

**LIST OF OPEN ELECTIVES
TO BE OFFERED IN THE ODD SEMESTER (CEG / ACT / SAP CAMPUS)**

R-2019

FACULTY OF CIVIL ENGINEERING								
SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
Department of Civil Engineering								
B.E. Civil Engineering								
1.	CE5791	Basics of Traffic Management	OE	3	3	0	0	3
2.	CE5792	Environmental Remediation Technologies	OE	3	3	0	0	3
3.	CE5793	Climate Change Adaptation And Mitigation	OE	3	3	0	0	3
B. E. Geoinformatics								
4.	GI5791	Computer Vision and Satellite Image Processing	OE	3	3	0	0	3
5.	GI5792	Remote Sensing Concepts	OE	3	3	0	0	3
FACULTY OF MECHANICAL ENGINEERING								
DEPARTMENT OF MECHANICAL ENGINEERING								
B.E. Mechanical Engineering								
1.	ME5791	Energy Auditing and Conservation	OE	3	3	0	0	3
2.	ME5792	Principles of Sustainable Engineering	OE	3	3	0	0	3
3.	ME5793	Future Energy Resources and Mobility	OE	3	3	0	0	3
4.	ME5794	Hydrogen Fuel for Powertrains	OE	3	3	0	0	3
5.	ME5795	Concepts of Competitive Manufacturing	OE	3	3	0	0	3
6.	ME5796	Solar Energy Technologies	OE	3	3	0	0	3
B.E. Materials Science and Engineering								
6.	ML5791	Plastics Engineering	OE	3	3	0	0	3
7.	ML5792	Nanomaterials and Applications	OE	3	3	0	0	3
DEPARTMENT OF INDUSTRIAL ENGINEERING								
B.E. Industrial Engineering								
8.	IE5791	Design of Experiments For Process and Parameter Optimisation	OE	3	3	0	0	3
9.	IE5792	Reliability Assessment And Maintainability Models	OE	3	3	0	0	3
DEPARTMENT OF MANUFACTURING ENGINEERING								
B.E. Manufacturing Engineering								
10.	MF5791	Electronics Packaging Technology	OE	3	3	0	0	3
11.	MF5792	Industrial and Bio-Inspired Robotics	OE	3	3	0	0	3
DEPARTMENT OF PRINTING TECHNOLOGY								
B.E. Printing and Packaging Technology								
12.	PT5791	Digital Photography	OE	3	3	0	0	3
13.	PT5792	Consumer and Industrial Packaging	OE	3	3	0	0	3
FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING								
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING								
B.E. Computer Science and Engineering								
14.	CS5791	Cyber Forensics	OE	3	3	0	0	3
15.	CS5792	Agile Methodologies	OE	3	3	0	0	3

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING								
B.E. Electronics and Communication Engineering								
16.	EC5791	Consumer Electronics	OE	3	3	0	0	3
17.	EC5792	Principles of Modern Communication Systems	OE	3	3	0	0	3
18.	EC5793	Computer Vision and Machine Learning	OE	3	3	0	0	3
19.	EC5794	Robotics	OE	3	3	0	0	3
B.E. Biomedical Engineering								
20.	BM5791	Principles of Telemedicine	OE	3	3	0	0	3
21.	BM5792	Electronics in Medicine	OE	3	3	0	0	3
DEPARTMENT OF INFORMATION SCIENCE AND TECHNOLOGY								
B.Tech. Information Technology								
22.	IT5791	Artificial Intelligence	OE	3	3	0	0	3
23.	IT5792	IOT Based Smart Systems	OE	3	3	0	0	3
24.	IT5793	Data Science and Analysis	OE	3	3	0	0	3
FACULTY OF TECHNOLOGY								
Department of Applied Science and Technology								
25.	AS5791	Unconventional Hydrocarbon	OE	3	3	0	0	3
26.	AS5792	Industrial Safety Management	OE	3	3	0	0	3
B. Tech. Leather Technology								
27.	LT5791	Orientation to Leather Manufacture	OE	3	3	0	0	3
28.	LT5792	Theory of Skin Proteins	OE	3	3	0	0	3
B. Tech. Textile Technology								
29.	TT5791	Basics of Textile Technology	OE	3	3	0	0	3
30.	TT5792	Textile Fibres	OE	3	3	0	0	3
B. Tech. Chemical Engineering								
31.	CH5791	Industrial Corrosion and Prevention	OE	3	3	0	0	3
32.	CH5792	Industrial Waste Water Treatment	OE	3	3	0	0	3
B.Tech. Industrial Biotechnology								
33.	IB5791	Overview of Biosafety	OEC	3	3	0	0	3
B.Tech. Food Technology								
34.	FT5791	Food Safety	OEC	3	3	0	0	3
B.Tech. Pharmaceutical Technology								
35.	PM5791	Forensic Science	OEC	3	3	0	0	3
FACULTY OF SCIENCE AND HUMANITIES								
B.E./B.Tech. students can take these electives.								
DEPARTMENT OF ENGLISH								
36.	HS5791	Basic Communication in English	OE	3	3	0	0	3
37.	HS5792	Introduction to Critical Thinking	OE	3	3	0	0	3
38.	HS5793	Reading Fiction	OE	3	3	0	0	3
FACULTY OF ARCHITECTURE AND PLANNING								
Department of Architecture								
39.	AR5791	Introduction to Art	OE	3	3	0	0	3
40.	AR5792	Introduction to Landscape and Landscape Design	OE	3	3	0	0	3
41.	AR5793	Traditional Water Management Systems	OE	3	3	0	0	3

OBJECTIVE:

To understand the basics of traffic engineering, planning, operation and its latest developments

UNIT I	INTRODUCTION	9
Introduction to Traffic Management - Importance and scope , Road characteristics, classification of urban and rural roads- overall view of road geometric elements		
UNIT II	TRAFFIC CHARACTERISTICS	9
Road User Characteristics - Vehicle characteristics - Pedestrian Flow - Facilities - Cycle traffic - Facilities		
UNIT III	ROAD ACCIDENTS	9
Road Accidents - Causes and Prevention - Conflict points - Case study		
UNIT IV	TRAFFIC CONTROL	9
Traffic signs and Road Marking - Channelizing Islands - Rotary Intersection - Traffic Signals - Grade separation		
UNIT V	ADVANCED TRAFFIC MANAGEMENT	9
Traffic signal coordination - Area traffic control - Command and control center - Intelligent Transportation System (ITS) - Parking - Advanced Traveller Information System - Electronic Toll Collection - Traffic Security		

TOTAL: 45 PERIODS

COURSE OUTCOME

CO1	Understand the principles and standards adopted in planning and Design of Traffic system
CO2	Understand the behavior of Traffic characteristics
CO3	Gain Information and knowledge about the causes of road accidents and prevention measures to ensure the safety of road users
CO4	Designing various types of control and regulatory measures to meet an efficient traffic network
CO5	Understand various traffic management measures in addressing the demand , pricing and ITS application

TEXTBOOKS

1. Kadiyali.L.R, "Traffic Engineering and Transport Planning" , Khanna Publishers , Delhi 2019
2. Khanna .K and Justo . C.E.G and Veeraragavan. A "Highway Engineering" , Nem Chand Bros, Roorkee, Revised 10th Edition, 2014
- 3.Srinivasa Kumar, "Introduction to Traffic Engineering", Universities Press, 2018

REFERENCES:

1. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management
2. Partha Chakroborty and Animesh das "Principles of Transportation Engineering" , PHI Learning Pvt. Ltd 2011
3. Papacosta.P.S and Prevedouros.P.D "Transportation Engineering and Planning, Third edition
4. Roger P Roess. William R. Mcshane and Elena S. Prassas, Traffic Engineering - Second Edition, Prentice Hall Publishers, Upper Saddle River, New Jersey 1998.

CO-PO MAPPING

PO/PSO		COURSE OUTCOME					OVERALL CORRELATION OF COs TO POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	3	2	3	1		2
PO2	Problem Analysis			1	3		2
PO3	Design / Development of Solutions		2		3		2
PO4	Investigation		2	3	2	1	2
PO5	Modern Tool Usage		1	2	2	3	2
PO6	Engineer and Society	2	2	2	3	2	3
PO7	Environment And Sustainability		2		2	2	2
PO8	Ethics			2	2	2	2
PO9	Individual and Team Work			3	2	2	2
PO10	Communication			1	1	1	1
PO11	Project Management and Finance			2	2	2	2
PO12	Life Long Learning			2	2	1	2

CE5792**ENVIRONMENTAL REMEDIATION TECHNOLOGIES****L T P C**
3 0 0 3**OBJECTIVE:**

- To impart knowledge on the technological profile, merits, challenges, success stories and recent advancements of the conventional and innovative technologies that are most commonly deployed for the restoration of contaminated sites.

UNIT I ENVIRONMENTAL POLLUTANTS**8**

Definition of the term environmental pollution - Broad categories of environmental pollutants including chemical, physical and biological pollutants with examples - Classes of chemical pollutants with examples - Organic Vs. Inorganic pollutants - Priority organic pollutants (POPs) Vs. Emerging pollutants - Potential pollutant sources - Occurrence and distribution of chemical pollutants in soils, sediments, air and biota

UNIT II ENVIRONMENTAL REGULATIONS AND SELECTION OF SUITABLE REMEDIAL MEASURES**6**

Existing global regulatory frameworks and policies for hazardous pollutants - Environmental and health challenges due to pollutants beyond permissible limits - Defining remediation goals using risk assessment guided by bioavailability concepts - Factors that affect the selection and suitability of remedial approaches - *In-situ* Vs. *ex-situ* remediation technologies

UNIT III EXISTING PHYSICAL AND CHEMICAL REMEDIATION TECHNOLOGIES**13**

Dig-and-dump - Pump-and-treat - Heating - Incineration - Pyrolysis - Chemical extraction - Vacuum enhanced extraction - Soil Flushing - Soil washing - Air sparging - Fracturing - Physical barriers – Enhanced volatilization - Electrokinetic remediation - Oxidation - Ozonation - Adsorption - Ion-exchange - Dehalogenation - Membrane gas separation – Merits – Demerits – Success stories

UNIT IV CONVENTIONAL BIOREMEDIATION APPROACHES FOR THE MANAGEMENT OF CONTAMINATED ENVIRONMENTS 9

Natural attenuation - Land farming - Biopiles - Bioaugmentation - Biostimulation - Composting - Bioreactors – Biofilters for air purification - Solidification/stabilization - Phytoremediation - Biosorption - Constructed wetlands – Technology suitable to specific contaminant - Advantages – Disadvantages – Case studies

UNIT V: EMERGING REMEDIATION TECHNOLOGIES 9

Microbial fuel cells - Nanoremediation - Transgenic plants and microbes - Microbial consortia in photo-hetero microbial system - Ultrasonic technology - Advanced photocatalytic oxidation – Biocatalysis - Hybridisation of different technologies to suit site specific needs - Sustainable remediation

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to:

- CO1:** Explain about the different types of environmental pollutants, their sources, and distribution in different environmental compartments
- CO2:** Explain about the impacts of environmental pollutants, existing regulations/policies factors to be considered for selecting right remediation technology for successful risk based clean-up of a problematic site
- CO3:** Select an appropriate physical and/or chemical clean-up option for environments contaminated with different types of pollutants in order to achieve the target remedial endpoints
- CO4:** Select a suitable bioremediation technology to achieve clean up goals
- CO5:** Possess a detailed knowledge of the emerging techniques that could successfully overcome the challenges faced in remediating different groups of contaminants and suit site specific needs

REFERENCES:

1. Hussain, C.M., The handbook of environmental remediation: classic and modern techniques, Royal Society of Chemistry, UK, 2020
2. Ok, Y.S., Rinklebe, J., Hou, D., Tsang, D.C. and Tack, F.M., Soil and Groundwater Remediation Technologies: a practical guide, CRC Press, US, 2020
3. Anwar, Y., Hakeen, K.R., Alharby, H.F. and Alghamdi, K.M., Environmental Contamination and Remediation, Cambridge Scholars Publishing, UK, 2018
4. De Albergaria, J.T. and Nouws, H.P., Soil remediation: Applications and new technologies. CRC Press, US, 2016
5. Bhandari, A., Surampalli, R., Champagne, P., Tyagi, R.D., Ong, S.K. and Lo, I., Remediation technologies for soils and groundwater, American Society of Civil Engineers, US, 2007

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	2	1	-	2	-	-	-	3	-	-
2	3	-	-	-	-	2	1	-	2	-	-	-	3	-	-
3	3	2	3	2	-	2	-	-	2	-	2	-	2	2	3
4	3	2	3	2	-	3	-	-	2	-	2	3	2	2	3
5	2	3	-	-	3	3	3	-	-	2	2	3	-	3	3
Avg.	3	2	3	2	3	2	1	-	2	2	2	3	3	2	3

1.low, 2-medium, 3-high, '- '- no correlation

OBJECTIVES:

- To understand the Earth's Climate System and the concept of Global Warming.
- To comprehend the impact of climate change on society and its mitigation measures.

UNIT I EARTH'S CLIMATE SYSTEM**9**

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

UNIT II OBSERVED CHANGES AND ITS CAUSES**9**

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

UNIT III IMPACTS OF CLIMATE CHANGE**9**

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

UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES**9**

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

UNIT V CLEAN TECHNOLOGY AND ENERGY**9**

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

TOTAL : 45 PERIODS**OUTCOMES:**

On completion of the course, the student is expected to be able to

CO1: Understand the basics and causes of climate change

CO2: Comprehend the latest IPCC climate scenarios

CO3: Gain in-depth knowledge on vulnerability of climate change

CO4: understand the adaptation measures to overcome the climate change impacts

CO5: Gain knowledge to mitigate climate change impacts in an ecofriendly manner

REFERENCES:

1. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.
2. IPCC Fifth Assessment Report, Cambridge University Press, Cambridge, UK, 2013
3. IPCC Fourth Assessment Report – The AR4 Synthesis Report,
4. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007
5. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press 2011

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	-	3	2	2	3	1	3	1	1	3	3	1	2
2	3	2	1	2	2	2	2	2	3	2	2	3	2	2	1
3	2	3	3	3	3	2	3	3	3	2	3	3	2	3	3
4	3	2	2	3	2	2	3	3	3	2	3	3	2	2	3
5	2	3	1	3	2	3	3	2	3	1	2	3	2	2	3
Avg.	2	2	2	3	2	2	3	2	3	2	2	3	2	2	2

1.low, 2-medium, 3-high, '-' - no correlation

GI5791

COMPUTER VISION AND SATELLITE IMAGE PROCESSING

L T P C
3 0 0 3

OBJECTIVE:

- The objective of the course is to describe about the fundamentals of computer vision and concepts of satellite data acquisition and analysis.

UNIT I FUNDAMENTALS OF COMPUTER VISION

9

Image Formation and Coordinate Transformations - Camera Matrix - Motion/Stereo Pin-hole model - Human eye / cognitive aspects of colour / 3D space; Illumination; Sampling and Quantization - Coordinate transformations and camera parameters - Satellite data acquisition Whisk and push broom scanning: data products - Data formats: Image Display systems

UNIT II IMAGE DEGRADATION AND RESTORATION

9

Sensor model; Sensor parameters – Spectral, Spatial, temporal and radiometric resolution; Image Representation-spatial, frequency and feature space domain - geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures- Atmospheric, Radiometric, Geometric Corrections- Image Geometry Restoration-Interpolation methods and resampling techniques.

