pumping systems. **4 Hours**

UNIT – III

Energy Storage: Introduction, Necessity of Energy Storage, and Methods of Energy Storage (classification and brief description using block diagram representation only).

3 Hours

Wind Energy: Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of a WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, Advantages and Disadvantages of WECS.

5 Hours

UNIT – IV

Biomass Energy: Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; Biomass program in India.

7 Hours

UNIT - V

Energy from Ocean: Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Estimation of Energy – Single basin and Double basin type TPP (no derivations. Simple numerical problems), Advantages and Limitation of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitation of OTEC.

5 Hours

Emerging Technologies: Fuel Cell, Small Hydro Resources, Hydrogen Energy, and Wave Energy. (Principle of Energy generation using block diagrams, advantages and limitations).

3 Hours

Course Outcomes:

At the end of the course student will be able to

1. Review various sources of energy their advantages and limitations and understand the solar energy basics
2. Explain the working principle and applications of solar based thermal, electrical and PV systems
3. Appreciate the importance of energy storage and wind energy systems
4. Illustrate the working principle and applications of biomass systems
5. Explain the process of design and implement of tidal, OTEC based energy conversion systems and comprehend the emerging technologies in the area of RES.

Course Articulation Matrix:

Course Outcomes Mapping with Program Outcomes & PSO														
Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO	
↓ Course Outcomes													1	2
CO1	2	1	1			1	2							
CO2	3	2	1			1	2							
CO3	3	1	1			1	2							
CO4	3	1	1			1	2							
CO5	3	1	1			1	2							

TEXT BOOK:

1. Rai, G. D., "Non-Conventional Sources of Energy", 4th Edition, Khanna Publishers, New Delhi, 2007

REFERENCE BOOKS:

1. Mukherjee, D., and Chakrabarti, S., "Fundamentals of Renewable Energy Systems", New Age International Publishers, 2005.
2. Khan, B. H., "Non-Conventional Energy Resources", TMH, New Delhi, 2006.

E Book /NPTEL / MOOC

1. https://online-learning.tudelft.nl/courses/sustainable-energy-design-a-renewable-future/
2. https://ocw.mit.edu/courses/energy-courses/
3. http://nptel.ac.in/courses/108108078/

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LINEAR SYSTEMS THEORY

Sub Code : 15EE8X11 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours: 39**

Course Learning Objectives:

1. To understand the state model, linearization of state equations.
2. To Apply state space technique for modeling of LTI systems, solve the state equation.
3. To Compute state transition matrix, the eigen values, eigen vectors.
4. To Analyze the system for controllability and observability and design the controller using pole placement techniques to ensure stability.
5. To understand the Lyapunovs' Stability Criteria and Liapunov functions

UNIT - I

State variable analysis & design: Introduction, concept of state, state variables & state model, state model of linear systems, linearization of state equations. State space representation using physical variables, phase variables & canonical variables. **7 Hours**

UNIT - II

Derivation of transfer function from state model, diagonalisation, Eigenvalues, Eigenvectors, generalized Eigenvectors. **7 Hours**

UNIT - III

Solution of state equation, state transition matrix & its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method. **8 Hours**

UNIT - IV

Concept of controllability & observability, methods of determining the same.
Pole placement techniques: stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement. **9 Hours**

UNIT - V

Sign definiteness, Sylvesters Criteria, Lyapunovs' Stability Criteria, Lyapunov stability theorem for systems represented in state variable form, Application

Liapunov stability criteria, Liapunov functions, direct method of Liapunov & the linear system, Hurwitz criterion & Liapunov's direct method. **8 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Apply the State variable analysis & design for the given control system problems
2. Illustrate the importance of Eigen values in control system.
3. Obtain the solution for the state equation for a given control system problems
4. Explain the concept of controllability & observability and apply Pole placement techniques
5. Illustrate the Liapunov stability criterion and apply it to control system problems.

Course Articulation Matrix:

Course Outcomes Mapping with Program Outcomes												
Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	1		1				1			
CO2	3	3	1		1				2			
CO3	3	3	1		1				2			
CO4	3	3	1		1				2			
CO5	3	2			1				1			

TEXT BOOKS:

1. J. Nagarath and M.Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 5th edition – 2007
2. M. Gopal, "Control Systems – Principles and Design", 4TH EDITION,2012

REFERENCE BOOKS:

1. K. Ogata, "Modern Control Engineering ", Pearson Education Asia/ PHI, 4th Edition, 2002.
2. Benjamin C. Kuo & Farid Golnaraghi, "Automatic Control Systems" 8th edition, John Wiley & Sons 2003. 4. Katsuhika Ogata, " Modern Control Engineering" PHI 2003

E Book / MOOC /NPTEL:

1. https://www.edx.org/course/introduction-control-system-design-first-mitx-6-302-0x
2. http://nptel.ac.in/courses/108103007/

3. http://www.nptelvideos.in/2012/11/advanced-control-system-design_27.html
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-241j-dynamic-systems-and-control-spring-2011/index.htm
5. https://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/index.htm

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INFORMATION AND ELECTRONIC COMMUNICATION TECHNOLOGY

Sub Code : 15EC8X12 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable students to

1. Understand the concepts of communication channel and related parameters.
2. Differentiate between different modulation schemes.
3. Encourage the concepts of channel access and technologies and cellular mobile technology.
4. Explain the microwave systems and the phenomenon associated with the propagation.
5. Distinguish various multiple access techniques of long distance communication.
6. Appreciate the concepts of optical fiber communication.
7. Explain the concepts of computer networking.

UNIT - I

Information theory and Communication: Measure of Information, Average Information, Entropy, Markov statistical model, Markov Binary and quaternary sources, Communication channels, Discrete communication channels, Entropy Functions, Mutual Information, Channel Capacity, Shannon Theorem, Capacity and Band limited channels, Shannon Hartley Theorem, Error control coding, Types of channels, Noise and errors, Block codes and Convolution codes. AM/FM/ PM Modulation, Sampling Theorem, PAM, TDM, PCM Modulation, PSK, BPSK,QPSK Modulation, Spread spectrum.

14 Hours

UNIT - II

Wireless Communication: wired and wireless communication**,** Atmospheric absorption Radio Wave propagation, Propagation model, Antennas, Reflection, Refraction, terrestrial communications, Link Budget, Path loss, SNR , Multipath propagation and fading, , Multiple access, FDMA, CDMA and CDMA

Satellite Communications: satellite orbits, Perturbations, Satellite Subsystems, Satellite applications, INTELSAT, DBS, GPS and Remote Sensing.

Optical Communications: Optical Fibers, Sources, Detectors and Optical Analog and Digital communication systems and Optical networks. **14 Hours**

UNIT - III

Mobile communication: Frequency Reuse, Cellular concepts , Handoff strategies, Mobility Management, GSM, GPRS Networks, 3G and 4G Mobile networks

Computer Communications: OSI, TCP/IP Communication Layers, Languages, Adhoc networks, Network Security, Multimedia, Audio/ Video Compression Latest trends

11 Hours

Course Outcomes:

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

1. Have a reasonable understanding a few of the technologies discussed in Electronics that has contributed to the development of , what is now termed as ICT
2. Define information and its quantification, the codes and the need for them
3. 3. Select suitable channels for communications, different modulation schemes
4. 4. Understand the working of high frequency/ optical devices and their limitations
5. 5. Appreciate the extent of use of computers in present communication systems.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1								3		1		
2	1			2								
3						3	2					
4						3	2					
5						3	2					

1: Low 2: Medium 3: High

TEXT BOOKS:

1. Abrahamson, **"Information theory and coding"**, McGraw Hill.
2. Veluswamy S, **"Information Theory and coding"** ,New Age International Publications.
3. Kamilo Feher, **"Wireless Communication and Applications"**, PHI.
4. Timothy Pratt, **"Satellite Communications"**, Wiley India.
5. Gred Keiser, **"Optical Fiber Communications"**, MGH.
6. Faraouzan, **"Data Communication"**, TMH.
7. Sumit Kasera, **"2.5 G mobile networks GPRS and EDGE", MGH.**

****

ROBOTICS

Sub Code : 15EC8X13 **Credits : 03**
Hrs/ Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable the students to

1. Course introduces the principle of robotic arm kinetic and dynamics.
2. Covers wide ranges of sensors such as distance, proximity, touch , force etc used in the robotic Modules.
3. Introduces the new dimensions of using artificial intelligency in the robotic system.

UNIT – I

Introduction: Historical developments, arm kinematics and dynamics, manipulated trajectory, planning and control, sensing, robot languages, machine intelligence. Robot arm kinematics: Direct kinematics problem and inverse kinematics solution.Robot arm dynamics: Lagrange-Euler formulation, Newton -Euler formulation equation of motion.