UNIT III IMAGE ENHANCEMENT

9

Histograms – types, scope, Univariate and multi variate statistics; Scattergrams; operators – point, local and regional operators; Contrast manipulation - contrast, spatial feature and multi image manipulation techniques - Fourier transform - principle component analysis - Optimal Rotation Transformation – Scale-space transform, wavelet transform. Multi-image fusion

UNIT IV IMAGE CLASSIFICATION

9

Training sites - methods of collection- training accuracy – Supervised- Parallelepiped, Minimum distance to mean and Maximum Likelihood classifiers - Baye's Theorem, Unsupervised- ISODATA and Chain methods – parametric Classification - Decision tree –SVM Classifier – other Non parametric classifiers - sub pixel classification – Hyper-spectral image analysis – Accuracy assessment- test accuracy.

UNIT V IMAGE ANALYSIS

9

Pattern recognition - boundary detection and representation - textural and contextual analysis decision concepts: Fuzzy sets - evidential reasoning - Expert system – Features, ArchitectureRule based expert system; Artificial Neural Network- Architecture- Types: Adaline, Madaline, SOM and BPN networks – Case studies

TOTAL : 45 PERIODS

OUTCOME:

- On completion of this course, the student shall be able to get familiarized about various fundamentals of computer vision, image enhancement and image processing techniques.

TEXT BOOKS:

1. David Forsyth and Jean Ponce, Computer Vision: A modern Approach, Pearson Education India; 2 edition, 2015
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.
3. Robert Shcwebgerdt, Remote sensing models & methods for image processing, 3 rd edition, 2006.

REFERENCES:

1. John A.Richards, Springer – Verlag, Remate Sensing Digital Image Analysis 2013.
2. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007.
3. W.G.Rees - Physical Principles of Remote Sensing, Cambridge University Press, 2012.

GI5792**REMOTE SENSING CONCEPTS****L T P C
3 0 0 3****OBJECTIVES:**

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

UNIT I REMOTE SENSING AND ELECTROMAGNETIC SPECTRUM 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – wave theory, particle theory, Stefan – Boltzmann Law and Wien’s Law – visible and non visible spectrum – Radiation sources: active & passive; Radiation Quantities

UNIT II EMR INTERACTION WITH ATMOSPHERE 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere - Scattering (Rayleigh, Mie, non-selective scattering) absorption and refraction – Atmospheric effects on visible, infrared, thermal and microwave spectrum – Atmospheric windows.

UNIT III EMR INTERACTION WITH EARTH 9

Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectro radiometer / Spectrophotometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water body – Factors affecting spectral reflectance of vegetation, soil and water body.

UNIT IV PLATFORMS AND SENSORS 9

Ground based platforms –Airborne platforms – Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Resolution concepts – Scanners - Along and across track scanners – Orbital and sensor characteristics of different satellites – Airborne and Space borne TIR sensors – Calibration – S/N ratio – Passive/Active microwave sensing – Airborne and satellite borne RADAR –SAR –LIDAR , UAV – High Resolution Sensors – Sensors for Earth Resources, Ocean Monitoring, Environmental Monitoring, Rainfall Estimation – Hyper Spectral Sensors

UNIT V DATA PRODUCTS, VISUAL AND DIGITAL IMAGE PROCESSING 9

Photographic (film and paper) and digital products – quick look products - High Resolution data products data - ordering – interpretation – basic characteristics of image elements – interpretation keys (selective and elimination) – visual interpretation of natural resources- Digital Image Processing- Preprocessing and Image Enhancement - Image Classifiers

TOTAL: 45 PERIODS

OUTCOMES:

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

- The characteristics of electromagnetic radiation and its interaction with earth features
- The types and configuration of various satellites and sensors
- The elements of data interpretation

TEXT BOOKS:

1. Richards, Remote sensing digital Image Analysis-An Introduction Springer - Verlag 2013.
2. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2015.

REFERENCES:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, American Society of Photogrametry, Virginia, USA, 2002.
2. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 2003.

ME5791**ENERGY AUDITING AND CONSERVATION****L T P C****3 0 0 3****OBJECTIVES:**

- To understand the various methods of energy auditing and management.
- To carryout energy accounting and balancing
- To impart knowledge on the various energy conservation opportunities of utilities.

UNIT I INTRODUCTION**9**

Types & Forms of Energy - Primary / Secondary Energy Sources –EC Act 2003 - Energy Auditing: Types, classifications, deliverables, barriers – Benchmarking - Roles & Responsibility of Energy Managers and Auditors – Basic Instruments for Energy Auditing.

UNIT II ENERGY COSTING AND ECONOMICS**9**

Data & Information Analysis – Energy Accounting and Balancing - Energy ROI – Depreciation - Financial Analysis Techniques – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept – CUSUM Technique – ESCO Concept – ESCO Contracts.

UNIT III ELECTRICAL SYSTEMS**9**

TANGEDCO Billing – HT and LT supply - Transformers - Efficiency - Power Factor - Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT IV THERMAL SYSTEMS**9**

Stoichiometry, Combustion principles, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency Computation and Encon Measures - Steam Traps - Cogeneration - Waste heat recovery devices.

UNIT V ENERGY CONSERVATION IN MAJOR UTILITIES**9**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems - Cooling Towers – D.G. sets.

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at <https://beeindia.gov.in/content/energy-auditors>, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2017.
2. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006

REFERENCES:

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. I.G.C. Dryden, "The Efficient Use of Energy" Butterworths, London, 1982
4. W.C. turner, "Energy Management Hand book" Wiley, New York, 1982
5. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987
6. Ursala Eicker, "Solar Technologies for buildings", Wiley publications, 2003
7. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN-0-582-03184, 1990.

ME5792

PRINCIPLES OF SUSTAINABLE ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

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

- To educate the need for sustainability and the basic principles on sustainability
- To perform sustainable assessment using LCA approaches
- To perform sustainable assessment using LCIA approaches
- To be aware of ethical concerns in sustainable Engineering
- To study various solutions to achieve sustainability

UNIT I INTRODUCTION

9

Anthropocene, Evolution, Finger print of Anthropocene, Eco-system status, Sustainability: Definitions & challenges, 3 Pillars, Nature- Environmental problems, Sustainable challenge, Requirements for sustainability, approaches towards sustainability, Reasons for unsustainability.

UNIT II SUSTAINABILITY ASSESSMENT - I

9

Goal Definition & Scope, Inventory, Framework, Footprint Assessment, Energy and Materials flow analysis, exergy, Life cycle assessment, LCA Approaches, Streamlined LCA, Ecosystem services in sustainability assessment, case studies.

UNIT III SUSTAINABILITY ASSESSMENT - II

9

Steps in LCIA, software of sustainability Assessment, case studies.

UNIT IV MACROETHICS OF SUSTAINABLE ENGINEERING

9

Framing ethics, level of ethics, Golden rule, Ethical theories, Analysing ethical situations, challenges, case studies.

UNIT V SOLUTIONS FOR SUSTAINABILITY

9

Designing sustainable processes and products, Ecosystem ecology, Industrial symbiosis, circular economy, ecosystem in engineering, economic policies, societal development, case studies.

TOTAL : 45 PERIODS

OUTCOMES:

- Understand and apply the basic principles of sustainability
- Conduct of Life cycle assessment using different approaches
- Conduct LCIA using softwares
- Understand the ethical part of sustainable engineering
- Design sustainable processes for various applications

REFERENCES

1. Bhavik R Bakshi, Sustainable Engineering Principles and Practice, Cambridge University Press, UK, 2019. DOI:10.1017/9781108333726
2. Braden R Allenby, THE THEORY AND PRACTICE OF SUSTAINABLE ENGINEERING, Pearson Education Limited, 2012. ISBN 10: 0-273-75216-2
3. Seliger, G , "Sustainable Manufacturing: Shaping Global Value Creation", Springer, 2012.
4. G. Atkinson, S. Dietz, E. Neumayer, —Handbook of Sustainable Manufacturing. Edward Elgar .Publishing Limited, 2007

UNIT I CURRENT AND FUTURISTIC ENERGY RESOURCES 9

High Carbon Fuels - Gasoline and Diesel Fuels. **Low Carbon Fuels** – Ethanol, Methanol, Isobutanol, Dimethyl Ether(DME), Polyoxymethylene Dimethyl Ether (PODE), Compressed and Liquefied Natural Gas (CNG & LNG). **Zero Carbon Fuels** – Hydrogen and Ammonia Fuels. – Physiochemical Properties – Improvements in Fuel Quality as per BS Norms – Current and Future plans on storage and distribution infrastructures.

UNIT II ALTERNATE ENERGY RESOURCES 9

Fuel Cell stacks – Types – Working, Batteries – Types – Working – Materials, Comparison of Fuel Cell and Battery. Future scopes in Fuel Cell and Batteries.

UNIT III CURRENT AND FUTURE INTERNAL COMBUSTION ENGINES(ICE) FOR MOBILITY 9

BSVI Qualified ICE Powered Vehicles and Technologies, Conventional Hybrid Vehicle Technologies, Advanced Combustion Mode enabled ICEs and Hybrids, Hydrogen and Ammonia Fuelled ICEs, Flexi Fuel Engines. Low Carbon Fuelled ICEs. Decarbonisation and De-fossilization.

UNIT IV ALTERNATE ENERGY RESOURCES POWERED MOBILITY 9

Fuel Cell Powered Vehicle Technologies, Battery Powered Electric Vehicle Technologies, Requirements of fuelling and charging Infrastructures, Comparison of Merits and Demerits, Life cycle analysis and Carbon credit gained between Alternate and Conventional Fuel powered mobility.

UNIT V DATA ANALYSIS OF CURRENT AND FUTURE MOBILITY APPLICATIONS 9

Student should analyse and present the case study report by observing the market trends and predictions by reading reports, magazines, research articles, books, chapters, and online tools.

Evaluation of student case study report can be performed by Power Point Presentation or Correcting Hard Copy Reports.

TOTAL : 45 PERIODS**BOOKS FOR REFERENCE:**

1. Pundir B.P. I.C. Engines Combustion and Emission, 2010, Narosa Publishing House
2. Barclay F.J., Fuel Cells, Engines and Hydrogen, Wiley, 2009.
3. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK 2005.
4. HCCI Diesel Engines - Nptel - <https://nptel.ac.in/courses/112104033/34>
5. HCCI and CAI Engines – Nptel - <https://nptel.ac.in/courses/112104033/33> CO PO PS
6. Rakesh_Kumar_Maurya Characteristics and Control of Low Temperature Combustion Engines, Springer - ISSN 0941-5122 ISSN 2192-063X (electronic), Mechanical Engineering Series, ISBN 978-3-319-68507-6 ISBN 978-3-319-68508-3 (eBook), <https://doi.org/10.1007/978-3-319-68508-3>.
7. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
8. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons 1998

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To acquaint with the benefits, properties and availability of hydrogen as an energy source in many engineering applications
- To develop an understanding of using hydrogen as a fuel for spark ignition (S.I.) internal combustion engines
- To develop an understanding of using hydrogen as a fuel for compression ignition (C.I.) internal combustion engines
- To acquaint with the basic principle of operation of hydrogen fuel cells and its environment impacts
- To appreciate the application and limitations of using hydrogen fuel cells in vehicles

UNIT I	HYDROGEN AS ENERGY SOURCE	9
Hydrogen Production: Thermal Processes, Electrolytic Processes, Photolytic Processes - Hydrogen Distribution - Hydrogen Storage - Combustion Properties - Pollution - World and Indian Scenario		
UNIT II	HYDROGEN IN S.I. ENGINE SYSTEM	9
Design modification of Engine, Combustion Characteristics - Dual Fueling, Direct Injection of Gaseous and Liquefied Hydrogen.		
UNIT III	HYDROGEN IN C.I. ENGINE SYSTEM	9
Design modification of Engine, Combustion Characteristics - Dual Fueling, Direct Injection of Gaseous and Liquefied Hydrogen. Hydrogen enrichment		
UNIT IV	FUEL CELLS	9
Fuel Cells: Description, working principle, anodic, cathodic and cell reactions - fabrication of electrodes and other components- applications - advantages, disadvantages and environmental aspects - Fuels for Fuel Cells: Hydrogen - Sources and preparation, reformation processes for hydrogen - clean up and storage of the fuels - use in cells, advantages and disadvantages of using hydrogen as fuel.		
UNIT V	FUEL CELL FOR VEHICLES	9
Operating Principle - Fuel Cell Stack Assembly - Drive Train details- Safety Aspects of a Hydrogen Fuel Cell - FCVs vs BEVs vs ICE - Challenges Ahead for FCVs		

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the benefits, properties and availability of hydrogen as an energy source in many engineering applications
- Analyse the hydrogen's performance as a fuel for spark ignition (S.I.) internal combustion engines
- Analyse the hydrogen's performance as a fuel for compression ignition (C.I.) internal combustion engines
- Understand the basic principle of operation of hydrogen fuel cells and its environment impacts
- Appreciate the application and limitations of using hydrogen fuel cells in vehicles

REFERENCES:

1. Johannes Topler and Jochen Lehmann, Hydrogen and Fuel Cell Technologies and Market Perspectives, Springer, 2016
2. Pasquale Corbo, Fortunato Migliardini and Ottorino Veneri, Hydrogen Fuel Cells for Road Vehicles (Green Energy and Technology), Spinger, 2011.
3. Alternative Fuels (A decade of success and Promise) edited by Reda Moh.Bata,SAE PT-48, ISBN 1-56091 – 593 – 5.
4. Hydrogen Fuel Cells for Road Vehicles, April 2010, Springer

ME5795	CONCEPTS OF COMPETITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- 1 To explain the lean principles and the need to follow these principles in industries.
- 2 To give an overview of the various tools and techniques involved in lean manufacturing used in industries.
- 3 To learn the basics involved in Green manufacturing.
- 4 To give an understanding of the various tools used in a six sigma project for quality improvement.
- 5 To provide an overview of the DMAIC methodology in a six sigma project.

UNIT I	LEAN MANUFACTURING	9
Evolution of Mass production, Evolution of Toyota (Lean) Production System, Need for Lean production, 7 Wastes in Manufacturing, Principles of Lean production – Value, Value stream, Flow, Pull, Perfection.		
UNIT II	LEAN MANUFACTURING – TOOLS AND TECHNIQUES	9
Lean Tools to eliminate waste - 5S, Standardised work, TPM, Poka Yoke, JIT, Kanban, Value stream mapping. Lean manufacturing in service industries.		
UNIT III	GREEN MANUFACTURING	9
Green manufacturing - Definition, motivation and barriers to green manufacturing - Environmental impact of manufacturing - Waste generation- Energy consumption - Strategies for green manufacturing – Green manufacturing by design – Life cycle assessment.		
UNIT IV	SIX SIGMA – TOOLS AND TECHNIQUES	9
Cost of Quality – Conformance and Non-Conformance cost, Seven Basic Quality Control Tools, Seven Management tools, FMEA.		
UNIT V	SIX SIGMA METHODOLOGY	9
Need for Six Sigma, Six Sigma Team, DMAIC Methodology - Define, Measure, Analyse, Improve and Control; Lean Six Sigma.		

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the importance and evolution of lean principles.
- Apply the various tools, techniques and methodology of lean manufacturing to improve the efficiency of an organization.
- Explain the need for green manufacturing techniques.
- Explain the various tools and techniques needed for a six sigma project.
- Apply six sigma methodology to improve quality in a given situation.

TEXTBOOKS:

1. Issa Bass and Barbara Lawton, “Lean Six Sigma using Sigma XL and Minitab”, Tata McGraw Hill 2010.
2. Pascal Dennis, “Lean production Simplified: A plain language guide to the world’s most powerful Production system”, Productivity Press 2007

REFERENCES:

1. Dornfield David, “Green Manufacturing”, Springer, 2012
2. James Womack and Daniel T. Jones, “Lean Thinking: Banish waste and create wealth in your organization”, Free Press 2003.
3. Donna C. S. Summers, “Six sigma: Basic tools and techniques”, Pearson / Prentice Hall 2007.
4. Mike Rother and Rother Shook, “Learning to See: Value-Stream Mapping to Create Value and Eliminate” Muda, The Lean Enterprise Institute 2003
5. Yasuhiro Monden, Toyota Production System: “An Integrated approach to Just-in-Time”, CRC Press 2012

ME5796

SOLAR ENERGY TECHNOLOGIES

L T P C
3 0 0 3

UNIT I SOLAR DOMESTIC WATER HEATING

9

Solar flat plate collector - evacuated tubular collectors - concentrator collectors – Components of collectors – Collector performance – System layouts and installation solar water heating systems- Reduction of fuel bills and pollution.