Planning trajectories: General considerations, joint interpolated trajectories, planning Cartesian path trajectories. **16 Hours**

UNIT – II

Sensing: Range, proximity, touch, force and torque sensing. Low level vision: Image acquisition, illumination, geometry pre processing. High level vision: Segmentation, description, 3D structure recognition, interpretation. Robot programming languages: Characteristics of robot languages, task languages. **16 Hours**

UNIT – III

Robot intelligence: State space search, predicate logic, means-ends analysis, robot learning, task planning expert systems. **7 Hours**

Course Outcomes:

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

1. Apply the theory of robotic arm kinetic in the robotic design applications.
2. Understand the basics of planning trajectories.
3. Use different sensor modules and processor to control the working of robotic arm.
4. Understand the use of different Robot programming languages
5. Apply the artificial intelligence in to the robotic device in a feasible way.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	3	2	2	1	1	1	1	1	2
2	3	3	2	3	2	2	1	1	1	1	1	2
3	3	3	2	3	2	2	1	1	1	1	1	2
4	3	3	2	3	2	2	1	1	1	1	1	2
5	3	3	2	3	2	2	1	1	1	1	1	2

1: Low 2: Medium 3: High

TEXT BOOK:

1. Fu K S. et al, **"Robotics-Control, Sensing, Machine and Intelligence",** McGraw Hill.

REFERENCE BOOKS:

1. Mittal and Nagarath, **"Robotics and Control"**, TMH, 2003.
2. Groover MP et al., **"Industrial Robotics"**, TMH.

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OBJECT ORIENTED PROGRAMMING WITH C++

Sub Code : 15CS8X14 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to:

1. **Compare** and **contrast** the advantages and benefits of procedural and object oriented programming
2. **Describe** the various object oriented concepts and determine how these concepts can help to model real time data
3. **Choose** appropriate object oriented programming concepts to model a given problem statement
4. **Compare** the efficiency and privacy of data in object oriented programming compared to procedural programming
5. **Develop** algorithms and programs that use the concept of classes, objects, inheritance, polymorphism, operator overloading, function overloading

UNIT - I

Principles of object – oriented programming:

A look at Procedure Oriented Programming, object Oriented Programming Paradigm, Basic Concepts of OOP, Benefits of OOP, Object oriented languages ,Applications of OOP

3 Hours

Beginning with C++:

What is C++?, Applications of C++, Structure of C++ program, Basic Data types, derived data types, user defined data types, variables in C++, dynamic initialization of variables, reference variables, operators in C++ , scope resolution and memory management operator-new & delete,

5 Hours

UNIT - II

Functions in C++:

Function prototyping, Inline Functions, Default Arguments, Function Overloading

3 Hours

Classes and objects:

Introduction, C Structure Revisited, Specifying a Class, Defining Member Functions, Static data and member functions, Arrays of Objects, Friend Functions, Returning Objects.

5 Hours

UNIT - III

Constructors and Destructors

Introduction, Constructors, Parameterised Constructors, Multiple Constructors in a Class. Constructors with Default Arguments, Copy Constructors, Dynamic Constructors, Destructor's.
3 Hours

Operator Overloading and Type Conversions

Introduction, Defining Operator Overloading, Overloading the Various Operators, Overloading the Increment and the Decrement Operators (Prefix and Postfix), Overloading the Unary Minus and the Unary Plus Operator, Overloading the Arithmetic Operators. Overloading the Relational Operators, Rules for overloading operators. Type Conversions.

5 Hours

UNIT - IV

Inheritance

Introduction, Defining Derived Classes, Single Inheritance, Protected Access Specifier, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes. **6 Hours**

Virtual Functions and Polymorphism

Virtual Functions, Pure Virtual Functions. **2 Hours**

UNIT - V

Templates and Exception Handling

Introduction, Function Templates, Class Templates, Overloading of Template Functions. **3 Hours**

Working with files

Classes for Files Stream Operations, Opening and Closing a File, Error Handling during File Operations. **4 Hours**

Course Outcomes:

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

1. **Explain** basic concepts of object oriented programming
2. **Design** and **analyze** concepts of classes and objects
3. **Implement** and **apply** object oriented approaches operator overloading and function overloading.
4. **Implement** and **apply** object oriented approaches inheritance and polymorphism.
5. **Analyze** the working of files, generic programming using templates.

Course Articulation Matrix:

POs / COs	a	b	c	D	e	F	g	h	i	j	k	l
1	H											L
2	H	H										M
3		H			M					L		M
4		H			M					L	L	H

H : High M: Medium L : Low

TEXT BOOKS:

1. **E.Balagurusamy: Object – Oriented Programming with C++, Third Edition, Tata McGraw Hill.** (Chapters 1.3 to 1.8, 2.1, 2.2, 2.6, 3.5 to 3.7, 3.11 to 3.15, 3.17,4.3, 4.6 to 4.7,4.10, 51 to 5.4,5.11 to 5.13, 5.15 to 5.16, 6.1 to 6.8, 6.11, 7.1 to 7.4 7.7 to 7.9, 8.1 to 8.10, 9.6 to 9.7, 11.2 to 11.3,11.9 and 12.1,12.2,12.4,12.6).

REFERENCE BOOKS:

1. Robert Lapore: Object – Oriented Programming in Turbo C++, Fourth Edition, Sams Publishing
2. Herbert Schildt: C++ The Complete Reference, Third Edition, Mcgraw-Hill Osborne Media;
3. K.R. Venugopal, B. Rajkumar and T. Ravi Shankar: Mastering C++, Tata McGraw Hill, New Delhi, 1999; 25th Reprint, 2006

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ESSENTIALS OF INFORMATION TECHNOLOGY

Sub Code : 15CS8X15 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to:

1. **Outline the** fundamentals of python programming.
2. **Implement** the object oriented concepts using python programming.
3. **Describe** the basic concepts of Relational Database Management System.
4. **Apply** the normalization to the Databases and develop databases using SQL and PL/SQL Queries.
5. **Develop** the data base connectivity in integration with python and perform various Database operations.

UNIT – I

PROGRAMMING FUNDAMENTALS

Introduction to Programming: Why Programming, What is Computer Program, What is an Algorithm, Flowchart, Pseudo Code; Python Fundamentals: – Introduction to python, Variables and Data Types, Comments, Input Function, Operators, Coding Standards, Integrated Development Environment(IDE) ;Control Structures: Selection Control Structures, ,Looping/Iterative Control Structures; Data Structures: String , List, Dictionary and Tuple ,Set, Functions: Built-in functions, User-defined Functions, Recursion.

7 Hours

UNIT – II

OBJECT ORIENTED PROGRAMMING USING PYTHON

Introduction to Object Oriented Paradigm: Abstraction and Entity, Encapsulation and Data hiding, Class and Object, Unified Modelling Language (UML), Object Oriented Approach, Class Variables, Class methods and Static Methods, Documentation, Inheritance & Polymorphism. UML: is-a relationship (Generalization),

Types of Inheritance, Multiple Inheritance, Polymorphism, Benefits of OOP, Relationships: has-a relationship: Aggregation & Composition, uses-a relationship; File handling, Exception Handling, Raising Exceptions

8 Hours

UNIT – III

RELATIONAL DATABASE MANAGEMENT SYSTEM - I

Data and Need for DBMS: Data – Is it important, What is Data, Do we need to store data, How to Store / Handle Data, What is DBMS and its Models, Functional Needs of DBMS,Data perspectives in DBMS;Relational Model and Keys: What is RDBMS, Data representation in RDBMS,Keys in RDBMS;Database Development Life Cycle; Data Requirements; Logical Database Design: Different

Approaches in Logical Design,ER Modeling,ER Notations,Steps in ER Modeling;Physical Database Design: Converting ER Model to Relational Schema.

8 Hours

UNIT – IV

RELATIONAL DATABASE MANAGEMENT SYSTEM - II

Normalization: Functional Dependency, First Normal Form: 1NF, Second Normal Form: 2NF, Third Normal Form: 3NF, Normalization Guidelines; Implementation with SQL: What is SQL,Data types and Operators in SQL,SQL Statements:SQL - Built-in Functions;SQL - Group By and Having. Inner Join, Outer Join, Self Join, Sub Queries: Independent Sub queries, Correlated Sub queries, Index, Views, Transactions, PL/SQL.

8 Hours

UNIT - V

PYTHON DATABASE INTEGRATION

Python Database Integration: SELECT Operation :Retrieve Data from Database, Attributes of Cursor object, Bind variables. **CREATE and INSERT Operation** :Creating a table, Insert Operation, Inserting Multiple Records, UPDATE Operation, DELETE Operation, Graphical user interfaces; event-driven programming paradigm; creating simple GUI; buttons, labels.

8 Hours

Course Outcomes:

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

1. **Explain** the basic program constructs of Python Programming.
2. **Design** and **apply** the object oriented programming construct using Python to build the real world application.
3. **Summarize** the concepts related to Relational Database Management System .
4. **Design and develop** databases from the real world by applying the concepts of Normalization using SQL and PL/SQL
5. **Perform** the various Database operations by connecting Python with Database.

Mapping of POs & COs:

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12
1	H		H		H				H			
2		H			H				L		M	
3		H			H				L		M	
4		H	H		H				L		M	
5	H		H		H						H	

H : High M: Medium L : Low

TEXT BOOKS:

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2012, Cengage Learning.
2. Magnus Lie Hetland, "Beginning Python From Novice to Professional", Second Edition.
3. Mark Summerfield, Programming in Python 3 - A Complete Introduction to the Python Language, Second Edition.
4. Elmasri, Navathe, "Fundamentals of Database Systems", Third edition, Addison Wesley.