UNIT II SOLAR LIGHTING

9

Solar cell and its types – Working principle of a solar cell – Solar home lighting systems – Solar street lighting systems - Solar lanterns – Applications - Rural electrification process – standalone and grid connected PV systems

UNIT III SOLAR COOKING

9

Introduction – Types of solar cookers – Advantages and disadvantages - Box type – Parabolic dish cooker - Performance evaluation of solar cookers – Testing of a solar cooker – Applications of solar cooking - Solar Steam Cooking System.

UNIT IV SOLAR DRYING AND SOLAR DESALINATION

9

Introduction – Need for solar drying - Basics of solar drying – Types of solar dryers –Applications- Performance evaluation.
Necessity for desalination - Basics of solar still – Components of solar still – Performance evaluation - Socioeconomic Benefits

UNIT V SOLAR COOLING

9

Solar Refrigeration and air conditioning – Absorption cooling – Adsorption cooling - Solar powered vapor compression system – Peltier cooling - Desiccant Cooling - Zero energy buildings.

ML5791

PLASTICS ENGINEERING

L T P C
3 0 0 3

UNIT I INTRODUCTION

9

Engineering plastics –. Basic concepts – Classification – Thermoplastics and Thermosets – Tacticity – Crystalline and Amorphous polymers – Molecular weights of polymers – Polydispersity – MWD -Glass transition temperature (T_g) – Polymerization methods and Techniques

UNIT II PROCESS ENGINEERING

9

Compounding - Mixing Devices – Extrusion – Injection moulding – Compression and Transfer moulding – Calendering – Rotational moulding – Blow moulding Vacuum and thermoforming methods – Finishing techniques - Mould designs and types – clamping force - ejection devices – mould screw standards – feeding devices

UNIT III CHARACTERIZATION AND TESTING METHODS

9

Thermal – TGA, DSC, TMA, Mechanical – Tensile, Compressive, impact, Chemical - IR, NMR, Optical – Electrical - Molecular weight – GPC, melt index, Flammability

UNIT IV COMPOSITES

9

Matrices and fiber reinforcements - Processing of polymer matrix composites – Thermoplastic matrix composites – injection moulding and thermoset matrix composites – Hand layup, filament winding, pultrusion, resin transfer moulding

UNIT V SPECIALTY POLYMERS

9

Conducting polymers – Polymers for biomedical applications- controlled drug delivery systems, bones, dentistry, Lithography, Ionic polymers, polymer membranes for water treatment – High temperature performance polymers – Batteries and Energy – Construction and Transportation

TOTAL : 45 PERIODS

REFERENCES:

1. Crawford R.J. *Plastics Engineering*, Pergamon Press, London, 1987.
2. Richard G.Griskey, *Polymer Process Engineering*, Chapman and Hall, 1995
3. R.W. Dyson, *Speciality Polymers*, Chapman and Hall, New York, 1987.
4. J.A. Brydson, *Plastic Materials*, Newness - Butterworths, 7th Edn, London, 1999.
5. F.N. Billmayer, *Text Book of Polymer Science*, 3rd edition, John Wiley and sons, New York, 2002.

ML5792

NANOMATERIALS AND APPLICATIONS

L T P C
3 0 0 3

OBJECTIVES:

- To motivate the students to understand the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications.
- To import knowledge on dimensionality effects on different properties of nanomaterials.
- To import knowledge on different processing techniques employed for fabricating nanomaterials
- To import knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Import knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I NANOMATERIALS

9

Introduction, Classification: OD, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS

9

Size and inter face/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING

9

Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV STRUCTURAL CHARACTERISTICS

9

Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture.stress analysis

UNIT V APPLICATIONS

9

Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings, applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

OUTCOMES

1. Ability to evaluate nanomaterials and understand the different types of nanomaterials
2. Ability to recognise the effects of dimensionality of materials on the properties
3. Ability to process different nanomaterials and use them in engineering applications
4. Ability to use appropriate techniques for characterising nanomaterials
5. Ability to identify and use different nanomaterials for applications in different engineering fields.

TEXT BOOKS:

1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007.
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

OBJECTIVES:

- To understand the fundamental principles of Classical Design of Experiments (DoE) and Taguchi's approach
- To develop skills to design and conduct experiments using DoE and Taguchi's approach
- To develop competency for analysing the data to determine the optimal process/product parameters

UNIT I CONCEPTS AND TERMINOLOGY**9**

Review of hypothesis testing - Steps, simple comparative experiment, Steps in experimentation. Terminology - factors, levels, variables, Design principles – replication, randomization, blocking, confounding, Analysis of variance, sum of squares, degrees of freedom.

UNIT II SINGLE FACTOR EXPERIMENTS**9**

Completely randomized design, Randomized block design, effect of coding the observations, Latin Square design, comparison of treatment means.

UNIT III FACTORIAL EXPERIMENTS**9**

Main and interaction effects, two and three factor full factorial design, 2^k designs with two and three factors, Yate's algorithm, practical applications.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS**9**

Blocking and confounding in 2^k design, nested design, two level fractional factorial design, fitting regression models, introduction to response surface methods.

UNIT V TAGUCHI TECHNIQUES**9**

Introduction, Orthogonal designs, data analysis using ANOVA and response graph, parameter design – noise factors, objective functions (S/N ratios), Applications.

TOTAL: 45 PERIODS**OUTCOMES:**

- CO1: To learn various design principles and steps involved in designing an experiment
 CO2: To formulate objective(s) and identify key factors in designing experiments for a given problem.
 CO3: To develop appropriate experimental design to conduct experiments for a given problem.
 CO4: To analyze experimental data to derive valid conclusions.
 CO5: To design robust products and processes using Taguchi's parameter design approach.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2									
CO2	2	2	2	2								
CO3	3	3	3	3	3							
CO4	1	3	3	3	2							
CO5	2	2	3	3	3							

TEXT BOOKS:

1. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.
2. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2012.

REFERENCE:

1. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

OBJECTIVES:

- Impart knowledge in reliability engineering concepts.
- Conduct life data analysis
- Assess Reliability of a system
- Describe the maintenance policies and construct inspection decision models
- Impart knowledge in Maintenance management techniques.

UNIT I RELIABILITY CONCEPT 9

Reliability definition – A priori and posteriori probabilities of failure -Reliability parameters- $f(t)$, $F(t)$ and $R(t)$ functions- Mortality graph –Useful life.

UNIT II FAILURE DATA ANALYSIS 9

Data classification – Survival graphs -Time to failure distributions – Probability plotting: Exponential, Weibull - Goodness of fit tests: Kolmogorov Smirnov test, Bartlett's test, Chi square test.

UNIT III RELIABILITY PREDICTION 9

Series parallel configurations – Parallel redundancy – m/n system – Standby system -Complex systems: RBD approach – Baye's method – Minimal path and cut sets - Fault Tree analysis.

UNIT IV MAINTENANCE STRATEGIES 9

Maintenance objectives -Maintenance policies – Imperfect maintenance –PM versus b/d maintenance – Inspection decisions: Maximizing profit & Minimizing downtime – Tero Technology.

UNIT V MAINTENANCE DECISIONS 9

Repair time distributions – Maintainability prediction – Measures of maintainability – System Availability – Maintenance staffing- Spare parts management – Maintenance planning and scheduling.

TOTAL: 45 PERIODS**OUTCOMES:**

CO1: Able to acquire knowledge in Reliability Engineering.

CO2: Able to conduct failure data analysis.

CO3: Can carry out reliability assessment of any complex system.

CO4: Able to demonstrate the application of maintainability models

CO5: Manage effectively the maintenance related functions of an organization.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							1
CO2	3	3	1	2	2							1
CO3	2	3	2	2	2							1
CO4	2	2	1	2	2							1
CO5	2	2	1	2	3							2

TEXT BOOKS:

1. Charles E. Ebeling, "An Introduction to Reliability and Maintainability Engineering", Tata McGraw Hill, New Delhi. 2017.
2. Bikas Bhadury and S.K.Basu, "Terotechnology: Reliability Engineering and Maintenance Management", Asian Books Pvt. Ltd., New Delhi, 2003.

REFERENCES:

1. Andrew K.S.Jardine & Albert H.C. Tsang, "Maintenance, Replacement and Reliability –Theory and Applications", Taylor and Francis, Florida, 2013.

MF5791**ELECTRONICS PACKAGING TECHNOLOGY****L T P C
3 0 0 3****OBJECTIVES:**

- To impart knowledge on wafer preparation, PCB fabrication, through hole technology and surface mount technology
- To introduce the types of electronic components and their packaging
- To elaborate various steps in surface mount technology
- To be conversant with various testing and inspection methods of populated PCB's
- To outline various defects, repair, rework and quality aspects of Electronics assemblies.

UNIT I INTRODUCTION TO ELECTRONICS PACKAGING**9**

History, definition, wafer preparation - crystal growth, crystal trimming and grinding, wafer slicing, edge rounding, lapping, etching, polishing, laser inspection-Printed circuit boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection. Electronics Packaging - Through hole technology(THT), Surface mount technology(SMT) and Mixed technology

UNIT II ELECTRONIC COMPONENTS AND PACKAGING**9**

Through hole components – axial, radial, multi leaded, odd form. Surface-mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, package marking and testing. miniaturization and trends.

UNIT III SURFACE MOUNT TECHNOLOGY PROCESS**9**

SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, packaging of components for automated assembly, soldering- wave soldering, reflow process, process parameters, profile generation and control, lead free soldering, adhesive, underfill and encapsulation process

UNIT IV INSPECTION AND TESTING OF POPULATED PCBS**9**

Inspection techniques, equipment and principle - X-ray Radiography, X-ray Laminography, Ultrasonic Imaging, Automated Optical Inspection, Laser Inspection, Infrared Inspection. Testing of PCB assemblies-Manual Testing, Populated Substrate shorts testing, In-Circuit Analysis, In-Circuit Testing, Functional Testing, In-Product Testing.

Defects and Corrective action - stencil printing process, component placement process, reflow soldering process,

UNIT V REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES**9**

Repair tools, methods, rework criteria and process - coating removal, conductor repair, base board repair, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, testing, reliability, and environment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- CO1: Identify wafer preparation, PCB fabrication, through hole technology and surface mount technology.
 CO2: Recognize the importance of various electronic components and their packaging
 CO3: Demonstrate various steps in surface mount technology
 CO4: Identify various testing and inspection methods of populated PCB's
 CO5: Discuss various defects, repair, rework and quality aspects of Electronics assemblies.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.3											0.9	0.3	
2	0.9	0.3											0.9	0.3	
3	0.9	0.9	0.6	0.6									0.9	0.3	
4	0.9	0.9	0.9		0.6								0.9	0.3	
5	0.9	0.9	0.9		0.6		0.9						0.9	0.3	0.9

TEXT BOOKS:

1. Prasad R., "Surface Mount Technology – Principles and practice", second Edition, Chapman and Hall, 2012, New York, ISBN 9789401165341.
2. Tummala R.R., "Fundamentals of microsystem packaging", Mc -Graw Hill, 2001, ISBN 00-71-37169-9.

REFERENCES:

- Puligandla Viswanadham and Pratap Singh, "Failure Modes and Mechanisms in Electronic Packages", Chapman and Hall, New York, 1998, N.Y. ISBN-13: 978-0412105913.
 Totta P., Puttlitz K. and Stalter K., "Area Array Interconnection Handbook", Kluwer Academic Publishers, Norwell, MA, USA, 2012. ISBN 9781461355298
 Lee N.C., "Reflow Soldering Process and Trouble Shooting SMT,BGA,CSP and Flip Chip Technologies", 2003, Elsevier Science. ISBN 978-0-08-049224-7
 Zarrow P. and Kopp D. "Surface Mount Technology Terms and Concepts", 1997, Elsevier Science and Technology,.ISBN 0750698756.
 Harper C.A., "Electronic Packaging and Interconnection Handbook" Second Edition, McGraw Hill Inc., New York, N.Y., 2004, ISBN: 9780071430487
 Martin B. and Jawitz W., "Printed Circuit board materials handbook", McGraw-Hill Professional, 1997 ISBN-13: 978-0070324886

COURSE OBJECTIVES

- To introduce the relevance of this course to the existing technology through demonstration, case studies and contribution of scientists.
- To understand the most advanced applications and working principles of robotic systems.
- To understand the robotics programs for basic and advanced robots.
- To investigate animal locomotion principles such as ground locomotion, flapping flight, swimming, and water surface locomotion and adapting those principles to bio-inspired robotic platforms.
- To introduce latest state of the art in robotics.

UNIT I INTRODUCTION 9

Robotic system overview - Mechatronics - Anatomy of mechatronics systems - Actuator Systems - Sensors Systems - Control Systems, processors, controllers, open loop systems and closed loop systems.

UNIT II INDUSTRIAL ROBOTICS 9

Industrial Robotics definition and generations - anatomy - configuration and work envelop – Path control - end-effectors, grippers and tools - selection and design - collaborative robots – human robot interaction(HRI).

UNIT III INDUSTRIAL ROBOT PROGRAMMING 9

Lead through Programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End Effectors commands and simple Programs. RGV, AGV: Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations – Economic Analysis of Robots.

UNIT IV BIO-INSPIRED ROBOTS 9

Introduction – nature and robotics – biologically inspired designs vs. traditional technology –Animals vs. robots - Bio-Inspired Materials and Structures - Bio-Inspired Sensors - Muscle: Biomechanics vs. Artificial Muscle Actuators – case study.

UNIT V PRINCIPLES OF ANIMAL LOCOMOTION 9

Basic Physics of Locomotion: quantification and evaluation of nature – measurement of maneuverability and agility - Energy requirements for locomotion - Scaling effects - Locomotion on Ground - Crawling (worms, snakes, etc.) - Jumping - Walking - Running – Climbing - Flying - Gliding and Soaring - Hovering - Flapping Flight - Moving on the Surface of Water - Walking – Jumping – Running – Swimming – Oars and Hydrofoils – Undulation – Jet Propulsion.

TOTAL:45 PERIODS**COURSE OUTCOMES**

Upon completing of the course students will be able to:

- CO1: Gain knowledge on the basics of robotics.
- CO2: Understand the various components of robotic systems.
- CO3: Develop robotics programming for basic and advanced robots.
- CO4: Analyse the various animal locomotion principles in bio–inspired robotic platforms.
- CO5: Acquire knowledge on various contemporary technologies in robotics.

TEXTBOOKS

1. Toshio Fukuda, “Bio-Inspired Robotics”, applied Science 2018. (ISBN-10 : 303897045X, ISBN-13 : 978-3038970453)
2. Groover. M.P. “Industrial Robotics, technology, programming and application” Mc-Graw Hill book and co. 2012 (ISBN 1259006212, 9781259006210)

REFERENCES

1. Bio-mechanisms of Swimming and Flying: Fluid Dynamics, Biomimetic Robots, and Sports Science, edited by Naomi Kato and Shinji Kamimura, Springer Verlag, 2007 (ISBN : 4431733795, 9784431733799).
2. Biomimetic Sensor Technology, Kiyoshi Toko, Cambridge University Press, 2000 (ISBN : 0521593425, 9780521593427).
3. Biomimetics: Biologically Inspired Technologies, edited by Yoseph Bar-Cohen, CRC Press, 2005 (ISBN : 9780849331633).
4. Biomimicry for optimization, control, and automation, Passino, Kevin M., 2004 (ISBN-10 : 1852338040, ISBN-13 : 978-1852338046)
5. Biomimicry : innovation inspired by nature, Benyus, JanineM.,2002 (ISBN-10 : 9780060533229, ISBN-13 : 978-0060533229)
6. Neuro technology for Biomimetic Robots, edited by Joseph Ayers, Joel L. Davis, and Alan Rudolph, MIT Press, 2002 (ISBN : 0585437483, 9780585437484).