REFERENCE BOOKS:

1. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, ISBN:978-0-13-274718-9, 2013.
2. Raghu Ramakrishnan and Johannes Gehrke : Database Management Systems (Third Edition), McGraw-Hill, 2003

E-BOOKS:

1. http://www.diveintopython3.net/

TUTORIALS:

1. http://www.learnpython.org/
2. https://docs.python.org/2/tutorial/index.html
3. http://en.wikibooks.org/wiki/Non-Programmer%27s_Tutorial_for_Python_3/Intro
4. https://developers.google.com/edu/python/introduction

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CONSUMER ELECTRONICS

Sub Code : 15EC8X18 **Credits : 03**
Hrs/ Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable the students to

1. Learn and design operating principles of "real world" electronic devices
2. Study broader view of key principles of electronic device's operation and presents a block circuit diagram.
3. Learn to integrate the many different aspects of emerging technologies and able to build unique mix of skills required for careers.

UNIT – I

SOUND: Properties of sound and its propagation, Transducers (Micro Phone, Loud Speakers), enclosures, mono-stereo, Amplifiers, Multiplexers, mixers, Synthesizers.
VISION: B/W TV, CTV concepts, B/W & Color Cameras, Displays. **15 Hours**

UNIT – II

RECORDING AND PLAYBACK: Optical discs; recording and playback, audio and video systems, Theatre Sound, Studios, Editing.

COMMUNICATIONS AND BROADCASTING: Switching Systems, Land lines, Modulation, Carrier, Fiber optics, Radio and TV broad casting

DATA SERVICES: Data services, mobiles, terrestrial & Satellite Systems, GPS, Computers, internet Services. **15 Hours**

UNIT – III

UTILITIES: Fax, Xerox, Calculators, Microwave ovens, Washing Machines, A/C & refrigeration, Dishwashers, ATMS, Set -Top boxes, Auto Electronics, Industrial Electronics, Robotics, Electronics in health / Medicine, nano- technologies. **9 Hours**

Course Outcomes:

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

1. Recall basics of sound.
2. Recall basics of television and camera.
3. Explain basic working of Recording, storage devices,
4. Explain basics of communication and broadcasting.
5. Recall basic working of commonly used electronic gadgets

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	1					1					2	2
2	1					1					2	2
3	1					1					2	2
4	1					1					2	2
5	1					1					2	2

1: Low 2: Medium 3: High

TEXT BOOKS:

1. Anand, **"Consumer Electronics",** Khanna publications, 2011.
2. Bali S. P., **"Consumer Electronics",** Pearson Education, 2005.

REFERENCE BOOK:

1. **Gulati R. R., "Modern Television Engineering", Wiley Eastern**

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OPTO ELECTRONIC DEVICES

Sub Code : 15PH8X19 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. To understand the basic principles of construction, working and applications of various optoelectronic devices.
2. Study of sources of radiation like lasers and LED, their specific properties and hence their use for applications.
3. Study of radiation detectors like semiconductor detector, diode as detector and photo multiplier.
4. Exploring the ways of harnessing solar energy and assessing the efficiency of solar energy converters
5. Understanding the fabrication and applications of optical fibers, optical modulators and waveguides for optical communication.

UNIT - I

Optical processes in Semiconductor & Display devices

Elements of optical phenomena in Semiconductors- fundamentals of Fermi-Dirac distribution, band structure, direct and indirect band gap semiconductors, generation-recombination mechanisms, absorption and emission processes.

Display devices- cathode ray tube, liquid crystal display, charge coupled devices,

9 Hours

UNIT - II

Lasers and optical fibers

Lasers- basic principles, optical resonator-types, modes and quality factor, practical lasers- Nd-YAG, CO_2, Excimer laser**,** applications.

Optical fibers- types of fibers, modes of propagation, attenuation and losses, optical fiber communication system, advantages. **8 Hours**

UNIT - III

Optical sources and detectors

Light emitting diode- electroluminescence in p-n junction, LED characteristics, efficiency and responsivity, Heterojunction LED**,** Surface-Emitting LED and Edge emitting LED.

Semiconductor laser- basic structure, laser action, heterojunction laser, quantum well laser,

Photo detectors- photo conductor detector, junction photo diode, p-i-n photo diode, avalanche photo diode. Photo multiplier tube. **9 Hours**

UNIT - IV

Solar cells

Introduction, Basic principles: current-voltage characteristics**,** Efficiency & Fill factor, Spectral response. Solar radiation and air mass notation. Homojunction solar cells, heterojunction and cascaded solar cells, Schottky barrier solar cells. Temperature and radiation effects, Optical concentration, Materials requirements, Solar cell design,

7 Hours

UNIT - V

Integrated optics and modulators

Modulation of light- Analog and digital modulation, Direct modulation - using LED and Semiconductor diode laser (SDL). External modulation - Electro-optic modulators (Pockels effect), Electro-absorption modulators. Acousto-optic modulation. Waveguides- device structure, waveguide devices – waveguide lenses, light bending devices, optical power dividers, directional couplers, waveguide polarizer, wavelength multiplexers and demultiplexers. Waveguide coupling. Optoelectronic integrated circuit. **6 Hours**

Course Outcomes:

1. Ability to choose the appropriate device to meet the requirement of a particular application.
2. Making modifications to device structures by understanding the factors affecting their performance.
3. Attempting better efficiency and utility through an understanding of the principles of performance.
4. Use the technical knowledge acquired to troubleshoot and rectify devices and circuits.
5. Explore the possibility of designing devices with better characteristics.

Mapping of PO's & CO's:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M		L			H		M	M
CO2	H	H	H	M		M			H		M	M
CO3	H	H	H	M		M			H		M	M
CO4	H	H	H	M		H			H		M	M
CO5	H	H	H	M		H			H		M	M

TEXT BOOKS:

1. P.R.Sasikumar 'Photonics – an introduction', PHI Learning Pvt. Ltd.,New Delhi, 2012 edition.
2. Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.

REFERENCE BOOKS:

1. J.Wilson and J.Haukes 'Opto electronics- an introduction', Prentice Hall of India, New Delhi.
2. Jasprit Singh 'Opto electronics- an introduction to Materials and Devices' McGraw Hill international ed., 1998.
3. A.Ghatak and Thyagarajan 'Introduction to opto electronics' New Age International Publication.

E-resources:

1. http://nptel.ac.in/courses/115102026/

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CHEMISTRY OF NATURAL PRODUCTS

Sub Code	**: 15CH8X21**	**Credits**	**: 03**
Hrs/Week	**: 3+0+0+0**	**Total Hours**	**: 39**

Course Learning Objectives:

This course will enable students to

1. Identify the structure of terpenoids and their biosynthesis.
2. Elucidate the structure of β-carotene, haemoglobin and chlorophyll.
3. Understand the chemistry underlying steroids and sex hormones.
4. Get introduced to the different types of prostaglandins as well as theory and chemistry behind natural dyes.
5. Gain knowledge on general methods of structural determination of some of the important alkaloids.

UNIT – I

TERPENOIDS

Introduction and classification, isoprene rules, general methods of determination of structure of terpenoids. Structure elucidation of the following terpenoids-geraniol, α-pinine, camphene and farnesol. Biosynthesis of terpenoids. **8 Hours**

UNIT - II

CAROTENOIDS

Introduction and classification of carotenes. Structural elucidation of β-carotene.

PORPHYRINS

Introduction to porphyrins, structure and degradation products of haemoglobin and chlorophyll. **7 Hours**

UNIT - III

STEROIDS

Introduction, Dile's hydrogenation. Chemistry of cholesterol, Blanc's rule, Barbier-Wielman degradation, Oppenuer oxidation. Constitution of bile acids.

Sex hormones: Chemistry of oestrone, progesterone, androsterone and testosterone.

8 Hours

UNIT – IV

PROSTAGLANDINS

Introduction, nomenclature, classification, and biological role of prostagladins. Structure elucidation of PGE_1, Biosynthesis of PGE_2 and $PGF_{2\alpha}$.

NATURAL DYES

Introduction, Witt's theory of colour, methods of dyeing, chemical constitution of alizarin.

8 Hours

UNIT – V

ALKALOIDS

Definition, Classification and isolation of alkaloids. General methods of structural determination of alkaloids. Detailed study of structure elucidation of the following alkaloids- papaverine, cinchonine and nicotine. **8 Hours**

Course Outcomes:

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

1. Elucidate the structure of terpenoids like geraniol, a-pinine, camphene and farnesol.
2. Explain the structural chemistry of carotenoids and porphyrins.
3. State the basic reactions governing steroids and sex hormones.
4. Explain the biological role and structure of prostaglandins and state the methods employed for dyeing.
5. Apply the general methods of structural determination to elucidate the structure of alkaloids like papaverine, cinchonine and nicotine.

Course Articulation Matrix:

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	**1**	**3**			**2**		**3**			**2**	**2**		
CO 2	3	**3**	**3**			**2**		**3**			**2**	**2**		
CO 3	3	**3**	**3**			**2**		**1**			**2**	**2**		
CO 4	2	**1**	**3**			**2**		**2**			**1**	**2**		
CO 5	1	**3**	**3**					**2**			**2**	**2**		

TEXT BOOK:

1. Organic Chemistry of Natural Products, Vol.-I & Vol.-II, O.P. Agarwal (Goel Publishing House) 2014.

REFERENCE BOOKS:

1. Natural Products Chemistry, Vol. I & II, K. Nakanishi, T. Goso, S. Ito, S. Natori and S. Nozoe, Academic Press, Ny, 1974.
2. Organic Chemistry of Natural Products, Vol. I & II- Gurudeep R. Chatwal (Himalaya Publishing House) 2013.
3. An Introduction to Alkaloids- G.A. Swal (Backwell Scientific Publications) 1967.
4. Hand book of naturally occurring Compounds, Vol. II, terpenes, T.K. Davon, A.I. Scott, Academic Press, Ny, 1974.