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.3										0.3	0.6	0.6
2	0.6	0.6	0.6		0.3	0.3						0.6	0.6	0.6	0.6
3	0.9	0.9	0.9	0.9	0.9	0.6						0.9	0.9	0.9	0.9
4	0.9	0.6	0.9	0.6	0.6							0.6	0.9	0.3	0.9
5	0.9	0.9	0.9	0.6	0.9	0.9						0.9	0.9	0.6	0.6

PT7591

DIGITAL PHOTOGRAPHY

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

OBJECTIVES

The students should be made to:

- To learn about the history of photography and different types of digital camera
- To understand the lights and lighting techniques used in photography
- To learn about the application of photography in journalism
- To gain knowledge of Image editing software and printing photographs
- To know about the various applications of digital photography

UNIT I INTRODUCTION

9

History of Photography, Basics of Digital Photography, Basic art and Visualizations, Types of digital photography, Types of Digital Cameras and accessories, Parts of a Camera, Camera lenses, Exposures - Apertures, shutter speeds and ISO, Applications of digital photography.

UNIT II LIGHT AND LIGHTING TECHNIQUES

9

Colour Temperature, Electromagnetic spectrum, Different types of Lights and their applications – Soft light, Hard light, Available Light, Key-Low, High, Side, Fill Light, Kicker, Background light. Three point lighting; Five point lighting, Light Reflectors and Diffusers. Light meters and Light measuring Devices.

UNIT III PHOTOJOURNALISM

9

Introduction to photojournalism, Documenting, presenting news using photographs, Different types of photojournalism, Picture editing for Newspaper and magazines, Role of a photo editor, Telling stories through pictures, Ethics in Photojournalism.

UNIT IV DIGITAL RETOUCHING AND DIGITAL OUTPUT

9

Image size and Resolution, Selection of Tools and Techniques for Digital Manipulation, Image compression and file formats. Selective Effects to images and filters, Image Processing and Editing software; Color and Tonal value correction, Ethics in image editing; Evaluating an image and imaging problems. Different types of printing media for hard copy, Different types of Printers with respect to their resolution.

UNIT V APPLICATIONS OF PHOTOGRAPHY

9

Psychology of Colour in Photography; Emotions of Different Colours; Genres of Photography - Black and white photography, Wildlife photography, Landscape, Cityscape, Architecture, Advertising, Fashion, Food, Automobile, Sports, Travel, Children, Natural photography; Portfolio making, Case studies and Photography in online applications.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- Choose camera settings and lenses for required photography.
- Use appropriate lights and lighting techniques for digital Photography.
- Tell stories and news articles through photographs.
- Edit and Retouch a digital Image.
- Design a portfolio with digital photography.

TEXT BOOKS:

1. Scott Kelby, "The Digital Photography Book", 3rd edition, Peachpit Press, 2009
2. Ben long, "Complete Digital Photography", Charles River Media, Third Edition, 2005.
3. Micheal Freeman, "The Photographer's Eye: Composition and Design for Better Digital Photos", Focal Press; 2nd edition (1 June 2007)

REFERENCES:

1. Fil Hunter, Steven Biver, "Paul Fuqua, Light-Science & Magic: An Introduction to Photographic Lighting", Focal Press, 2007
2. Balakrishna Aiyer, "Digital Photojournalism", Authors press, 2005

PT5792

CONSUMER AND INDUSTRIAL PACKAGING

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

OBJECTIVES

- To learn about the automotive industry and the role of packaging in automotive industry.
- To understand the material handling and packaging design concepts
- To explain and perform transport worthiness tests for a given package
- To follow several package waste management systems in industry
- To understand the importance of hazardous material packaging

UNIT I INTRODUCTION

9

Automotive industry and various departments, automotive parts- electrical, mechanical, warehousing, sourcing, management practices-supply chain, Just in Time (JIT), scope of requirements. Packaging Materials-Plastics-films, containers, pallets, straps, cushions; Paperboard-cartons, corrugated boards, honeycomb, laminates; Wood-crates, boxes, pallets, Metal- crates, boxes.

UNIT II MATERIAL HANDLING AND PACKAGING

9

Introduction - Significance and dimension of Material Handling. Material Handling Systems- Planning, unitization, ergonomics, standardization, safety principle and space utilization Material Handling Equipment – storage equipment's, engineered system, Industrial Trucks, Packaging Perspective, Loading & Unloading Techniques of Materials/ULDs on Vehicles, Ships etc.

UNIT III DISTRIBUTION CHANNELS & TRANSPORT MANAGEMENT 9
Introduction to Distribution Channels – Types & levels of Channels – Marketing Systems -Choice of Distribution Channels. Principles of Transportation Functions – Transportation Management – Legal Types & Modes. Introduction to INCO Terms.

UNIT IV CORROSION PROTECTION AND PACKAGE WASTE MANAGEMENT 9
Wax, Shellac, Varnish, Plastics, Paints, Corrosion resisting packaging materials-VCI film, VCI tablets, VCI Kraft paper; Package recycling methods, 3R's 4R's and 7R's. Bio based packaging materials- dry grass, banana bark, natural fiber composites.

UNIT V RETURNABLE AND EXPANDABLE PACKAGING 9
Container classifications- bulk, intermediate (IBC), non-bulk; package labels; shipping papers; UN Package markings and design types; Drum Reconditioning-marking; Drum Re- manufacturing; Composite IBC marks; Closure notifications; Nominal steel Drum marks-size, tolerance; ISTA.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of course the student will be able to:

1. Summarize the intricacies and allied fields of automotive industry
2. Create specialized bulk packages for automotive industry.
3. Apply knowledge on Handling and storage of automotive and industrial products
4. Manage packaging waste effectively in the industry
5. Select and design package for bulk packaging

REFERENCES:

1. Gayle Woodside, "Hazardous Materials and Hazardous Waste Management" John Wiley & Sons, 1995
2. Hans - Hermann Braess, Ulrich Seiffert "Handbook of Automotive Engineering", Society of Automotive Engineers, 2005
3. Joseph F. Hanlon, Robert J. Kelsey, and Hallie Forcinio, "Hand book of Package Engineering", Third Edition, CRC press, 1998
4. Nicholas P. Cheremisinoff, "Transportation of Hazardous Materials: A Guide to Compliance" Taylor & Francis, 1994
5. Walter F. Friedman, and Jerome J. Kipnas, "Industrial Packaging" , Willey.
Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of Packaging professionals, Naperville, Illinois, USA, 2002.

OBJECTIVES

- To understand the basic concepts and principles of cyber forensics
- To understand the importance of information in cyber forensics
- To correctly define and cite appropriate instances for the application of computer forensics
- To understand the tools and techniques to collect and analyze computer forensic evidence
- To understand the process of recovering electronic evidence in cyber forensics

UNIT I DIGITAL INVESTIGATION 9

Digital Evidence and Computer Crime - History and Terminology of Computer Crime Investigation - Technology and Law - The Investigative Process -Investigative Reconstruction - Modus Operandi, Motive and Technology -Digital Evidence in the Courtroom.

UNIT II UNDERSTANDING INFORMATION 9

Methods of storing data: number systems, character codes, record structures, file formats and file signatures - Word processing and graphic file formats - Structure and Analysis of Optical Media Disk Formats - Recognition of file formats and internal buffers - Extraction of forensic artifacts– understanding the dimensions of other latest storage devices – SSD Devices.

UNIT III COMPUTER BASICS FOR DIGITAL INVESTIGATORS 9

Computer Forensic Fundamentals - Applying Forensic Science to computers - Computer Forensic Services - Benefits of Professional Forensic Methodology -Steps taken by computer forensic specialists.

UNIT IV FORENSIC TOOLS AND PROCESSING OF ELECTRONIC EVIDENCE - I 9

Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information,

UNIT V FORENSIC TOOLS AND PROCESSING OF ELECTRONIC EVIDENCE – II 9

Process of computer forensics and digital investigations, processing of digital evidence, digital images, damaged SIM and data recovery, multimedia evidence, retrieving deleted data: desktops, laptops and mobiles, retrieving data from slack space, renamed file, ghosting, compressed files.

TOTAL: 45 PERIODS**OUTCOMES**

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

- Illustrate the fundamentals of cyber forensics
- Analyze the importance of digital information for investigation
- Recognize the applications of computer forensics
- Apply tools and techniques to analyze computer forensic evidence
- The process of recovering electronic evidence

REFERENCES:

1. Bill Nelson, Amelia Phillips and Christopher Steuart; “Guide to Computer Forensics and Investigations” – 5th Edition, Cengage, 2016 BBS.
2. John R Vecca “Computer Forensics: Computer Crime Scene Investigation”, 3rd Revised Edition, Jones & Bartlett Learning, LLC, 2010
3. Marjie T. Britz “Computer Forensic & Cyber Crime : An Introduction”, 3rd Edition, 2013.

4. Joakim Kävrestad, "Fundamentals of Digital Forensics : Theory, Methods, and Real-Life Applications", 2nd Edition, Springer, Cham, 2020.
5. C. Altheide & H. Carvey, "Digital Forensics with Open Source Tools, Syngress", 2011. ISBN: 9781597495868.

CS5792

AGILE METHODOLOGIES

L T P C

3 0 0 3

OBJECTIVES:

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

UNIT I INTRODUCTION AND PRINCIPLES

9

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values .

UNIT II AGILE SOFTWARE PROCESS MODELS

9

Extreme Programming – Twelve Practices of XP- User Stories – Pair Programming – Test Driven Development – Scrum – Scrum Methodology – Sprints – Scrum Teams - Scrum Meetings - Lean Software Development - Lean Approach - Waste Management, Kaizen – Kanban – Kanban in Manufacturing- Principles of Kanban, Workflow of Kanban- Kanban boards, Kanban cards.

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT

9

Agile Information Systems – Agile Decision Making - Earl's Schools of Knowledge Management – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – Knowledge Management in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT IV REQUIREMENTS AND TESTING AGILE REQUIREMENTS

9

User Stories - Backlog Management - Agile Architecture: Feature Driven Development - Agile Risk Management: Risk and Quality Assurance - Agile Tools - Agile Testing: Agile Testing Techniques - Test-Driven Development - User Acceptance Test - Agile Review: Agile Metrics and Measurements - The Agile approach to estimating and project variables.

UNIT V MEASUREMENT

9

Agile Measurement - Agile Control-control parameters - Agile approach to Risk - The Agile approach to Configuration Management - The Atern Principles - Atern Philosophy - Rationale for using Atern - Refactoring - Continuous integration - Automated Build Tools - Scaling Agile for large projects: Scrum of Scrums - Team collaborations - Scrum - Estimate a Scrum Project - Track Scrum Projects - Communication in Scrum Projects - Best Practices to Manage Scrum.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Realize the importance of interacting with business stakeholders in determining the requirements for a software system"
- Perform iterative software development processes: how to plan them, how to execute them.
- Point out the impact of social aspects on software development success.
- Develop techniques and tools for improving team collaboration and software quality.
- Perform Software process improvement as an ongoing task for development teams. Show how agile approaches can be scaled up to the enterprise level.

TEXT BOOKS:

- 1) Viktoria Stray Rashina Hoda , Maria Paasivaara, Philippe Kruchten ,” Agile Processes in Software Engineering and Extreme Programming”, Springer, 2020
- 2) Mark Linesy and Scott W Ambler,” Introduction to Disciplined Agile Delivery”, 2nd Edition: A Small Agile Team's Journey from Scrum to Disciplined DevOps, 2018

REFERENCES:

- 1) James Shore, Shane Warden, "The Art of Agile Development", Second Edition O'Reilly Media, Inc. October 2021
- 2) Mike Cohn" Succeeding with Agile: Software Development using Scrum" 2015, Pearson
- 3) Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009.
- 4) Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.
- 5) Robert C Martin, Micah Martin, "Agile Principles, Patterns and Practices in C#", Pearson Education, 2007.
- 6) Craig Larman, "Agile and Iterative Development: A Manager's Guide", Addison-Wesley, 2004.

EC5791

CONSUMER ELECTRONICS

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

COURSE OBJECTIVES:

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field Effect Transistors, Power control devices etc.,
- To know about the working principle of LED, LCD and other Opto-electronic devices.
- To introduce the concept of Sensors and voice controls.
- To provide the knowledge on Smart home devices.
- To gain knowledge on current communication technology.

UNIT I CONSUMER ELECTRONICS FUNDAMENTALS

9

History of Electronic Devices- Vacuum Tubes, Transistors, Integrated Circuits- Moore Law, Semiconductor Devices, Diodes, Rectifiers, Transistors, Logic Gates, Combinational Circuits, ADC, DAC and Microprocessors, Microprocessor Vs Microcontrollers, Microcontrollers in consumer electronics, Energy management, Intelligent Building Perspective.

UNIT II ENTERTAINMENT ELECTRONICS 9

Audio systems: Construction and working principle of: Microphone, Loud speaker, AM and FM receiver, stereo, Home theatre. Display systems: CRT, LCD, LED and Graphics displays Video Players: DVD and Blue RAY. Recording Systems: Digital Cameras and Camcorders.

UNIT III SMART HOME - SENSORS 9

Technology involved in Smart home, Home Virtual Assistants- Alexa and Google Home. Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT IV HOME APPLIANCES 9

Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks.

UNIT V INTRODUCTION TO SMART OS AND COMMUNICATION 9

Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems. Cordless Telephones, Fax Machines, PDAs- Tablets, Smart Phones and Smart Watches.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

Upon successful completion of this course students will be able to

- Explain the V-I characteristic of diode, UJT and SCR. Describe the equivalence circuits of transistors.
- Operate the basic electronic devices such as PN junction diode, Bipolar and Field Effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.
- Gain knowledge on sensors and controls.
- Emphasize the need for communication systems.
- Explore the current technology and apply on home applications.

TEXT BOOKS:

1. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2018.
2. Philp Hoff "Consumer Electronics for Engineers" - Cambridge University Press.1998.

REFERENCES:

1. Jordan Frith, " Smartphones as Locative Media ", Wiley. 2014.
2. Dennis C Brewer, " Home Automation", Que Publishing 2013.
3. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2012.
4. Nick vandome, Smart homes in easy steps, - Master smart technology for your home 2018.

PO-CO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3		1	2						1	
CO2	1		2		3							3
CO3	2				2		1					1
CO4	2				3		2					2
CO5	2	2	2	2	2							2

COURSE OBJECTIVES:

- To introduce the relevance of this course to the existing technology with a futuristic vision along with socio-economic impact and issues
- To understand the design of a cellular system
- To study the characteristic of wireless channel
- To enable the student to understand the necessity for satellite based communication, the essential elements involved and the transmission methodologies.
- To enable the student to understand the role of radar systems as navigational and landing aid.

UNIT I FUNDAMENTALS OF COMMUNICATION 9

The evolution of electronic communication: From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

UNIT II CELLULAR COMMUNICATION 9

Mobile Cellular Communications: Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone – setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

UNIT III WIRELESS COMMUNICATION 9

Wireless Communication: Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMAX) - Future mobile and wireless networks: Introduction to 5G- device to device communication- IoT.