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PROFESSIONAL & COGNITIVE COMMUNIQUE

Sub Code : 15HU8X24 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. Understand how to think critically and apply emotional intelligence in workplace
2. Understand manners, etiquettes and cultural sensitivity required for career life
3. Understand the gender perspectives in online and offline spaces
4. Understand how human body is comprehended in social and virtual spaces
5. Understand the different ways to read and write

UNIT - I

Commonsense and Emotional Intelligence

Common Sense: The Terms: Common Sense, Commonsensical Consensus, and Critical Thinking. Unsettling Commonsensical Consensus. Role of Language in Common Sense and Critical Thinking.

Emotional Intelligence: Nature, Function and Types; Emotion, Intelligence and Creativity; Growth and Development of Emotional Intelligence. (Case Studies- Tomiya, Pig and Bitch, Cookies) **8 Hours**

UNIT - II

Manners and Etiquettes

Manners and Etiquettes: What is Etiquette? Work Place Etiquette, Workplace Readiness Skills, Physical and Psychological Working Conditions.

Workplace: Significance of Cross Cultural Understanding; Cultural Sensitivity, Impact of Social Media, Self-Representation. **8 Hours**

UNIT - III

Social Media and Gender Perspectives

Social Media and its Impacts: Emergence of Social Media, Impact on Gender and Self Representation, Regulatory and Liberatory aspects of Social Media, Offline Norms and Online Behaviour.

Gender Perspectives: Gender and Sex, Genderization, Homogeneity and Heterosexuality, Gender Expressions, Gender schooling **8 Hours**

UNIT - IV

Body and Panopticisim

Body: Representation of Body, Commodification, Gender Perspectives of Body

Panopticism: Ways of Seeing, Discipline and Punishment, ISA and RSA **7 Hours**

UNIT - V

Writing and Reading

Writing: Creative Writing, Formal Writings / Informal Writing, Plagiarism

Reading: Styles of Reading, Scanning, Skimming, Detailed Reading **8 Hours**

Course Outcomes:

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

1. Think critically
2. Comprehend etiquttes and manners in different situatuions
3. Be gender sensitive in both offline and online behaviour
4. Exhibit better comprehension of the socil implications of human body
5. Understand the importance of reading and writing skills

REFERENCE BOOKS:

1. Geetha.V. *Gender.* Kolkatta: WebImpressions, 2009.
2. Bailey, Jane, et al. "Negotiating With Gender Stereotypes On Social Networking Sites: From "Bicycle Face" to Facebook." *Journal of Communication Enquiry* 37.2 (2013): 91-112.
3. Barry, Peter. *Beginning Theory.* New Delhi: Viva Books, 2010.
4. Berger, John. *Ways of Seeing.* London: Penguin Books, 1977.
5. Cranny-Francis, Anny, et al. *Gender Studies:Terms and Debates.* New York: Palgrave Macmillan, 2003.
6. Gauntlett, David. *Media, Gender and Identity: An Introduction.* London: Routledge, 2008
7. Pilcher, Jane, and Imelda Whelehan. *50 Key Concepts in Gender Studies.* London: Sage, 2004.Print.

8. Jeanne, Haraway Donna. *Simians, Cyborgs, and Women.* London: Free Association Books, 1991.Web.
9. Koskela, Hille. "Webcams, TV Shows and Mobile Phones: Empowering Exhibitionism." *Surveillance Society* 2.3 (2004): 199-215.Web.

Important Links:

1. http://www.cyberpsychology.eu
2. http://www.surveillance-and-society.org/articles2(2)/webcams.pdf
3. http://eprints.rclis.org

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FUNDAMENTALS OF OPERATING SYSTEMS

Sub Code : 15IS8X27 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. Summarize the general concepts of an operating system related to process and threads.
2. Demonstrate the process scheduling algorithms, detecting and avoiding deadlocks.
3. Summarize the process synchronization and memory management concepts of an operating system.
4. Discuss the file implementation in operating system
5. Explain secondary storage concepts of an operating system

UNIT - I

INTRODUCTION AND SYSTEM STRUCTURES
Operating system definition; Operating System operations; Different types of operating system –Distributed systems, Real time systems
OPERATING SYSTEM SERVICES; User - Operating System interface; Operating System structure.
PROCESS MANAGEMENT: Process concept; Process scheduling;
MULTI-THREADED PROGRAMMING: Overview; Multithreading models. **7 Hours**

UNIT - II

PROCESS SCHEDULING
Basic concepts; Scheduling criteria; Scheduling algorithms;
DEADLOCKS

System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. **8 Hours**

UNIT - III

PROCESS SYNCHRONIZATION

The Critical section problem; Semaphores; Classical problems of synchronization; Monitors.

MEMORY MANAGEMENT

Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. **8 Hours**

UNIT – IV

VIRTUAL MEMORY MANAGEMENT

Background; Demand paging; Page replacement; Allocation of frames.

FILE SYSTEM

File System: File concept; Access methods; Directory structure; **8 Hours**

UNIT - V

IMPLEMENTING FILE SYSTEM

File system structure; File system implementation; Directory implementation; Allocation methods;

SECONDARY STORAGE STRUCTURES, PROTECTION

Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. **8 Hours**

Course Outcomes:

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

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C8X27.1	Discuss the operating system structure and management of process	2
C8X27.2	Apply the process scheduling algorithms , deadlock prevention and avoidance concepts of operating system	3
C8X27.3	Discuss synchronization of process and memory management concepts	2
C8X27.4	Describe the file implementation in operating system	2
C8X27.5	Explain the secondary storage structure and management	2

Course Articulation Matrix:

POs / COs	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l	PO m	PO n
C8X27.1	M				L				L					
C8X27.2	M	M			M				M					
C8X27.3	M	M			M				M					
C8X27.4	M								M					
C8X27.5	M	M			M				M					

TEXT BOOK:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 7 ed Wiley-India, 2006

REFERENCES BOOKS:

1. William Stallings,"Operating System Internals and Design Principles",5ed,Pearson Education,Asia,2005.
2. Gary Nutt," Operating System"3 ed, Pearson Education,2004
3. D.M Dhamdhere: Operating systems - A concept based Approach, 2ed, Tata McGraw-Hill, 2002.
4. P.C.P. Bhatt: Operating Systems, 2 ed, PHI, 2006.

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OPERATIONS MANAGEMENT & ENTREPRENEURSHIP

Sub Code : 15ME8X28 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

1. Define production/operations management, Classify Production and service system and different type of production systems, Understand the importance of CRM and ERP

2. Appreciate the importance of Quality tools and methods in operations management
3. Analyze the data draw variable process control charts and determine process capability; Understand salient issues concerning reliability
4. Understand the issues related to entrepreneurship, characteristics of an entrepreneur and different studies carried out during project appraisal.
5. Identify and differentiate the different national and state level funding agencies.

UNIT - I

Introduction to Production/ Operations Management: Concept of production, Classification of production systems, Production Management, Concept of operations, Distinction between Manufacturing Operations and Service Operations, Objectives of Operations Management (Customer Service and Resource utilization/ Competitive advantage through Quality-Delivery-Cost), Scope of Operations Management. Introduction to Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP).

7 Hours

UNIT - II

Introduction to Quality Concepts: The Meaning of Quality and Quality Improvement, Key dimensions of Quality, Concept of cost of quality. Customers' perception of quality.

TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM.

Managing Quality: Quality circles, Continuous Improvement- Juran's Trilogy, PDSA cycle, Kaizen, 7 QC tools,

Philosophy of statistical process control and modeling process quality: Normal distribution tables, Finding the Z score, Central limit theorem, Chance and assignable causes of variation, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, warning limits) **9 Hours**

UNIT - III

Control charts for variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, Simple Numerical Problems,

Process capability: The foundation of process capability, Natural Tolerance limits, c_p – process capability index, c_{pk}, p_p – process performance index, summary of process measures. Numerical problems. Concept of Six sigma.

Introduction to reliability, Mean time to failure, Mean time between failures, Bath tub curve, Reliability of series and parallel systems, Numerical problems on the above topics **8 Hours**

UNIT - IV

ENTREPRENEURSHIP: Concept of Entrepreneurship, Stages in entrepreneurial process, Role of entrepreneurs in Economic Development, Barriers to Entrepreneurship, Meaning of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur - an emerging Class.

Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Application of Operations Management concepts in Facility/ Business Location: General procedure for making locations decisions, Numerical Problems on application of Breakeven analysis and Transportation method to make location decisions. **8 Hours**

UNIT - V

SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI, Government policy towards SSI; Different Policies of SSI, Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO/GATT on SSI, Supporting Agencies of Government for SSI, Ancillary Industry and Tiny Industry (Definition Only)

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC. **7 Hours**

Course Outcomes:

1. Define production/operations management, Classify Production and service system and different type of production systems, Understand the importance of CRM and ERP
2. Appreciate the importance of Quality tools and methods in operations management
3. Analyze the data draw variable process control charts and determine process capability; Understand salient issues concerning reliability
4. Understand the issues related to entrepreneurship, characteristics of an entrepreneur and different studies carried out during project appraisal.
5. Identify and differentiate the different national and state level funding agencies.

Course Articulation Matrix

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	2	1	1	2	2	3	2	2	2	1	1
CO 2	3	2	2	3	1	1	1	1	3	2	2	2	1	1
CO 3	3	2	3	3	1	1	1	1	3	2	3	2	2	2
CO 4	2	2	2	3	1	1	1	1	3	3	3	2	2	2
CO 5	2	2	2	3	1	1	2	1	3	3	3	2	2	2

TEXT BOOKS:

1. **Production / Operations Management**, Joseph G Monks, McGraw Hill Books
2. **Production and Operations Management**, William J Stevenson, Tata McGraw Hill, 8th Edition.
3. **Statistical Quality Control**: RC Gupta, Khanna Publishers, New Delhi, 2005.
4. **Total Quality Management**: Dale H. Besterfield, Pearson Education, 2003.
5. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai – Himalaya Publishing House

6. **Entrepreneurship Development** – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2006 (2 & 4).

REFERENCE BOOKS:

1. **Statistical Quality Control:** E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher.
2. **Statistical Process Control and Quality Improvement:** Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
3. **Statistical Quality Control for Manufacturing Managers:** W S Messina, Wiley & Sons, Inc. New York, 1987
4. **Statistical Quality Control:** Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
5. **Principles of Quality Control:** Jerry Banks, Wiley & Sons, Inc. New York.
6. **Entrepreneurship Development** – S.S.Khanka – S.Chand & Co.

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/110105067/
2. https://www.edx.org/course/operations-management-iimbx-om101-1x

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PHYSICS OF SEMICONDUCTOR DEVICES

Sub Code : 15PH8X29	**Credits : 03**
Hrs/Week : 3+0+0+0	**Total Hours : 39**

Course Learning Objectives:

1. To understand the basic principles of construction, working and applications of various semiconductor devices.
2. Study of basic electronic devices, their specific properties and hence their use for applications.
3. Study of radiation detectors like semiconductor detector, diode as detector and photo multiplier.
4. Exploring the ways of harnessing solar energy and assessing the efficiency of solar energy converters
5. To study the use of semiconductor devices in optical and microwave communication.

UNIT - I

Semiconductors – Band picture, Fermi-Dirac statistics, Basic properties. p-n junction – basic fabrication steps, abrupt and graded junctions, applications.

Bipolar transistor, static characteristics, amplifier, frequency response and switching.

8 Hours

UNIT – II

Field effect transistor – JFET fabrication, characteristics, applications.
Uni-junction transistor – fabrication, characteristics, comparison with JFET,
Applications- relaxation oscillator, diode pump.
SCR – construction, two transistor model, operation, applications. **8 Hours**

UNIT - III

MESFET : Metal-semiconductor junctions – ohmic and rectifying, energy band diagrams, applications.

MOSFET fabrication, MOS structures – implanted and induced channels, energy band diagrams, applications. **8 Hours**

UNIT - IV

Hetero-junctions – fabrication, comparison with homo-junctions, advantages, HBTs- materials and characteristics.

Microwave diodes – Tunnel diode, IMPATT diode, transferred electron devices,

quantum devices, hot electron devices. **7 Hours**

UNIT - V

Photonic devices – Light emitting diodes, visible and infra-red LEDs, organic LED, semiconductor laser, photo-detector – Photo conductor as a detector, p-n junction, double hetero-junction detector, p-i-n junction, Avalanche photo diode, solar cells.

8 Hours

Course Outcomes:

1. Ability to choose the appropriate device to meet the requirement of a particular application.
2. Making modifications to device structures by understanding the factors affecting their performance.
3. Attempting better efficiency and utility through an understanding of the principles of performance.
4. Use the technical knowledge acquired to troubleshoot and rectify devices and circuits.
5. Explore the possibility of designing devices with better characteristics.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M		L			H		M	M
CO2	H	H	H	M		M			H		M	M
CO3	H	H	H	M		M			H		M	M

CO4	H	H	H	M		H			H		M	M
CO5	H	H	H	M		H			H		M	M

REFERENCE BOOKS:

1. Sze S.M : Semiconductor Devices – Physics and Technology, John Wiley Publication 2012
2. Nandita & Amitava Das Gupta : Semiconductor Devices, PHI Learning Publication 2011

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INTRODUCTION TO GEOINFORMATICS

Sub Code : 15CV8X30 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

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

1. Provide the basics and physics of Photogrammetry, Remote sensing (RS), Global Positioning System (GPS) and Geographic Information System (GIS) along with the knowledge of Image interpretation techniques.
2. Understand the digital image processing techniques
3. Equip the students to Identify and Explain the significance and real world applications of GEOINFORMATICS in various Engineering practices

UNIT – I

Introduction: Remote sensing and its Principles

Introduction –What is Remote sensing and GIS. Principles of RS & GIS.

Physical basis of Remote sensing: Remote sensing model, EM spectrum. Blackbody concept, atmospheric windows, ranges of sensing systems, spectral response of common earth features.,

Platforms and Sensors: Ground, Aircraft & Spacecraft platforms.

Photographic sensors & resolutions: Various types of sensors & resolutions, scanners, radiometers, RADAR, thermal infrared imagery, LIDAR, MSS

Mission planning, Indian satellites and sensors, capabilities, data products

8 Hours

UNIT – II

Photogrammetry:

Photogrammetry-basic principles and photo interpretation. Application of aerial photo interpretation to various disciplines

Interpretation and Analysis techniques: Multispectral, Multitemporal, Multisensoral, Multistage concepts

Photo-interpretation techniques for aerial photos and satellite imagery

Visual & Digital Image interpretation (VIP & DIP)

Interpretation elements, False Colour composites (FCC)

8 Hours

UNIT – III

Digital Image Processing and Analysis:

Digital Analysis: Preprocessing and processing (DIP)

Image restoration/enhancement procedures

information extraction, pattern recognition concepts

Post processing procedures.

7 Hours

UNIT – IV

GIS: Concept and Spatial models

Fundamentals of GIS, spatial and non-spatial data, vector and raster GIS

GIS Hardware and Software

Georeferencing, digitization, thematic maps Overlay Analysis, O**peration of GIS**

Maps: Co-ordinate systems and Map projections, Map scale, data display and cartography

8 Hours

UNIT – V

Geoinformatics and Virtual GIS:

Modern Surveying and Geoinformatics

GPS, its functionalities and applications

GIS Functionality: Introduction, data acquisition, preliminary data processing data storage and retrieval, spatial search and analysis

Graphics and interaction

Virtual GIS and Real world applications

8 Hours

Course Outcomes :

At the end of the course, upon successful completion, each student will be able to:

1. ***Define, Describe and Distinguish*** the Physical basis of remote sensing and the principles of Photogrammetry, RS & GIS techniques, and the various types of platforms, sensors & resolutions in RS with a special reference on Indian satellites and data products.

2. ***Define, Describe and Distinguish*** Photogrammetry, its basic principles, photo interpretation with Visual & Digital Image process and appraise its application in related disciplines.
3. ***Define, Explain and*** **Analyze** digital image formats, different stages involved in Digital Image Processing, and apply and classify the information extracted for various purposes.
4. ***Describe, Distinguish, Illustrate*** Maps and Overlays- its components, preparation and projections, Geographic Information System- its components, data structures, process and operation, and GPS.
5. ***Identify, Describe, Analyze, and Evaluate*** the applications and significance of geospatial technology or GEOINFORMATICS (Photogrammetry, RS, GIS & GPS) in various fields of Engineering practices

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**M**	**M**					**M**				**H**		M	H	
CO2	H	H	M	M	M	M	M				M	M	M	M	
CO3	H	H	M	M	M	M	M				H	M	M	M	
CO4	**H**	**H**	**H**	**M**	**M**	**M**	**M**				**L**	**L**	**L**	**L**	
CO5	M	M	M	H	L	L	L				M	M	M	M	

Note : L: Low (1) / Slight; **M: Medium (2)/** Moderate; **H: High (3) /** Substantial

TEXT BOOKS:

1. Bhatta, Basudeb (2011) ***Remote Sensing and GIS*** 2nd edition Oxford University Press, New Delhi
2. Lillesand, T.M., Kiefer, R.W and Chipman, J.W. (2004) ***Remote sensing and image interpretations*** 5th edition, John Wiley and sons, New Delhi
3. Anji Reddy , M. (2006) *Text Book of* ***Remote Sensing and Geographical Information Systems***, Third Edition, BS Publication, Hyderabad

REFERENCE BOOKS:

1. Anji Reddy , M. and Hari Shankar, Y. (2006) ***Digital Image Processing***, BS Publication, Hyderabad
2. Bernhardsen, Tor (2002) ***Geographic Information Systems*** - ***An 3rd*** Ed., Wiley India Pvt. Ltd., New Delhi

3. Canada Centre for Remote Sensing **(2011)** ***Fundamentals of Remote sensing- Tutorial***
4. Chang, Kang-tsung (2008) ***Introduction to Geographic Information Systems*** 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi
5. Korte, George B. (2001), ***The GIS Book***, Onword Press, Thomson Learning Inc., USA
6. Kumar, S. (2016) ***Basics of Remote sensing and GIS*** *University Science Press (*Laxmi Publications(P) Ltd.), New Delhi
7. Longler, Paul A., Goodchild, Michael F., Maguire, David J., Rhind. David W., (2004) ***Geographic Information Systems and Science*** John Wiley & Sons Ltd., ESRI Press
8. Sabins, F.L.(1997) ***Remote Sensing: Principles and Interpretation*** 3rd edn. Freeman and Company, New York, 494p.