UNIT IV SATILLITE COMMUNICATION 9

Satellite: History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation - Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneers of Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

UNIT V INTRODUCTION TO RADAR AND NAVIGATION 9

RADAR & NAVIGATION: Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system- Modern Navigation systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
- CO2: The student would be capable of designing a cellular system based on resource availability and traffic demands.
- CO3: The student would be capable of characterizing a wireless channel and evolve the system design specifications.
- CO4: The student would be able to demonstrate an understanding of the basic principles of satellite orbits and the communication system components.
- CO5: The student would be able to demonstrate an understanding of the basic principles of radar design and identify suitable navigation systems.

TEXT BOOKS:

1. S.Haykin, A Communication Systems, 4Ce, John Wiley 2007
2. Rappaport Theodore S- Wireless Communications: Principles and Practice, 2CE, Pearson Education India, 2010

REFERENCES:

1. B.P.Lathi, A Modern Digital and Analog Communication Systems, 3Ce, Oxford University Press, 2007
2. Vijay. K.Garg, A Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.
3. Myron Kyton and W.R.Fried A Avionics Navigation Systems, John Wiley & Sons 1997.

PO-CO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2							
CO2	2	2	2	2	2			2				2
CO3	2	2	2									
CO4	2	3	2							2		
CO5	2	2	2		2							2

EC5793**COMPUTER VISION AND MACHINE LEARNING****L T P C****3 0 0 3****COURSE OBJECTIVES:**

- To provide the basic knowledge on computer vision.
- To understand simple image processing techniques, and algorithms.
- To give an exposure to selected machine learning models.
- To interrelate machine learning concepts and their application in computer vision problems.
- To impart knowledge on different learning algorithms.

UNIT I INTRODUCTION TO COMPUTER VISION**9**

Point operators - Linear filtering - neighbourhood operators - Feature detection and matching

UNIT II SEGMENTATION**9**

Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods

UNIT III MOTION ESTIMATION**9**

Translational alignment - Parametric motion - Optical flow - Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding

UNIT IV MACHINE LEARNING MODELS**9**

Types - Supervised and Unsupervised - Parametric and non-parametric models - discrete and continuous distributions - Generative models for discrete data - Gaussian models

UNIT V LEARNING ALGORITHMS**9**

Decision Trees - Multilayer Perceptrons - Kernel Machines - hidden Markov models - Deep learning - Applications of deep networks

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Comprehend and appreciate the 'significance and role' of this course in the present contemporary world.
- Explore the main challenges behind selected contemporary image processing and computer vision problems.
- Demonstrate the principles and applications of contemporary machine learning techniques.
- Implement machine learning algorithms on image and video-related problems.
- Ability to design and develop systems using learning models and algorithms.

TEXT BOOKS:

- 1) Richard Szeliski , 'Computer Vision: Algorithms and Applications' Springer, 2011.
- 2) Kevin P. Murphy 'Machine Learning - A Probabilistic Perspective', The MIT Press Cambridge, Massachusetts, London, England, 2012.

REFERENCES:

- 1) EthemAlpaydin , 'Introduction to Machine Learning' The MIT Press Cambridge, Massachusetts London, England, II Edition , 2010
- 2) Simon J.D. Prince, 'Computer Vision: Models, Learning, and Inference' Cambridge University Press 2012.
- 3) Forsyth and Ponce, '**Computer Vision: A Modern Approach**' Pearson India, 2015.
- 4) **Amin Ahmadi Tazehkandi, 'Hands-On Algorithms For Computer Vision : Learn How To Use The Best And Most Practical Computer Vision Algorithms'** Packt Publishing Limited, 2018.

PO-CO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12
CO1						2						
CO2		2		2	1	2						
CO3	2	2	2									
CO4	1	1	1	1								
CO5			2	2								2

EC5794

ROBOTICS

L T P C
3 0 0 3

OBJECTIVES:

- To introduce basic robotic terminologies
- To illustrate kinematics and path planning
- To illustrate various parts of robots
- To impart knowledge on machine vision systems
- To apply robot based concepts for automation

UNIT I INTRODUCTION TO ROBOTS

9

Introduction – Robotics -Definition and origin of robotics –components and structure of robots-different types of robot – various generations of robots – degrees of freedom – Robot classifications and specifications – Spatial descriptions and transformations

UNIT II KINEMATICS OF ROBOTS 9

Link Description - Link-Connection Description - Convention for Affixing Frames To Links - Manipulator Kinematics- Actuator Space-Joint Space And Cartesian Space, Solvability, Algebraic Vs. Geometric, Jacobians, Singularities, Static Forces In Manipulators- Case Studies: Kinematics Of Two Industrial Robots, Inverse Manipulator Kinematics.

UNIT III SENSORS AND ACTUATION SYSTEMS OF ROBOTS 9

Position sensors – optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors – Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors. Robot Control through Vision sensors, Robot vision locating position, Robot guidance with vision system, End effector camera Sensor. Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

UNIT IV ARTIFICIAL INTELLIGENCE IN ROBOTICS 9

AI introduction, Intelligent Agent - Types of Agents, Agent environment, Problem solving- search algorithms, Examples of AI - Healthcare, Education, Agriculture, Defense.

UNIT V APPLICATIONS OF ROBOTICS 9

Telepresence robot, Autonomous mobile robots, Walker Robots, Solar-ball Robot, Underwater bots, Aerobots, Advanced robotics in Space - Specific features of space robotics systems - Next generation robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
- CO2: Ability to design and develop robotic based systems.
- CO3: Integrate mechanical and electrical hardware for a real prototype of robotic device.
- CO4: Ability to develop system for industrial automation and medical applications.
- CO5: Ability to provide automatic solution for replacing humans in life threatening area.

TEXT BOOKS:

1. Introduction to Robotics: Mechanics and control : J. Craig , Pearson,2008
2. Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence", McGraw Hill, International Editions, 1987.

REFERENCES:

1. Robotics Engineering : R. Klafter, PHI learning, 2009
2. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
3. Robot : Dynamics and Control, Spong&Vidyasagar, McGraw Hill 2008.
4. Matthew T. Mason , Mechanics of Robotic Manipulation (Intelligent Robotics and Autonomous Agents) , MIT press 2022.
5. Frank Chongwoo Park and Kevin Lynch Modern Robotics: Mechanics, Planning, and Control Cambridge university press, 2017

PO-CO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12
CO1	3				3							
CO2	2											
CO3	2	1										
CO4	1	2	2		2							
CO5	1				1							

OBJECTIVES:

- To have a clear understanding of the concepts of Telemedicine, including basic terminologies, services, impact and challenges of telemedicine.
- To understand the generic architecture of telemedicine systems and Constituents of each sub-system of telemedicine.
- To know the computer and networking technologies for telemedicine.
- To understand health records and data management for health care services.
- To implement and understand clinical cum technical aspects of telemedicine.

UNIT I INTRODUCTION TO TELEMEDICINE 9

Definitions of telemedicine – History of telemedicine – Organs and Forms of telemedicine – Evolution and benefits of telemedicine – Impact of telemedicine on healthcare delivery – Issues in telemedicine – Type of digital information (audio, video, still images, text and data).

UNIT II ARCHITECTURE OF TELEMEDICINE SYSTEMS 9

Telemedicine as a system – Critical sub-systems of telemedicine – Regulatory sub-systems – Optional sub-system of telemedicine – Telecommunications Approach – Elements of telecommunications systems – PTOS, Wireless System. Modalities of telecommunications systems (e-health) – Wireless Communication and Satellite Communications – VSAT based dedicated videoconferencing system – Mobile applications of telemedicine (m-health).

UNIT III COMPUTER AND NETWORKING TECHNOLOGIES FOR TELEMEDICINE 9

Internet based telemedicine practices – WWW approach - Applied web browser for healthcare practice – PC based Audio and Video conferencing – Types of network topologies – LAN, WAN and Body Sensor – Personal Area Network (Adhoc network) – 3 tier architecture model.

UNIT IV DATA AND INFORMATION STANDARDS IN TELEMEDICINE 9

Role of standards in Healthcare – Health Level Seven (HL7) – Digital Imaging and Communication in Medicine (DICOM), Logical Observation Identifiers Names and Codes (LOINC), Systematized Nomenclature of Medicine – Clinical Terms (SNOMED) Adoption of Information Systems Standards in Healthcare – Ethical and legal aspects of telemedicine, confidentiality of data, and the law, patient rights and consent-Security /access to medical Records, reimbursements. Values to the Patient, Clinician, and Health Care Organization training, cost, administration, Challenges to Successful Implementation – Healthcare Management Information Systems.

UNIT V CLINICAL AND TECHNICAL ASPECTS OF TELEMEDICINE 9

Applications of telemedicine – Perspective of clinicians – Telemedicine and diagnostic imaging (tele radiology) – Telemedicine and monitoring of physiological parameters (telehealth) – Telemedicine and surgery (tele surgery). m-health - Diffusion of IT innovations in Healthcare – Healthcare Status, Delivery Systems & Issues in Developing Countries like India – Future of Healthcare – Challenges and Future Trends including Opportunities for rural and emergency/disaster healthcare projects.

TOTAL:45 PERIODS**TEXT BOOKS:**

1. Olga Ferrer Roca, M.Sosaludicissa (editors), “Hand book of Telemedicine”, IOS press, 2002.
2. Norris.A.C, “Essentials of Telemedicine and Telecare”, John Sons & Ltd, 2002.

REFERENCES:

1. Wootton R, Craig J, Patterson V, “Introduction to Telemedicine”, Royal Society of Medicine Press Ltd, London, 2nd edition, 2006, ISBN 1-85315-425-3.
2. Maheu, M.M.Whitten, P.Allen, “E-Health, Telehealth, and Telemedicine” Jossy-Bass, New York, 2001 ISBN: 0-7879-4420-3.
3. Latifi, R. “Current Principles and Practices of Telemedicine and e-Health” IOHS Press, Washington DC, 2008 ISBN: 978-1-85603-806-09.

4. Bashshur, R.L., Shannon G.W. "History of Telemedicine", New Rochelle NY: Mary Ann Liebert Publishers, 2009 ISBN: 978-1-934854-11-2.
5. Shashi Gogia, Fundamentals of Telemedicine and Telehealth, Academic Press, 2019.
6. R.S. Khandpur, Telemedicine: Technology and Applications: (m-Health, Telehealth and e-Health), PHI Learning, 2017

COURSE OUTCOMES:

CO1: Understand the important concepts of Telemedicine concepts and their evolution.

CO2: Perform the design of architecture of telemedicine system and their sub-system.

CO3: Evaluate the application of computer and networking technologies for telemedicine.

CO4: Assimilate the information of health record standards and data management for healthcare services.

CO5: Analyse & monitoring with respect to clinical and technical aspects of telemedicine in current senerio.

PO-CO matrix:

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3	2		2					
CO2	2		3	2		2			2	3		
CO3	2	2	3	2					2			
CO4	2				2	2	2	1				
CO5						1				3		

BM5792

ELECTRONICS IN MEDICINE

L T P C
3 0 0 3

OBJECTIVES:

- To understand the various techniques and devices that are used in the field of cardiology
- To learn and understand the various methods and devices used for diagnosing the abnormalities of brain
- To gain knowledge on the various instruments used to treat the kidney disorders
- To understand the function of various devices used in circulatory system.
- To understand the principle, techniques and devices used to correct eye and ear problems.

UNIT I ELECTRONICS IN CARDIOLOGY

9

Physiology of Heart and its abnormalities, Cardiac Monitoring and Recording Devices- ECG, Pacemaker, Defibrillators, Counter pulsation technique, Intra aortic balloon pumping and prosthetic heart valves and Imaging for cardiovascular system.

UNIT II ELECTRONICS IN NEUROLOGY

9

Neurons and its abnormalities, EEG, Evoked response – Auditory and Visual sensory, Polysomnography, nerve stimulator and Imaging for brain disorders.

UNIT III ELECTRONICS IN NEPHROLOGY

9

Nephrons and its abnormalities, Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Artificial kidney, Lithotripsy.

UNIT IV ELECTRONICS IN CIRCULATORY SYSTEM 9

Interrelationships among Pressure, Flow, and Resistance, Blood and blood components, blood cell counters, Methods for blood flow meter, EM and ultrasonic blood flow meters, Blood Pressure, Plethysmography technique, Heart Lung machine, Respiration rate, Respiratory volume measurement, spirometer, Ventilators.

UNIT V ELECTRONICS IN VISUAL AND AUDITORY SYSTEM 9

Anatomy of eye and its abnormalities, Laser in ophthalmology, Ear and its abnormalities Types of Deafness, Audiometer, Hearing Aids and cochlear implants.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1:** Apply different medical devices in the measurement of parameters related to cardiology
- CO2:** Describe the various brain abnormalities and different techniques that are used to identify it.
- CO3:** Ability to comprehend the various aspects of haemodialysis and lithotripsy
- CO4:** Measure various nonelectrical physiological parameters
- CO5:** Elucidate the effectiveness of modern medical devices and technology that are used to tackle the various visual and auditory disorders.

TEXT BOOKS:

1. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 4th edition 2010.
2. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 3rd edition 2014.

REFERENCES:

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education India, 2nd Edition, 2015.
2. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology, Pearson Education 4th edition New Delhi 2001.
3. Joseph D. Bronzino, Donald R. Peterson - The Biomedical Engineering Handbook, CRC Press, 2019.
4. Myer Kutz - Biomedical Engineering Fundamentals, McGraw Hill, Third Edition, 2021.
5. Guyton, Arthur C & John E. Hall, Text book of Medical Physiology – WB Jaunders company Philadelphia – 11th edition 2006.

PO-CO MATRIX:

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2			2	2	1			3		
CO2					1	2	2			2		
CO3					3	3	2			2		
CO4	2	2			1	2	3			2		
CO5	2	2			3	2	1			2		

OBJECTIVES:

- To know the underlying structure behind intelligence mathematically.
- To know the logical implications in computational intelligence.
- To know the automated learning techniques.
- To study the techniques of knowledge representation.
- To explore the adaption of artificial intelligence techniques in real-time scenarios.

UNIT I INTELLIGENT AGENTS AND SEARCH TECHNIQUES**12**

Agents and Environments – Good Behavior: The Concepts of Rationality – The Nature of Environments – The Structure of Agents – Problem Solving by Search – Uninformed Search – Searching with Costs – Informed State Space Search – Heuristic Search: Greedy – A* Search – Problem Reduction Search – Game Search – Constraint Satisfaction Problems.

SUGGESTED ACTIVITIES:

- Flipped classroom on structure of agents.
- Uninformed search - Searching with costs.
- Solve puzzles with uninformed and informed searches.
- Practical - Implementation of search through Python/other languages.

SUGGESTED EVALUATION METHODS:

- Tutorials on various topics of the unit.
- Assignments on puzzles with uninformed and informed searches.
- Quizzes on agents, environments and search
- Evaluation of the programming exercises.

UNIT II REASONING WITH LOWER ORDER LOGICS**9**

Logical Agent – Proposition Logic – Syntax and Semantics – Theorem Proving – Model Checking – Inference in First Order Logic: Forward Chaining – Backward Chaining – Resolution.

SUGGESTED ACTIVITIES:

- Reasoning methods through puzzles and real life scenarios.
- Practical - Inference through Prolog/Python.
- Practical - Programming through Prolog/ Python for various topics such as reasoning through resolution.

SUGGESTED EVALUATION METHODS:

- Tutorials on reasoning methods.
- Assignment problems on different topics of the unit.
- Quizzes on inference techniques in logic.
- Evaluation of the programming exercises.

UNIT III KNOWLEDGE REPRESENTATION**6**

Knowledge Representation Issues – Approaches for Knowledge Representation: Simple Relational Knowledge – Inherited Knowledge – Semantic Nets – Frames – Semantic Web – Ontology.

SUGGESTED ACTIVITIES:

1. Examples of knowledge representation through different methods and reasoning.
2. Practical - Ontology creation using a tool like Protégé.

SUGGESTED EVALUATION METHODS:

- Tutorials on different topics of the unit.
- Assignments on knowledge representation through different methods and reasoning.
- Quizzes on different methods of knowledge representation.
- Evaluation of the programming exercise.