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CORROSION SCIENCE

Sub Code : 15CH8X31 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

1. To provide fundamental aspects of electrochemistry related to corrosion.
2. To understand the types of corrosion attacking on the metal.
3. To study the corrosion at elevated temperature.
4. To provide methodologies for measuring the corrosion of materials.
5. To identify practice for the prevention and remediation of the corrosion

UNIT - I

FUNDAMENTALS OF CORROSION

Definition, Cost of corrosion, Corrosion Damage and consequences, Classification of corrosion, Electrochemical Aspects of corrosion, Electrochemical reactions, Different Environmental aspects, polarization and passivity, Standard electrode potential, EMF and Galvanic series, Potential-pH (Poubaix Diagram). **8 Hours**

UNIT - II

FORMS OF CORROSION

Uniform corrosion, Galvanic corrosion, Crevices corrosion, Filiform corrosion, Pitting corrosion, Inter granular corrosion, Selective leaching, Erosion corrosion, Cavitation damage, Stress corrosion, Impingement attack, Inlet tube corrosion, Corrosion fatigue, Hydrogen blistering, Hydrogen embrittlement. **9 Hours**

UNIT - III

CORROSION AT ELEVATED TEMPERATURE

Pilling bed worth rule, Electrochemical and morphological aspects of oxidation, Oxide defect structure. High temperature materials-mechanical properties and oxidation resistance. Metal-gas reactions. Hot corrosion of alloys. **8 Hours**

UNIT - IV

CORROSION RATE DETERMINATION

Weight loss method, Tafel extrapolation method, linear polarization method, cyclic voltammetry, electrochemical impedance spectroscopy. **7 Hours**

UNIT – V

CORROSION PREVENTION METHODS

Materials Selections, Design, Change of the environments: Atmospheric corrosion, Control of atmospheric corrosion, Changing medium, Inhibitors, Cathodic and Anodic protection, Protective coatings. **7 Hours**

Course Outcomes:

1. Explain the fundamentals of difference in electrode potential across an interface in particular a metal/ electrolyte and the relationship between rates of electrochemical reactions and the potential drop across interfaces.
2. Analyze the causes and mechanisms of various types of corrosion including uniform, galvanic, crevice, pitting, inter granular and various modes of environmentally cracking.
3. Acquire knowledge of influence high temperature on microstructure corrosion performance.
4. Explain the concepts of different measuring techniques of corrosion.
5. Identify the materials that will exhibit adequate corrosion resistance in a particular environment and remedial action that will reduce corrosion to an acceptable level.

Course Articulation Matrix:

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	**1**						**3**			**2**			
CO 2	3	**3**						**3**			**2**			
CO 3	3	**3**						**1**			**2**			
CO 4	3	**1**						**2**			**1**			
CO 5	3	**3**						**2**			**2**			

1: Low 2: Medium 3: High

TEXT BOOK:

1. Corrosion Engineering; Mars G Fontana; 3rd Edition; Mc Graw-Hill Education (India) Private Limited.

REFERENCE BOOKS:

1. Corrosion; Chamberlian and K. Trethway, Longman scientific and technical published by John Wiley and Sons.

2. Principles and Prevention of Corrosion; Denny A. Jones, 2nd Edition, Prentice-Hall of India private Limited, New Delhi.

LINKS AND VIDEO LECTURES:

1. Corrosion and Corrosion Control, 4th Edition R. Winston Revie ISBN: 978-0-470-27725-6,512 pages March 2008.
2. **http://nptel.ac.in/courses/113108051/**
3. **https://www.slideshare.net/akshaykhanna1997/corrosion-presentation-13565660?next_slideshow=1**
4. **http://www.npl.co.uk/upload/pdf/basics_of_corrosion_control.pdf**

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APPLICATION OF SIGNAL PROCESSING

Sub Code : 15EC8X32 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable students:

1. To understand the concept of Analog and Digital Frequency and Sampling Theorem.
2. To understand Discrete Time Signals, Systems ,and Analyse Discrete Time Linear Time Invariant (LTI) systems
3. To understand Z transform.
4. To understand Convolution (Linear and Circular) and Correlation.
5. To understand the DFT and Fast Fourier Transform (FFT) using Radix 2 Decimation In Time, and Decimation In Frequency FFT Algorithms.
6. To Design and Analyze the characteristics of Analog filters.
7. To Design IIR filter using Bilinear transformation
8. To design FIR filter using Windowing techniques.
9. To design Linear Phase FIR filters using frequency sampling technique.
10. To implement Digital filters using various structures.
11. To understand Speech coding, Speech enhancement, Noise cancellation and Speech recognition.

UNIT - I

SIGNALS AND SYSTEMS:

Basic elements of DSP – Concepts of frequency in Analog and Digital Signals , Sampling theorem , Discrete Time Signals, Systems , Analysis of Discrete Time Linear Time Invariant (L.T.I.) systems ,Z transform ,Convolution (Linear and Circular), Correlation.

FREQUENCY TRANSFORMATIONS:

Introduction to Discrete Fourier Transform (DFT), Properties of DFT, Filtering methods based on DFT, Fast Fourier Transform (FFT) using Radix 2 Decimation In Time, and Decimation In Frequency FFT Algorithms. **14 Hours**

UNIT – II

IIR FILTER DESIGN:

Analog filter design , Infinite Impulse Response (IIR) filter from analog filter using Bilinear transformation, High pass,Band pass,and Band reject filter design using frequency translation, Structures of IIR filter.

FIR FILTER DESIGN:

Linear phase Finite Impulse Response (FIR)Filter design using Windowing chniques, Frequency sampling techniques, Structures of FIR filter . **14 Hours**

UNIT – III

APPLICATIONS:

Speech coding, Speech enhancement, Noise cancellation, Speech recognition. **11 Hours**

Course Outcomes:

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

1. Explain Sampling Theorem and Analyse Discrete Time Linear Time Invariant (LTI) systems and to comprehend Z transform, Convolution (Linear and Circular) and Correlation.
2. Compute the DFT and Fast Fourier Transform (FFT) using Radix 2 Decimation In Time, and Decimation In Frequency FFT Algorithms.
3. Design Analog filter, IIR filter
4. Design FIR filter.
5. Interpret Speech coding, Speech enhancement, Noise cancellation and Speech Recognition

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	1					1					2	2
2	1					1					2	2
3	1					1					2	2
4	1					1					2	2
5	1					1					2	2

1: Low 2: Medium 3: High

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, **"Digital Signal Processing –Principles,Algorithms & Applications"**, Fourth edition, Pearson education / Prentice Hall, 2007.
2. Emmanuel C. Ifeachor, & Barrie.W.Jervis, **"Digital Signal Processing"**, Second edition, Pearson Education / Prentice Hall, 2002.

REFERENCE BOOKS:

1. Alan V.Oppenheim, Ronald W. Schafer & Hohn. R.Back, **"Discrete Time Signal Processing"**, Pearson Education, 2nd edition, 2005.
2. Andreas Antoniou, **"Digital Signal Processing"**, Tata McGraw Hill, 2001.

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HUMAN RESOURCE MANAGEMENT

Sub Code : 15ME8X33 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

1. To develop a meaningful understanding of HRM theory, functions and practices.
2. To apply HRM concepts and skills across various types of organizations.
3. To understand the concepts of e-HRM.

UNIT - I

Human Resource Management & HRP:
Introduction, meaning, nature, scope of HRM. Major functions of HRM, Personnel Management vs Human Resource Management, job design, job evaluation, job analysis, job specification, job enlargement, job enrichment. Role of HR Manager.HR Planning.Process HRP.

8 Hours

UNIT – II

Recruitment: Definition, Sources and Methods of Recruitment
Selection: Definition and Process of Selection. Cost benefit analysis of selection.
Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. Performance Appraisal methods

8 Hours

UNIT - III

Training and development: Training v/s development, stages in training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.
Compensation: employee remuneration, rewards, Wage and Salary Administration, Bonus, fringe benefits.