UNIT IV AI PLANNING AND NATURAL LANGUAGE PROCESSING**9**

Classical Planning – Types – Partial Order Planning – Graph Plan and SAT Plan – Natural Language Processing Basics: Syntax – Semantics – Introduction to Statistical NLP.

SUGGESTED ACTIVITIES:

- Flipped classroom on planning types and the background of plan.
- Out of class activity – Classical Planning, Boolean satisfiability.
- In class – Graph plan.
- Practical - Programming through PDDL/Python to develop a plan for block world, cargo world etc.

SUGGESTED EVALUATION METHODS:

- Tutorials on planning types and the background of plan.
- Assignments on graph plan.
- Quizzes on planning and natural language processing basics.
- Evaluation of the programming exercise.

UNIT V LEARNING AND APPLICATIONS**9**

Logical Formulation of Learning – Knowledge in Learning – Explanation-based Learning – Learning using Relevance Information – Application with NLP: Developing a Simple Chatbot – Types of Chatbot.

SUGGESTED ACTIVITIES:

- Flipped classroom on knowledge in learning.
- Assignments on problem solving in learning techniques.
- Practical - Programming exercises using Python/other programming languages such as: Programming for HMM.
- Explore the available Chatbot models such as Watson and adapt to a specific domain such as Education or Customer relations.

SUGGESTED EVALUATION METHODS:

- Tutorials on knowledge in learning.
- Evaluation of the programming exercise.
- Quizzes on knowledge in learning.

TOTAL:45 PERIODS

OUTCOMES:

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

CO1: Understand the search techniques.

CO2: Apply the search techniques to real-time problems.

CO3: Apply the reasoning techniques to real world problems.

CO4: Understand the representation of knowledge.

CO5: Understand the learning techniques.

CO6: Apply AI techniques in developing real world applications.

TEXT BOOKS:

1. Stuart J. Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Third Edition, Pearson Publishers, 2015.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Third Edition, Tata McGraw-Hill Education, 2008.

REFERENCES:

1. Dheepak Khemani, "A first course in Artificial Intelligence", McGraw Hill Education Pvt Ltd., NewDelhi, 2013.
2. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly, 2009, <https://www.nltk.org/book/>.
3. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmaan Publishers Inc; Second Edition, 2003.
4. NPTEL, "Artificial Intelligence", <http://nptel.ac.in/courses/106105079/2>.
5. Udacity, "Introduction to Artificial Intelligence", <https://in.udacity.com/course/intro-to-artificial-intelligence--cs271>.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓							
CO2	✓	✓	✓		✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓			✓	✓							
CO5	✓	✓			✓							
CO6	✓	✓	✓	✓	✓				✓			✓

IT5792

IOT BASED SMART SYSTEMS

L T P C

3 0 0 3

OBJECTIVES:

- To understand smart objects and IoT Architectures.
- To learn about various IoT related protocols.
- To build simple IoT systems using open hardware such as Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To build IoT based smart systems.

UNIT I FUNDAMENTALS OF IoT

9

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Open Hardware Platforms for IoT.

Suggested Activities:

- Survey of different real world IoT applications.
- Assignments on operational principles of sensors and actuators.
- Mini project on building a smart system - Identify the sensors required for the system, connect sensors (such as temperature, pressure, light) to a suitable IoT hardware platform and take measurements.

Suggested Evaluation Methods:

- Evaluation of survey for breadth and depth - pair-wise comparison.
- Quiz on sensors and actuators.
- Demonstration of practical setup on connecting sensors.

UNIT II IoT PROTOCOLS - I

9

IoT Access Technologies: Physical and MAC Layers, Topology and Security of IEEE 802.15.4, 1901.2a, 802.11ah and LoRaWAN – Network Layer: Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo.

Suggested Activities:

- Assignment on access technologies (simulator could be used).
- Flipped classroom on 6LoWPAN.
- Mini project on building a smart system - Choose appropriate access technology and connect the hardware to the Internet.

Suggested Evaluation Methods:

- Quiz on access technologies.
- Quiz on 6LoWPAN.
- Demonstration of practical setup on connecting to the Internet.

UNIT III IoT PROTOCOLS - II

9

Routing over Low Power and Lossy Networks (RPL) – Application Transport Methods: Application Layer Not Present, Supervisory Control and Data Acquisition (SCADA) – Application Layer Protocols: CoAP and MQTT – Service discovery – mDNS.

Suggested Activities:

- Assignment on RPL (simulator could be used).
- Mini project on building a smart system - Choose appropriate application protocol and connect to the cloud using available open platforms (such as IBM Bluemix).

Suggested Evaluation Methods:

- Quiz on RPL for different topologies.
- Demonstration of practical setup on connecting to the cloud.

UNIT IV CLOUD, FOG AND DATA ANALYTICS FRAMEWORKS

9

Cloud and Fog Topologies – Cloud Services Model – Fog Computing – Structured versus Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Security in IoT – CISCO IoT System – IBM Watson IoT Platform.

Suggested Activities:

- Use a simulator such as FogSim to study the characteristics of fog computing.
- Mini project on building a smart system - Choose appropriate analytics mechanisms to analyze the data collected, and build the application.

Suggested Evaluation Methods:

- Quiz on fog characteristics.
- Demonstration of application with analytics.

UNIT V APPLICATIONS**9**

Smart and Connected Cities: Street Layer, City Layer, Data Center Layer and Services Layer, Street Lighting, Smart Parking Architecture and Smart Traffic Control – Smart Transportation – Connected Cars.

Suggested Activities:

- Design the architecture and use cases for various smart systems (eg., agriculture, home automation, smart campus, smart hostel).
- Mini project on building a smart system - Enhance the system with additional smart features.

Suggested Evaluation Methods:

- Report and presentation of architecture solutions.
- Demonstration of complete smart system.

TOTAL: 45 PERIODS**OUTCOMES:**

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

1. Explain the concept and architecture of IoT.
2. Choose the right sensors and actuators for an application.
3. Analyze various protocols for IoT.
4. Apply data analytics and use cloud/fog offerings related to IoT.
5. Analyze applications of IoT in real time scenario.
6. Design an IoT based smart system using open hardware platforms and open cloud offerings.

TEXTBOOK:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", CISCO Press, 2017.

REFERENCES:

1. Perry Lea, "Internet of things for architects", Packt, 2018.
2. Jan Ho"ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key Applications and Protocols", Wiley, 2012.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

5. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
6. <https://www.arduino.cc/>
7. https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓										✓
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓		✓	✓		✓	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

IT5793

DATA SCIENCE AND ANALYTICS

L T P C

3 0 0 3

OBJECTIVES:

- To learn the fundamentals of data science and big data.
- To gain in-depth knowledge on descriptive data analytical techniques.
- To gain knowledge to implement simple to complex analytical. Algorithms in big data frameworks.
- To develop programming skills using required libraries and packages to perform data analysis in Python.
- To understand and perform data visualization, web scraping, machine learning and natural language processing using various Data Science tools.

UNIT I INTRODUCTION TO DATA SCIENCE AND BIG DATA

9

Data Science – Fundamentals and Components – Data Scientist – Terminologies Used in Big Data Environments – Types of Digital Data – Classification of Digital Data – Introduction to Big Data – Characteristics of Data – Evolution of Big Data – Big Data Analytics – Classification of Analytics – Top Challenges Facing Big Data – Importance of Big Data Analytics – Data Analytics Tools.

Suggested Activities:

- Case studies on big data application domain.
- Real world domain specific problems involving big data and listing out the challenges.
- Demonstration on data analytics tools.

Suggested Evaluation Methods:

- Student assignment on case studies related to healthcare, climate change, e-commerce, retail business, manufacturing etc.
- Group presentation on big data applications with societal need.
- Quizzes on topics like big data terminologies, big data applications, etc.

UNIT II DESCRIPTIVE ANALYTICS USING STATISTICS

9

Types of Data – Mean, Median and Mode – Standard Deviation and Variance – Probability – Probability Density Function – Types of Data Distribution – Percentiles and Moments – Correlation and Covariance – Conditional Probability – Bayes' Theorem – Introduction to Univariate, Bivariate and Multivariate Analysis – Dimensionality Reduction using Principal Component Analysis and LDA – Dimensionality Reduction using Principal Component Analysis and Linear Discriminant Analysis (LDA) – Principal Component Analysis (PCA) example with Iris Data Set from UCI repository.

Suggested Activities:

- Solving numerical problems based on statistics and probability.
- Demonstration of descriptive analysis using Python.
- Demonstrate PCA using Iris data set in Python.

Suggested Evaluation Methods:

- Assignment on data understanding using open source tools.
- Student Presentation of real world applications and the required descriptive analysis.
- Quiz on all topics in descriptive analytics using statistics.

UNIT III PREDICTIVE MODELING AND MACHINE LEARNING

9

Linear Regression – Polynomial Regression – Multivariate Regression – Multi Level Models – Data Warehousing Overview – Bias/Variance Trade Off – K Fold Cross Validation – Data Cleaning and Normalization – Cleaning Web Log Data – Normalizing Numerical Data – Detecting Outliers – Introduction to Supervised And Unsupervised Learning – Reinforcement Learning – Dealing with Real World Data – Machine Learning Algorithms –Clustering – Python Based Application.

Suggested Activities:

- Solve numerical problem solving using linear regression models.
- Demonstrate data cleaning using WEKA tool.
- Demonstration of data preprocessing and machine learning features in Python.

Suggested Evaluation Methods:

- Simple lab based activities for machine learning in Python using small benchmark datasets.
- Tool based assignments on linear, polynomial and multivariate regression using real world case studies.
- Assignment on comparative analysis of two or more data sets using their features.

UNIT IV DATA ANALYTICAL FRAMEWORKS

9

Introducing Hadoop –Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Introduction to NoSQL: CAP theorem – MongoDB: RDBMS Vs MongoDB – Mongo DB Database Model – Data Types and Sharding – Introduction to Hive – Hive Architecture – Hive Query Language (HQL).

Suggested Activities:

- Case studies on applications involving usage of data analytical frameworks.
- Demonstration of Installation and configuring Hadoop and MapReduce.
- Design and develop algorithms to be executed in Map Reduce involving numerical methods for analytics.
- Installation of MongoDB and simple data management.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in Hive, implement analytical techniques using Map-Reduce Tasks and Result Projection.
- Practical – Programming assignments in MongoDB.
- Quiz on Hive query language.

UNIT V DATA SCIENCE USING PYTHON**9**

Introduction to Essential Data Science Packages: Numpy, Scipy, Jupyter, Statsmodels and Pandas Package – Data Munging: Introduction to Data Munging, Data Pipeline and Machine Learning in Python – Data Visualization Using Matplotlib – Interactive Visualization with Advanced Data Learning Representation in Python.

Suggested Activities:

- Demonstration of simple Python scripts using NumPy and SciPy Package.
- Demonstration on NumPy arrays and matrix operations.
- Simple lab activities on dimensionality reduction and feature selection using Python.
- Demonstration of experiments on data visualization using matplotlib functions.

Suggested Evaluation Methods:

- Mini Project using Python for data analytics with benchmark datasets.
- Quiz on data visualization functions.

TOTAL: 45 PERIODS**OUTCOMES:**

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

CO1: Identify the real world business problems and model with analytical solutions.

CO2: Solve analytical problem with relevant mathematics background knowledge.

CO3: Convert any real world decision making problem to hypothesis and apply suitable statistical testing.

CO4: Write and demonstrate simple applications involving analytics using Hadoop and MapReduce.

CO5: Use open source frameworks for modeling and storing data.

CO6: Perform data analytics and visualization using Python.

TEXT BOOKS:

1. Frank Pane, "Hands On Data Science and Python Machine Learning", Packt Publishers, 2017.
2. Seema Acharya, Subhashini Chellapan, "Big Data and Analytics", Wiley, 2015.

REFERENCES:

1. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials", Packt Publications, 2nd Edition, 2016.
2. DT Editorial Services, Big Data, Black Book, Dream Tech Press, 2015.
3. Yuxi (Hayden) Liu, "Python Machine Learning", Packt Publication, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓						✓	✓
CO2	✓	✓	✓	✓	✓						✓	✓
CO3	✓	✓		✓	✓				✓		✓	✓
CO4	✓	✓	✓	✓	✓				✓		✓	
CO5		✓	✓	✓	✓				✓			
CO6	✓	✓	✓	✓	✓						✓	✓

AS5791

UNCONVENTIONAL HYDROCARBON

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

OBJECTIVES

The course is aimed to

- To understand the graphical distribution of unconventional hydrocarbon resources
- To understand the characterization of source and reservoir rock
- To understand methodology to produce these reserves
- To understand environmental consequences of producing reserves
- Demonstrate awareness related to environmental issues involved in the development of non-conventional hydrocarbon resources

UNIT I LOW PERMEABILITY (TIGHT) SANDS 9

Occurrences, Resources, Reservoir characteristics, Drilling and Completion methods, facilities, Reservoir Management, challenges, limitations on development and present activity

UNIT II COAL BED GAS 9

Occurrences, Resources, Reservoir characteristics, Drilling and Completion methods, facilities, Reservoir Management, challenges, limitations on development and present activity, Water and Environmental issues

UNIT III SHALE GAS AND OIL RESERVOIRS 9

Occurrences, Resources, Reservoir characteristics, Drilling and Completion methods, facilities, Reservoir Management, challenges, limitations on development and present activity, Water and environmental issues

UNIT IV HEAVY OIL 9

Occurrences, Resources, Reservoir characteristics, Drilling and Completion methods, facilities, Reservoir Management, challenges, limitations on development and present activity, environmental issues

UNIT V GAS HYDRATES 9

Occurrences, Resources, Reservoir characteristics, Recovery methods, facilities, challenges, limitations on development and present activity, environmental issues, gas storage, types and locations of gas storage reservoirs, technical issues and terminology, gas storage volume and economics

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course students are expected to

CO1: Recognize and apply the concept of continuous accumulation of Low permeability region

CO2: Apply the concepts related to exploration and development of Coal Bed Gas

CO3: Apply the concepts related to exploration and development of Shale Gas and Oil Reservoir

CO4: Understanding the formation of Heavy oil

CO5: Apply different conversion for Formation of Gas Hydrates

TEXT BOOKS:

1. Unconventional Oil and Gas resource handbook – Y. Zee Ma, Stephen Holditch 1st Edition 2015
2. Halliburton Tight Gas book James T. Bartis, Frank Camm, David S. Ortiz, Producing Liquid Fuels from Coal, Prospects and Policy Issues. NETL, DOE, USA, 2008.

REFERENCE:

1. Petroleum Exploration Hand Book by Moody, G.B. McGraw-Hill Inc (2010)
2. Warner, H.R., 2009, Emerging and Peripheral Technologies, Society of Petroleum Engineers, Handbook, Volume VI.
3. Pramod Thakur, Steve Schatzel and KashyAminian, (Editors), 2014, Coal Bed Methane: From Prospects to Pipeline, Elsevier.
4. Rafiqul Islam, M, 2014, Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development, Gulf Professional Publishing.

AS5792

INDUSTRIAL SAFETY MANAGEMENT

L T P C
3 0 0 3

OBJECTIVE:

- To learn about importance of safety and its regulations
- To know about types of hazards and safety management to mitigate it
- To provide necessary assists to safety audits and techniques
- To realize about the requisite of safety education and training
- To know about the waste management system and its significance

UNIT I NEED FOR SAFETY IN INDUSTRIES AND REGULATION

9

General definitions- Importance & objectives of safety- Safety Programmes & its key elements – safety policy – safety organization, Implementation of Health and safety culture & factors influencing it- Factories Act and Safety Regulations.

UNIT II OCCUPATION HEALTH AND SAFETY MANAGEMENT

9

Physical hazard- chemical hazards- biological hazards-ergonomical hazards-Fire hazards-, Electrical hazards-safety management structure & its importance-safety philosophy & psychology- - emergency planning-on site & off site emergency planning- work permit systems

UNIT III SAFETY AUDIT AND SAFETY DOCUMENTS

9

Objective of safety audit- elements of audits-, checklist, third party certifications- what if analysis, HIRA (Hazard Identification & risk Assessment) - Job Safety Analysis (JSA), safety – survey, Tool box talks, safety committee meeting-inspection, sampling- EMS models case studies

UNIT IV SAFETY EDUCATION AND TRAINING 9

Importance of training-identification of training needs-training methods – programme, seminars, Conferences, competitions – method of promoting safe practice - motivation – communication -role of government agencies and private consulting agencies in safety training – creating Awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive Scheme, safety campaign – Domestic Safety and Training.

UNIT V WASTE MANAGEMENT SYSTEM 9

Waste classification and regulatory requirements- waste identification, characterization and classification-Methods of collection and disposal of solid wastes-health hazards-toxic and radioactive wastes incineration and vitrification -source reduction and recycling- collection-transport and material recovery- biological and thermal processing of wastes- waste disposal

TOTAL: 45 PERIODS

COURSE OUTCOME:

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

CO1: Recognize the value of safety role in industry and its regulations

CO2: Aware of the types of hazards dealt in industry and system to manage it

CO3: Understand about safety audit and safety techniques

CO4: Significance of safety education and training to employees

CO5: Importance of waste management system in industries and its procedure

TEXT BOOKS:

1. Accident Prevention Manual: Engineering & Technology 14th Edition National Safety Council; 14th Edition (August 2015).
2. Occupational Health & Safety, 3rd Edition National Safety Council; 3rd Ed. (2000).

REFERENCES:

1. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.
2. John Ridley, "Safety at Work", Butterworth & Co., London, 1983.
3. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973.
4. McCornick, E.J., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.

LT5791 ORIENTATION TO LEATHER MANUFACTURE

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

AIM

- This course aims at introducing the fundamentals of chemistry and technology of leather manufacture.

UNIT I RAW MATERIALS AND PRESERVATION 9

Unique characteristics of leather; Raw materials used for leather manufacture - Origin and characteristics of hides and skins; Categories of livestock; Grading systems; Defects in hides and skins; Various preservation techniques and their principles.

UNIT II PRETANNING PROCESSES 9

Principles and objectives of beamhouse processes viz., soaking, liming, reliming, deliming, bating, pickling, depickling and degreasing.

UNIT III TANNING PROCESSES 9

Definition and objectives of tanning; Types and basic chemistry of vegetable tannins; Basic chemistry of basic chromium sulfate; Principles involved in vegetable and chrome tanning and their mechanism in brief; Combination tannages.

UNIT IV POST TANNING PROCESSES**9**

Types of syntans; Basic chemistry of phenolic and acrylic syntans; Types of fatliquors; Basic chemistry of fatliquors; Types of dyes; Basic chemistry of acid, basic, direct and metal complex dyes; Principles and objectives of post tanning processes viz., neutralisation, retanning, dyeing and fatliquoring; Various unit operations involved.

UNIT V FINISHING TECHNIQUES**9**

Types of binders; Basic chemistry of protein, resin and PU binders; Types of pigments; Basic characteristics of pigments; Basic theory of coating; Principles and objectives of finishing; Classification of finishing; Types of auxiliaries and finishes.

TOTAL : 45 PERIODS**OUTCOMES :**

CO1 : Understand the application and uniqueness of the leather.

CO2 : Have knowledge on pre-tanning and tanning processes

CO3 : Comprehend the process rationale for making specific leather.

CO4 : Have knowledge on post-tanning and finishing processes

CO5 : Aware of various preservation techniques of the skins / hides

TEXT BOOKS

1. Sarkar, K.T., Theory and Practice of Leather Manufacture Ajoy Sorcor, Madras, 1981.
2. Dutta, S.S., Introduction to the Principles of Leather Manufacture, Indian Leather Technologists Association, Calcutta, 1980.
3. Thorstenson, T.C., Practical Leather Technology, Robert E. Krieger Publishing Co., alabar, Florida, 1985.
4. Fred O Flaherty, Roddy, T.W. and Lollar, R.M. 'The Chemistry and Technology of Leather', Vol.I & II, Type of tannages, Rober E. Krieger Publishing Co., New York, 1977.
5. Beinkiewicz, K. 'Physical Chemistry of Leather Making', Robert E. Krieger Publishing Co., Florida, 1983.

REFERENCE

Koteswara Rao, C., and Olivannan, M.S., Lecture Notes on dyeing and finishing of leathers, CLRI, Madras, 1983.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Understand the application and uniqueness of the leather.	-	1	1	1	1	2	3	3	1	-	2	1	2	1	1
CO2	Have knowledge on pre-tanning and tanning processes	2	2	3	2	1	3	3	1	1	-	1	1	3	2	2

CO3	Comprehend the process rationale for making specific leather.	2	3	3	3	1	2	2	1	1	-	2	1	3	2	2
CO4	Have knowledge on post-tanning and finishing processes	2	2	3	2	2	2	3	1	1	-	1	1	3	2	2
CO5	Aware of various preservation techniques of the skins / hides	2	2	3	2	2	3	3	1	1	-	2	1	3	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

AIM

- To understand the basic structure and function of skin and its components

UNIT I STRUCTURE, CHARACTERISTICS AND FUNCTIONS OF SKIN 9

Organization of skin components in different animals; Structure and function of skin; epidermis, dermis, cutaneous and subcutaneous tissues; hair; fat tissue; nerve; erectopilli muscle; sweat glands.

UNIT II COMPOSITION OF HIDES AND SKINS 9

Constituents of hides and skins; Fibrous and non-fibrous proteins in skin; Structure, function and properties of amino acids Structure and properties of mono, di, iligo and polysaccharides; complex carbohydrates; Structure and properties of Fatty acids;

UNIT III BIOSYNTHESIS OF COLLAGEN 9

Transcription and translation - collagen genes and mRNA - synthesis of pro chains – intracellular processing of collagen - extracellular modifications. Steps in collagen biosynthesis and their significance - specific enzymes and their reaction.

UNIT IV MOLECULAR AND SUPRAMOLECULAR STRUCTURE OF COLLAGEN 9

Collagen triple helix; Amino acid composition and primary structure; Chemistry and properties of crosslinks - intramolecular and intermolecular crosslinks –difunctional and multifunctional crosslinks denaturation, renaturation. Native collagen fibrils - 3 Dimensional structure – stabilisation -assembly-fibril organisation. Electron microscopic appearance of collagen.

UNIT V APPLICATIONS OF COLLAGEN 9

Purification of collagen; Preparation of collagenous biomaterials; Gelatin extraction; Use of Collagen/gelatin in food and beverages; Collagen use in cosmetic and medical fields

TOTAL : 45 PERIODS**OUTCOMES :**

CO1 : To understand various structural and functional features of skin

CO2 : To know about various constituents of skin

CO3 : To gain insights on the biosynthesis of collagen

CO4 : To be aware of the molecular and supramolecular structure of collagen

CO5: To know about various applications of collagenous protein

TEXT BOOK AND REFERENCES

1. G.N.Ramachandran and A.H.Reddy (Eds) "Biochemistry of collagen", Plenum, New York,1976.
2. Lehninger A.L., Nelson D.L., Cox M.M., "Principles of Biochemistry", CBS Publications, 1993.
3. K.A.Pieze and A.H.Reddy, (Eds), "Extracellular Matrix Biochemistry", Elsevier,
4. New York, 1984.
5. Darnell J., Lodish H., Baltimore D., "Molecular Cell Biology", Freeman W.H., 1990.
6. Fratzl, P; 'Collagen: Structure and Mechanics', Springer, 2008.

COURSE ARTICULATION MATRIX:

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	To understand various structural and functional features of skin	3	1	1	-	1	-	-	-	-	1	-	2	2	1	-
CO2	To know about various constituents of skin	3	1	1	-	-	-	-	-	-	1	-	2	3	2	-
CO3	To gain insights on the biosynthesis of collagen	3	-	1	-	1	-	-	-	-	1	-	2	1	-	-
CO4	To be aware of the molecular and supramolecular structure of collagen	3	-	1	-	1	-	-	-	-	1	-	2	1	-	-
CO5	To know about various applications of collagenous protein	3	2	2	2	1	1	1	1	-	1	1	2	2	-	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TT5791

BASICS OF TEXTILE TECHNOLOGY

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

OBJECTIVES

- To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing

UNIT I BASICS OF FIBRE SCIENCE AND SPINNING

9

Definition of fibre, classification of textile fibers; sequence of machineries in short staple yarn spinning from ginning to cone winding and their objectives; yarn numbering system

UNIT II BASICS OF WOVEN FABRIC PRODUCTION

13

Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms

UNIT III BASICS OF NON WOVEN AND KNITTED FABRIC PRODUCTION 5
knitting – classification, principle, types of fabrics; nonwoven process –classification, principle, types of fabrics.

UNIT IV BASICS OF CHEMICAL PROCESSING 13
Objectives of the processes - singeing, desizing, scouring, bleaching, mercerization; dyeingclassification of dyes, types of dyeing techniques; printing - types and styles of printing; finishing treatments – chemical and mechanical finishing.

UNIT V BASICS OF GARMENT MANUFACTURING 5
Anthropometry, basic principles of pattern making and grading, marker planning, spreading, cutting, sorting, sewing, finishing and packing.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, the students shall have the knowledge on

CO1: The basics of fibre science and yarn formation

CO2: The basics of weaving mechanism and woven fabric production

CO3: Nonwovens and knitted fabric production

CO4: Coloration and finishing of the fabrics

CO5: The basics of garment manufacturing

TEXT BOOKS

1. Hornberer M., Eberle H., Kilgus R., Ring W. and Hermeling H., "Clothing Technology: From Fibre to Fabric", Europa Lehrmittel Verlag, 2008, ISBN: 3808562250 / ISBN: 978-3808562253.

2. Wynne A., "Motivate Series-Textiles", Maxmillan Publications, London, 1997.

3. Carr H. and Latham B., "The Technology of Clothing Manufacture" Backwell Science, U.K., 1994, ISBN: 0632037482 / ISBN:13: 9780632037483

TT5792

TEXTILE FIBRES

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

OBJECTIVES

• To enable the students to learn about different types of fibres, their production, physical and chemical characteristics

UNIT I

9

Classification of fibres; definition of fibres; cotton, jute, flax fibres – cultivation, physical and chemical properties

UNIT II	9
Protein fibres – wool, silk, production, physical and chemical properties	
UNIT III	9
Synthetic fibres – polyester, nylon, acrylic, polyurethanes, polypropylene, polyethylene – production, physical and chemical properties	
UNIT IV	9
Manmade fibres – Viscose, modified viscose, modal, tencel and other metallic and non metallic fibres – production, physical and chemical properties	
UNIT V	9
Introduction to high performance fibres; Identification of textile fibres; specification of fibres.	

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student would know about

CO1: Classification of textile fibres; cultivation, physical and chemical properties of natural fibres

CO2: Production and properties of protein fibres

CO3: Production and properties of synthetic fibres

CO4: Production and properties of regenerated fibres

CO5: High performance fibres and identification of textile fibres

TEXT BOOKS

1. Srinivasa Murthy H. V., "Introduction to Textile Fibres", Textile Association, India, 1987.
2. Morton W. E. and Hearle J. W. S., "Physical Properties of Textile Fibres", The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95
3. Meredith R. and Hearle J. W. S., "Physical Methods of Investigation of Textiles", Wiley Publication, New York, 1989

CH5791	INDUSTRIAL CORROSION AND PREVENTION	L T P C
		3 0 0 3

OBJECTIVES

The student can able to impart Knowledge on fundamental concepts of corrosion and its types and to create corrosion prevention plans in various industries.

UNIT I	BASIC CONCEPTS OF CORROSION	9
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Corrosion – introduction, definitions and types basic concepts of corrosion behavior, importance of corrosion resistance, Electrochemical cells-definitions and principles, Potential measurements - galvanic cells, concentration cells, EMF and Galvanic series - bimetallic couples. Potential -pH diagrams – fundamental aspects. Prevention strategies

UNIT II	CORROSION CONTROL IN POWER INDUSTRIES	9
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Corrosion & its control in Power industries: Introduction, frequent forms of corrosion, environment, case studies, prevention methodology, corrosion resistance materials.

UNIT III CORROSION CONTROL IN PETROCHEMICAL INDUSTRIES**9**

Corrosion & its control in petrochemical industries: Introduction, regular forms of corrosion, environment, case studies, Prevention strategies – inhibitors and surface engineering. corrosion resistance materials.

UNIT IV CORROSION CONTROL IN MARINE INDUSTRIES**9**

Corrosion & its control in ship building and marine industries: Introduction, Metallurgical properties influencing corrosion. Common forms of corrosion, environment, Passivity – design of corrosion resistant alloys. case studies, and corrosion resistance materials

UNIT V CORROSION CONTROL IN FERTILIZER INDUSTRIES**9**

Corrosion & its control in fertilizer industries: Introduction, regular forms of corrosion, environment, Corrosion of medical implants –case studies, prevention methods, corrosion resistance materials.

TOTAL: 45 PERIODS**OUTCOMES:**

On the completion of the course students are expected to

CO1: Understand the fundamental concepts of corrosion and its types.

CO2: Gain knowledge in corrosion damages in various industries like Power, Petroleum, Marine and Fertilizer industries.

CO3: Analyze the corrosion prevention strategies in the industries.

CO4: Evaluate the case histories according to the industries

CO5: Able to Illustrate the causes and cures of corrosion problems

TEXT BOOKS:

1. M. G. Fontana, Corrosion Engineering (Third Edition) McGraw-Hill Book Company (NY) (1987)
2. M.Pourbaix,Atlas of Electrochemical Equilibria in aqueous solutions, NACE, Houston (1974).
3. Denny A Jones,Principles and Prevention of Corrosion (second edition),PrenticeHall, N. J.(1996).

REFERENCE BOOKS:

1. H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley (NY) (1985).
2. Handbook of Materials Failure Analysis with Case Studies from the Oil and Gas Industries ASH Makhlof and MahmoodAliofkhazraei, Elsevier Ltd

OBJECTIVES:

- To explain principles of treatment processes of pollutants
- To identify the best treatment strategy for treating water based on nature of Pollutant.

UNIT I WATER TREATMENT TECHNOLOGIES 9

Overall introduction about technologies adopted for water treatment – Rapid mixing- Flocculation-sedimentation –filtration- Disinfection- Membrane technology-nanotechnology.

UNIT II CHEMICAL, BIOLOGICAL AND PHYSIOCHEMICAL TECHNOLOGY 9

Introduction- aeration-Coagulation- Neutralization-Precipitation- Ion exchange- Advanced oxidation process- Flocculation-adsorption- settling - Bioreactors for treatment- Advanced biological treatments

UNIT III MEMBRANE AND NANO TREATMENT TECHNOLOGY 9

Membranes for water treatment - membrane separation process-ultra filtration- nanofiltration-nanomaterials as membrane filtration.

UNIT IV DESIGN AND CONSTRUCTION 9

Introduction- Design and construction of wastewater treatment plants on novel technology- nanofiltration and hybrid technologies- sustainable treatment technologies

UNIT V SELECTION OF WATER TREATMENT TECHNOLOGY 9

Introduction – Aeration-chemical-Physical-Biological-Membrane- Nano Technology-Hybrid technologies- Environmental regulations and compliance- cost and safety-based treatment.

TOTAL : 45 PERIODS**OUTCOMES:**

On the completion of the course students are expected to

CO1:To recognize and understand the treatment technologies available for pollution treatment.

CO2:To identify different types of treatment technologies

CO3:To understand the newer technologies and its measures for future generations.