Internal Mobility, External Mobility, Trade union Act (Amendment) 2001. **7 Hours**

UNIY - IV

Employee Grievances: Employee Grievance procedure. Discipline procedure
Collective bargaining; Characteristics, Necessity, Forms
Safety & Health; Industrial accidents, Safety
Quality circle; Meaning, Structure **8 Hours**

UNIT - V

IHRM. Managing IHRM. e-HR Activities, Global recruitment, selection, expatriates

e-HRM; Aspects of e-HRM,e-Job design & Analysis, Ethical issues in employment

8 Hours

Course Outcomes:

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

1. Apply the concept of HRM and its implementation
2. Understand concepts and skills recruitment.
3. Understand the need of training of development
4. Apply the HRM skills across various types of organizations.
5. Apply the concepts of e-HRM and ethical issues in employment

Course Articulation Matrix:

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	1	1	1	2	1	2	1	1	1	2	1	1
CO 2	2	1	1	1	1	2	1	3	1	1	1	1	1	1
CO 3	1	1	1	1	1	2	1	2	1	1	1	1	1	1
CO 4	2	1	1	1	1	1	1	2	2	1	1	1	1	1
CO 5	2	1	1	1		1	1	2	1	2	1	1	1	1

TEXT BOOK:

1. Essentials of Human Resource Management & Industrial relations-P Subba Rao, Third Revised Edition

REFERENCE BOOKS:

1. Human Resource Management - John M. Ivancevich, 10/e, McGraw Hill.
2. Human Resource Management-Flippo
3. Human Resource Management - Lawrence S. Kleeman, Biztantra , 2012.
4. Human Resource Management – Aswathappa K HPH

MOOC/NPTEL Resources:

1. http://edx.nimt.ac.in/courses/course-v1:nimtX+PGDM1212+2017_H1/about
2. http://nptel.ac.in/courses/122105020/

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SOLID STATE LIGHTING

Sub Code : 15EE8X34 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

1. To acquaint knowledge different types of light source and its utility.
2. To know the integration of lighting in diverse application.
3. To upgrade the knowledge in smart lighting.
4. To enumerate the skill in energy saving using solid state lighting.
5. To give insight to design steps involved in building solid state lighting

UNIT – I

Introduction: different types of light source –black body radiator, human vision, mesopic, scotopic, photopic vision, human light transduction model, lumen, luminous intensity, illumination, luminous efficacy, maintenance factor, depreciation factor, photometric analysis. **7 Hours**

UNIT – II

Color science: introduction to solid state lighting, construction of solid state lighting source, color renderance, correlated color temperature, binning, Macadam ellipse, different steps in Macadam ellipse, chromaticity diagram, color mixing, color evaluation techniques objective and subjective color analysis -problems **8 Hours**

UNIT – III

Converters for Lighting: drivers, linear regulator, switch mode regulators using buck, boost and buck boost converte **8 Hours**

UNIT – IV

Light and health: light as radiation, tissue damage by ultraviolet radiation, Tissue Damage by Visible and Near Infrared Radiation, Tissue Damage from Infrared Radiation beyond 1400 nm, Threshold Limit Values, Practical Considerations, Aging Effects, Risk of Exceeding Limits, Using Task Lights, Eyestrain, Migraine, Autism, Visual Comfort and Human Variability, Light Operating through the Circadian System, Sleep, blue light hazard. **9 Hours**

UNIT – V

Application of Solid state lighting: Horticulture lighting, Hospital lighting, architectural lighting, commercial lighting, Seasonal Affective disorder, Alzheimer, museum lighting. **7 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Analyse the color discrimination of the light source based on subjective and objective analysis
2. Identify the LED binning and illustrate the importance of Macadam ellipse
3. Categorize the color characteristic of the light source
4. To design the drivers for LEDs based on linear and switch mode regulators
5. Expound the application of solid state lighting in health, commercial and non-commercial sectors

Course Articulation Matrix:

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1										1
CO2	2	1	1									
CO3	1	2	1					1				
CO4	2	2	3	1					1		1	
CO5	1	1				1						1

TEXT BOOKS:

1. Light emitting diodes- Fred Schubert, 2nd Edition, Rensselaer Polytechnic Institute, New York, Cambridge University Press,2006.
2. LED for lighting Applications, 1st Edition, Patrick Mottier, Wiley, 2009

REFERENCE BOOKS:

1. LED lighting a primer to lighting the future Sal Cangeloso, Maker press, 2012
2. Understanding the LED illumination, M Nisa Khan, CRC Press, 2013.

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DATA ACQUISITION SYSTEM DESIGN USING LABVIEW

Sub Code : 15EC8X35 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable the students to

1. Learn different actuators and sensors for real world applications
2. Learn the basics of Labview software tools.
3. Learn to design a data acquisition system to perform data acquisition, analysis and display.

UNIT – I

SENSORS & TRANSDUCERS: Properties of sensors-accuracy, precision, resolution, sensitivity, range, linearity, errors and response time. Sensor types**-** Temperature, pressure, strain, force, hall effect sensors for voltage and current, piezo electric sensors. Resistance, capacitance, inductance variation transducers

ACTUATORS : Motors-DC, Stepper, Servo. Relays, Solenoids, Electrodynamic actuators.

15 Hours

UNIT – II

FUNCTION PALETTES: Structure palette: For Loop, While loop, case structure, sequence structure, Expression node, formula node, Math script, feedback, shared variable, local and global variable, Array palette –build, operate on array, Cluster palette, Numeric palette in general (specific – Enum constant, Ring constant, expression node, Boolean in general (AND, OR,NOT) – think of use in specific example from your domain, Comparison palette, String palette, Timing palette File I/O palette.

CONTROL PALETTES: Numeric (controls and indicators), Boolean (buttons & Switches), Text control, String & Path, Array, Graph indicators, Ring & Enum.

15 Hours

UNIT – III

DATA ACQUISITION: Properties of analog and digital signals, Basics of signal conditioning-aliasing, filters, Terms involved in data acquisition-Sampling rate, range, resolution, throughput, quantization, gain.

DAQ Hardware from NI- Analog and Digital DAQ cards, Arduino as DAQ card.

9 Hours

Course Outcomes:

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

1. Understand basic terminology in sensors and measurements.

2. Study choosing a sensor and transducer for a specific application.
3. Create LabVIEW code and use different Function palettes.
4. Create LabVIEW code and use different Control palettes.
5. Choose appropriate hardware to rig up any given experimental setup.

Mapping of POs & Cos:

CO \ PO	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2	2											
3			2	1	3				2		2	2
4			2	1	3				2		2	2
5			2	3					3		3	2

1: Low 2: Medium 3: High

TEXT BOOK:

1. Sanjay Gupta, Joseph John. "**Virtual Instrumentation Using LabVIEW"**, McGraw-Hill, 20052. Bali S. P.,

REFERENCE BOOKS:

1. Holman J P. "**Experimental Methods for Engineers"**, McGraw-Hill
2. D. Patranabis, "**Sensors and Transducers"**, Prentice Hall of India, 2003

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COMPUTATIONAL FLUID DYNAMICS

Sub Code : 15ME8X36 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable students to:

1. Understand the basic concepts of computational dynamics and a brief solution procedure.
2. Derive the equations related to turbulent flows and understand various discretization methods.
3. Understand the solution obtained by CFD.
4. Know the areas where CFD is applicable.

5. Know the application of CFD to multiphase systems and fluid structure interaction.

UNIT – I

INTRODUCTION: Computational Fluid Dynamics, Advantages, Applications, Future of CFD. **CFD SOLUTION PROCEDURE:** Problem set up-pre-process, Numerical solution – CFD solver, Result report and visualization-post-process. **8 Hours**

UNIT – II

GOVERNING EQUATIONS FOR CFD: Introduction, the continuity equation, the momentum equation, the energy equation, the additional equations for turbulent flows, generic form of the governing equations for CFD, boundary conditions. **CFD TECHNIQUES:** Introduction, Discretization of governing equations, Finite difference method, Finite volume method, converting governing equations to algebraic equation system, Numerical solutions.

9 Hours

UNIT - III

CFD SOLUTION ANALYSIS: Introduction, consistency, stability, convergence, accuracy, efficiency, case studies. **PRACTICAL GUIDELINES FOR CFD:** Introduction, grid generation, boundary conditions, turbulent modeling. **8 Hours**

UNIT - IV

APPLICATIONS OF CFD: Introduction, CFD as a design tool, indoor air flow distribution, CFD as a research tool, CFD applied to heat transfer coupled with fluid flow, buoyant free standing fire, flow over vehicle platoon, air/particle flow in human nasal cavity, high speed flows.

8 Hours

UNIT - V

ADVANCED TOPICS IN CFD: Introduction, advances in numerical methods and techniques – incompressible flows, compressible flows, moving grids, multigrid methods, parallel computing, immersed boundary methods. Advances in computational methods – DNS, LES, RANS-LES coupling for turbulent flows, multiphase flows, combustion, fluid- structure interaction, physiological fluid dynamics and other numerical approaches.

6 Hours

Course Outcomes:

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

1. Apply the basic concepts of computational dynamics
2. Derive the equations related to turbulent flows and understand various discretization methods
3. Estimate the solution s for problems using CFD.

4. Outline the areas where CFD is applicable.
5. Examine the application of CFD to multiphase systems and fluid structure interaction.

Course Articulation Matrix:

CO	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2
C15ME625.1	M	M	M	L	M	-	-	-	-	-	L	M	M	M
C15ME625.2	L	M	L	L	H	-	-	-	-	-	L	M	H	M
C15ME625.3	H	H	M	M	L	-	-	-	-	-	L	M	M	H
C15ME625.4	M	M	M	L	H	-	-	-	-	-	L	L	H	M
C15ME625.5	L	L	M	L	M	-	-	-	-	-	L	M	M	M

L : Low M: Medium H : High

TEXT BOOKS:

1. **Computational Fluid Dynamic – a practical approach,** Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu, Butterworth-Heinemann (ELSEVIER), 2008.
2. **Introduction to Computational Fluid Dynamics**, Pradip Niyogi, S.K. Chakrabarthy and M.K. Laha, Pearson Education, 2006.

REFERENCE BOOKS:

1. **An introduction to CFD,** H. Versteeg and W. Malalasekra, Pearson, Education, 2nd Edition, 2008.
2. **Introduction to Computational Fluid Dynamics,** Anil W. Date, Cambridge University press, 2007.
3. **Computational Fluid Dynamics – The basics and applications**, Anderson J.D. Jr, (1995), Mcgraw-Hill, New York.

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LINGUISTICS & LANGUAGE TECHNOLOGY

Sub Code	**: 15HU8X37**	**Credits**	**: 03**
Hrs/Week	**: 3+0+0+0**	**Total Hours**	**: 39**

Course Learning Objectives:

By the end of the course, students should be able to:

1. Introspect about the consciousness in one's language
2. Learn pronunciation and how the process helps to communicate effectively.
3. Build contextual speech and writing with the pedagogy in sentence structure.
4. Improve skill of applying language to enunciate words.
5. Progress on the speech aspects by understanding the acquisition of Second Language.

UNIT – I

Introduction to Linguistics:

Broad understanding of Linguistics, Language and characteristic features, Scientific Language, Levels of Linguistic Analysis (Phonetics, Phonology, Morphology, Syntax and Semantics); Approach to Linguistics (Traditional, Structural and Cognitive). **7 Hours**

UNIT – II

Phonology and Morphology:

Perspectives in Linguistics, Phonemes, Allophones, Phonemic Analysis, Morphology and Morphemes, Word building process, Morphological Analysis. **8 Hours**

UNIT – III

Syntax:

Constituent structure (Simple Sentence, Noun Phrase, Verb Phrase, Prepositional Phrase, Adjective Phrase, Adverb Phrase, Structure Rules), Tree Diagrams, Case, Movements (Wh-, NP-, Aux-). **10 Hours**

UNIT – IV

Meaning:

Semantics & Pragmatics, Text and Discourse. **6 Hours**

UNIT – V

Sociolinguistics & Psycholinguistics:

Notion of Language Variety, Languages in Contact, Language and Mind, Error Analysis.

8 Hours

Course Outcomes:

By the end of the course, students will be able to:

2. Understand the importance of language and its facets.
3. Demonstrate knowledge of sounds and competence in process of word building.
4. Evolve to reason the constituent parts of a sentence.
5. Understand the techniques of how 'meaning' is applied.
6. Analyse errors in day-to-day-conversations and how language is related to society.

Course Articulation Matrix:

COs / POs	a	b	c	d	e	f	g	h	i	j	k	l
CO 1		L			L	L			L			M
CO 2			M						M	M		
CO 3	M	H		H					H	M		
CO 4					M				L	M		
CO 5		M				M	L					L

REFERENCE BOOKS:

1. Akmaijan, A, R. A. Dimers and R. M. Harnish. *Linguistics: An Introduction to Language and Communication*. London: MIT Press, 1979.
2. Chomsky, Noam. *Language in Mind*. New York: Harcourt Brace Jovanovich, 1968.
3. Fabb, Nigel. *Sentence Structure*. London: Routledge, 1994.
4. Hockett, C. *A Course in Modern Linguistics*. New York: Macmillan, 1955.
5. O'Grady, W., O. M. Dobrovolsky and M. Aronoff. *Contemporary Linguistics: An Introduction*. New York: St. Martin's Press, 1991.
6. Pride, J. B. and J. Holmes. *Sociolinguistics*. Harmondsworth: Penguin, 1972.
7. Richards, J. C. *Error Analysis: Perspectives in Second Language Acquisition*. London: Longman, 1974.
8. Salkie, R. *The Chomsky Update: Linguistics and Politics*. London: Unwin Hyman Ltd., 1990.
9. Sinclair, J. M. C. H. and R. M. Coulthard. *Towards an Analysis of Discourse*. Oxford: OUP, 1975.
10. Thomas, Linda. *Beginning Syntax*. Oxford: Blackwell, 1993.
11. Verma, S. K. and N. Krishnaswamy. *Modern Linguistics: An Introduction*. New Delhi: OUP, 1989.
12. Wekker, Herman and Liliane Haegeman. *A Modern Course in English Syntax*. Kent: Croom Helm, 1985.

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INTRODUCTION TO PYTHON PROGRAMMING

Sub Code : 15IS8X38		**Credits**	**: 03**
Hrs/Week : 3+0+0+0		**Total Hours**	**: 39**

Course Learning Objectives:

This Course will enable students to

1. Construct python programs using data types and looping
2. Make use of python operators for manipulating lists, dictionaries and files.
3. Design object-oriented Python programs using classes and objects
4. Design useful stand-alone and CGI applications in Python
5. Discuss the basic image processing programming in python

UNIT – I

INTRODUCTION

Introduction to python, Installing Python; basic syntax, interactive shell, editing , saving , and running a script.

The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages;

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation **8 Hours**

UNIT - II

STRINGS

Strings and text files; manipulating files and directories, OS and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

STRING MANIPULATIONS:subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa, Binary, octal, hexadecimal numbers

LISTS, TUPLES, AND DICTIONARIES;basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries . **7 Hours**

UNIT - III

FUNCTIONS

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions.

CLASSES AND OOP

Classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block **8 Hours**

UNIT – IV

Graphical user interfaces: event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested framesa simple CGI form. **8 Hours**

UNIT – V

Multithreading, Networks, and Client/Server Programming: introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages; CGI programming, programming **8 Hours**

Course Outcomes:

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

Sl.No	Course Outcome	Bloom's Taxonomy Level (BTL)
C613.1	Experiment with the basics of python programming like data types and looping	3
C613.2	Apply the Python operators for manipulating lists, dictionaries and files	3
C613.3	Design object-oriented Python programs using classes and objects	5
C613.4	Design useful stand-alone and CGI applications in Python	5
C613.5	Discuss the basic image processing programming in python	2

Mapping of POs & COs:

POs / COs	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l	PO m	PO n
C8X38.1	**M**				**M**						**H**			
C8X38.2	**M**				**M**						**H**			
C8X38.3	**M**				**M**						**H**			
C8X38.4	**M**				**M**						**H**			
C8X38.5	**M**				**M**						**M**			

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXTBOOK:

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.

ADDITIONAL RESOURCE:

1. Think Python - a very good book you may want to read to complement your studies. PDF is free.

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INTRODUCTION TO ARTIFICIAL NEURAL NETWORK

Sub Code : 15EC8X39		**Credits**	**: 03**
Hrs/Week : 3+0+0+0		**Total Hours**	**: 39**

Course Learning Objectives:

This course will enable the students to

1. Understand the role of neural networks in engineering, artificial intelligence and cognitive modelling.
2. Provide knowledge of supervised and unsupervised learning in neural networks.
3. Develop neural network model for various artificial intelligence applications.

UNIT - I

Artificial Neural Systems: Biological Neurons, McCulloch-Pitts Neuron Model, Neuron Modelling for Artificial Systems, Perceptron and activation functions. Models of Artificial Neural Network-Feed-forward Network, Feed-back Network, Introduction to Classifiers and Expert Layered Networks. Learning and Adaption, Neural Network Learning Rules.

15 Hours

UNIT - II

Neural Processing Techniques: Supervised Classifiers-Decision Tree, Support Vector Machine (SVM), K-Nearest Neighbor (KNN), Random Forest and Convolutional Neural Network (CNN). Unsupervised Learning-K-means Clustering, Mixture models, Hierarchical clustering, Autoencoders, Deep Belief Nets, Hebbian Learning and Self Organizing Maps (SOM). Blind Source Separation Techniques- Principal Component Analysis (PCA), Independent Component Analysis (ICA) and Singular Value Decomposition (SVD).

15 Hours

UNIT - III

Neural Network Computation and Analysis: Class Labeling, Training and Testing a Classifier, *k*-fold Cross Validation, Confusion Matrices, Statistical Data Representation Tools and Performance Measure Techniques. Examples and Applications of Neural Network. **9 Hours**

Course Outcomes:

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

1. Recognize the characteristics of artificial neural systems and techniques.
2. Appreciate the significance of artificial neural techniques for discrimination of patterns.
3. Understand various neural network algorithms.
4. Methods to implement the computer-aided tools using classification techniques.
5. Simulate and analyze the algorithms using modern classification techniques.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	3	1	3					3	
2	3	1	3	2	3	2					3	1
3	3	2	3	3	3	1				1	2	
4	2			1								
5	2		2	1		1				2		2

1: Low 2: Medium 3: High

TEXT BOOKS:

1. Zurada JM. "**Introduction to Artificial Neural Systems"**, St. Paul West Publishers-USA, Vol. 8, 1992.
2. Samarasinghe S. "**Neural networks for applied sciences and engineering: from fundamentals to complex pattern recognition**", CRC Press; 2016.
3. Bishop, Christopher M. "**Machine learning and pattern recognition**", Information Science and Statistics, Springer, Heidelberg, 2006.

MOOC Link:

1. Introduction to Machine Learning: https://Onlinecources.nptel.ac.in/noc18_cs40.

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