CO4:To recognize different forms of treatment processes and apply them for suitable applications in for technological advancement and societal development.

CO5:To demonstrate the knowledge attained for selection of process for environmental issues

TEXT BOOKS:

1. Parimal Pal , “Industrial Water Treatment Process Technology” Butterworth-Heinemann. 2017.
2. Salomone, Roberta, Saija, Giuseppe, “Pathways to Environmental Sustainability- Methodologies and Experiences”, Springer International Publishing, 2014.

REFERENCES:

1. Lois Wright Morton, Susan S. Brown, “Pathways for Getting to Better Water Quality: The Citizen Effect,” Springer-Verlag New York,2011.
2. M. H. Unsworth,, D. Fowler, “Deposition of Pollutants on Plants and Soils; Principles and Pathways” Springer Netherland,1988.
3. Brian Alloway, David C. Ayres, “Chemical Principles of Environmental Pollution, Second Edition”, CRC Press, 1997.

OBJECTIVES

- To make the students understand the principles of biosafety
- To give knowledge about the different types of biosafety levels and their features
- To make the students aware of the ethics and regulations

UNIT I	INTRODUCTION	9
Biosafety and biocontainment – concepts and strategies, risk assessment, biosafety programs, risk communication		
UNIT II	WORKING ENVIRONMENT	9
Biological safety cabinets – level I, II, III, sample – collection, processing, storing, indexing and storage. Cleanrooms.		
UNIT III	SAMPLES	9
Animal, Plant, stem cells and genetically modified organisms – handling and maintenance, disinfection and decontamination, facility operation and maintenance, waste management.		
UNIT IV	ETHICAL GUIDELINES	9
Bioethics, Regulations on place in India for research on animal, plant, stem cells and genetically modified organisms, regulations in other countries – US (FDA/ GMP), European standard levels, emergency planning and response		
UNIT V	LAB PRACTICES	9
Good laboratory practices, quality systems in the laboratory, laboratory controls, safety hazards, documentation.		

TOTAL : 45 PERIODS

OUTCOMES

- To make the students become aware of the principles of biosafety and risk assessment
- To understand the level of biosafety level required under different scenario
- To become aware of the differences in handling different types of organisms
- Understand the regulatory issues involved in handling GE organisms
- Become aware of the ethical guidelines and GLP involved

TEXTBOOKS

1. Biosafety in Microbiological and Biomedical Laboratories, 5th ed. US Department of Health and Human Services 2009
2. Biological Safety, Principles and Practices, 4th ed. (Fleming & Hunt), ASM Press 2006

REFERENCES

1. Guide for The Care and Use of Laboratory Animals, 8th ed. (National Research Council), National Academies Press, 2011
2. Institutional Animal Care and Use Committee Guidebook, 2nd ed. NIH Guidelines For Research Involving Recombinant or Synthetic Nucleic Acid Molecules (2013)
3. Laboratory Biosafety Manual, 3rd ed. (WHO), 2004.

FT5791

FOOD SAFETY

**LT P C
3 0 0 3**

COURSE OBJECTIVES:

This course is designed to:

1. present the rules of personal hygiene and the importance of adhering to safety rules and regulations.
2. introduce the causes and prevention of food poisoning and to introduce the requirements of safety in the workplace.
3. introduce local legislation relating to the food service industry

UNIT I	CONCEPTS OF FOOD SAFETY	9
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Understanding what is safe food. Definition of food safety. Adulteration of food, Contamination malnutrition, obesity and metabolic syndrome. Unhygiene preparation filter, coloured foods and cancer, pesticides in food and health issues, Physical hazards, migration, cross-contamination.

UNIT II HAZARDS DUE TO FOOD PROCESSING**9**

Trans fatty acids and Cardio vascular diseases. Plastics in packaging; presence of vinyl polymer packaged drinking water and hazard thermal decomposition during barbecuing pyrolytic products and cancer- non-nutritive sweeteners of hazards. Preservatives – chemical, sulphites phenolic antioxidants, fat substitutes antibiotics and veterinary drugs.

UNIT III BIOLOGICAL HAZARDS**9**

Fungal toxins, aflatoxins, allergens, bacterial toxins, botulin, proper handling and storage procedures. Water activity and temperature of storage of meats, dairy and vegetables. Prevention of microbial hazards, sanitation, antimicrobial plastics, Intelligent packing. Prevention of food-borne illnesses. Pathogens in foods, E.coli, Salmonella, C.botulinum, Campylobacter. How to reduce food spoilage. Storage of uncooked food

UNIT IV HEALTH CLAIMS, LABELLING & SAFE FOOD**9**

Sports nutrition, nutraceuticals, pKV formula foods, health claims, labelling of the label. HACCP, GMP consumer protection, responsibilities of the food service operator. Hygiene procedures. Cost of illness.

UNIT V GLOBALIZATION AND FOOD SAFETY**9**

Genetically modified food (GM), Safety and labelling, Food audit, International food Standards ISO 9000, environmental issues in packaging.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

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

CO1: Explain various types of food contamination and factors that contribute to foodborne illness

CO2: Identify the characteristics of potentially hazardous foods

CO3: Describe the dangers of foodborne illness

CO4: Demonstrate the ability to explore and apply proper food handling techniques that will eliminate possible foodborne illness.

CO5: Demonstrate the ability to discuss the importance of food safety training in the workplace

TEXT BOOKS

1. Fortin, N. D. (2016). Food Regulation: Law, Science, Policy, and Practice. United Kingdom: Wiley..
2. Lightbourne, M. (2016). Food Security, Biological Diversity and Intellectual Property Rights. (n.p.): Taylor & Francis.
3. Mehta, Rajesh and J. George "Food Safety Regulation Concerns and Trade : The Developing Country Perspective". Macmillan, 2005

REFERENCE BOOKS:

1. Food Safety: A Guide to What You Really Need to Know, J M Hemminger; published in 2000 by Wiley-Blackwell
2. Principles of Food Sanitation (Food Science Text Series), 5th Edition 2006, N Marriott & R B Gravanni, published by Springer
3. HACCP and Sanitation in Restaurants and Food Service Operations, 2005L Arduser & D R Brown; Atlantic Pub. Group Inc.

OBJECTIVES

- To make the students aware of the fundamentals of forensic science
- To make the students aware of the principles behind the various techniques used for evidence analysis
- To make the students aware of the various instrumental analysis involved in detection

UNIT I INTRODUCTION**9**

Forensic science: Definition, History and Development. Types of crime, crime scene management and investigation; Collection, Preservation and forwarding of physical and trace evidences for analysis. Legal and court procedures.

UNIT II BLOOD BASED ANALYSES**9**

Blood based analysis, analysis of body fluids, Disputed paternity and maternity problems. DNA profiling.

UNIT III SAMPLE ANALYSIS**9**

Analysis of liquor; petroleum products; Examination of insecticides and pesticides; Identification of poisons; identification of fibres. Physical analysis of soil, glass, paints, lacquers, cement, inks, paper, and tool marks, foot prints and shoe prints

UNIT IV MATERIAL ANALYSIS**9**

Examination of vehicles, tyre marks, Ballistics, cyber forensics, Identification of handwriting, signatures, anonymous, disguised writings and forgery detection. Age of documents. History, classification, search, lifting and examination of fingerprints.

UNIT V INSTRUMENTATION**9**

Microscopy, spectroscopy, X-rays, NMR, Chromatography, Electrophoresis.

TOTAL: 45 PERIODS**OUTCOMES**

- To make the students aware of the importance of preserving the nature of crime field
- To make them aware of the science behind sample collection and the legality involved
- To make the students determine the contaminants or poisons present in liquor, food products
- To make the students aware of the different techniques involved in sample analysis
- To understand the instrumentation involved in the analysis

TEXTBOOKS:

1. Forensic Science -2008, Embar-Seddon, A and Pass A (Ed), Volumes 1-3
2. B. R. Sharma: Forensic Science in Criminal Investigation and Trials, Fourth Edition, Universal Law Publishing
3. B. Levine: Principles of Forensic Toxicology, 3rd Ed., AACCC Press, 2010.
4. Richard Saferstein, 2001, Criminalistic: An Introduction to Forensic Science. 7th edition Prentice-Hall, New Jersey
5. Fishes, B.A.J., 2000. Techniques of Crime Scene Investigation. VI edition CRC Press, Boca Raton, 2000.

REFERENCES:

1. Koppenhaver, K. (2007) Forensic Document Examination, Principles and Practice Humana Press
2. An Introduction to Forensic DNA Analysis, Rudin, Norah CRC Leviw Publishers, (2002)
3. Digital forensic for network internet and cloud computing clint garrison
4. Clarke's Analytical Forensic Toxicology by A. Negrusz and G. Cooper, 2nd Ed., Pharmaceutical Press, 2013.
5. Handbook of Fingerprint Recognition, Maltoni, Maio, Jain, Prabhakar, 2005

OBJECTIVES:

The Course will enable Learners with limited proficiency in English to,

- Learn the fundamental features of communicating in English.
- Develop the skills and sub skills of reading and comprehending the content read.
- Read and comprehend both short and longer texts in English.
- Listen and comprehend lectures in English.

UNIT I**9**

Listening - Listening to individual phonemes in English, identification and practice of phonemes.

Reading- Reading aloud of texts- short stories/ scenes from plays.

Speaking- Self-introduction in informal contexts- (necessary expressions to be given)

Writing- Development of hints

Grammar- Use of articles- countable and uncountable nouns.

UNIT II**9**

Listening- Listening to announcements in public places such as made on social media.

Reading- Short texts and answering questions.

Speaking- Asking and answering questions of a personal kind (hobbies, home, favourite sports person, ambitions,)

Writing- Using given expressions/ keywords to develop a story.

Grammar- Use of pronouns, verbs- regular & irregular, Adjectives- degrees of comparison.

UNIT III**9**

Listening- Listening to lectures and summarizing information.

Speaking- Reporting flow of Events (Sequence)

Reading – Reading summaries

Writing-Writing a précis

Grammar and Vocabulary- Needs based Grammar

UNIT IV**9**

Listening- Listening to description of a place/

Speaking –Role play (practicing conversations)

Reading- Newspaper Articles.

Writing- Dialogue Writing

Grammar and Vocabulary- Needs based Grammar

UNIT V**9**

Listening- Listening to a process.

Speaking- Describing an experience.

Reading- Reading essays.

Writing –Short essays.

Grammar and Vocabulary- Needs based Grammar Teaching Methods:

TOTAL: 45 PERIODS**OUTCOMES:**

At the end of the Course, Learners will be able to,

- Listen and comprehend information being given in English.
- Read and comprehend English texts.
- Speak English with confidence
- Produce a well-organized essay with adequate support and details.
- Write comprehension answers in English.

TEXT BOOK:

1. Y Prabhavati, M Lalitha Sridevi, Ruth Z Hauzel, " English All Round- Communication Skills for Undergraduate Learners" Orient BlackSwan, 2019.

REFERENCE BOOKS:

1. N. M. White " Unlock- Listening and Speaking Skills 1" Cambridge University Press, 2014.
2. N. M. White " Unlock- Reading and Writing Skills 1" Cambridge University Press, 2014.
3. Sadanand, Kamlesh. Susheela Punitha. "Spoken English Part 1- A Foundation Course" Orient BlackSwan, 2014.
4. A. Amin, R, Eravelly, F.J.Ibrahim. "Grammar Builder 2- A grammar guidebook for students of English" Cambridge University Press, 2004.

Suggested evaluation methods:

Assessment-25 (Listening & speaking)

Assessment -25 (Reading &Writing)

End semester-100

Teachers can use quizzes, visual inputs etc. to get their Learners to communicate in English

HS5792

INTRODUCTION TO CRITICAL THINKING

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3 0 0 3

COURSE OVERVIEW

This is an open elective course offered for B.E/B.Tech/ M.E/M.Tech students who are interested in learning 21st Century skills that will help them in their academics and career.

COURSE OBJECTIVES:

The main objectives of this course is

- To distinguish between assumptions, fact and opinions
- To identify strong and weak points, reasons and claims in an argument.
- To infer and interpret evidence, verbal and visual materials etc.
- To analyse various perspective and learn to be objective.
- To evaluate the empirical data objectively that will help in honing problem-solving skills

UNIT I INTRODUCTION TO CRITICAL THINKING

9

Introduction to critical thinking - Defining critical thinking –Elements of critical thinking - Distinguishing between facts and opinions –Elenctic method (asking relevant questioning)– small group discussions

UNIT II INDUCTING & INDUCTIVE REASONING

9

Classification of content - Interpreting & Evaluating verbal and visual content (Infographics) – Reading comprehension – Drawing inferences – Blooms Taxonomy – Deductive & Inductive Reasoning

UNIT III ANALYZING VISUAL AND VERBA MEDIA

9

Critically reviewing and analysing visual media like advertisement, news reports, documentaries & movies – Critical review writing of the visual media – Identifying and analysing symbols used in the content

UNIT IV IDENTIFYING FALLACIES

9

Rhetorical devices – Ambiguities in argument – Expressing opinions - Types of Fallacies – Discourse rules in group discussion – Group discussion – Components of Critical Thinking - Analyzing & solving problems- Case Study

UNIT V CRITICAL THINKING AND MEDIA**9**

Critiquing an article – Electronic Media & Critical thinking – Online sources of information & critical thinking – Lateral thinking –Critical thinking in Social media - Writing an article after collecting and evaluating data

TOTAL: 45 PERIODS**LEARNING OUTCOMES:**

By the end of the course students will be able to

- Accurately interpret evidence, statements, graphics, questions etc.
- Identify relevant arguments, reasons, claims, supporting arguments, pros and cons etc.
- Analyze and evaluate different perspectives and be more objective in decision making
- Distinguish between assumptions, facts and opinions and also to discern real news from fake news.
- Give importance to evidence and reason and be fair in making judgments.

REFERENCES

1. Abrami, Philip C., Robert M. Bernard, Eugene Borokhovski, David I. Waddington, C. Anne Wade, and Tonje Person, 2015, "Strategies for Teaching Students to Think Critically: A Meta-analysis", *Review of Educational Research*, 85(2): 275–314. doi:10.3102/0034654314551063
2. Center for Assessment & Improvement of Learning, 2017, *Critical Thinking Assessment Test*, Cookeville, TN: Tennessee Technological University.
3. A.L.Costa, "Developing minds: A Resource Book for Teaching Thinking", 3 rd Edition, Association for Supervision and Curriculum Development Alexandria, 2001.
4. R.Paul, "Critical Thinking: What every student needs to survive in a rapidly changing world", Foundation for Critical Thinking, Dillon Beach, CA, 1992.
5. Diane F Halpern, "Thinking Critically about Critical Thinking", Lawrence Erlbaum Associates, Mahwah,NJ, 1996.

HS5793**READING FICTION****LT PC
3 0 0 3****COURSE DESCRIPTION**

This course is designed to give students an introduction to fiction in English from around the world.

COURSE OBJECTIVES

- To give students who are already proficient in the use of the English language some exposure to fiction from different parts of the world
- To help students appreciate the nuances of literary language.
- To help students understand the denotative and connotative meanings in literary texts.
- To provide students with the material to discuss common themes of human concern.
- To provide students with the opportunity to practice their reading skills

UNIT I HISTORICAL FICTION**9**

Defining history and fiction and the intersection between the two - The language of historical fiction – historical truth vs literary truth - Text for study: *The Diary of Anne Frank*

UNIT II FANTASY / HORROR / GOTHIC FICTION**9**

Introduction to Gothic fiction –Different sub genres of Gothic fiction – origins and development
Text for study: Edgar Allan Poe – *The Pit and the Pendulum*

UNIT III WOMEN'S FICTION**9**

Introduction to fiction by women writers – Women's writing – characteristics - Text for study: Muriel Spark: *The Driver's Seat*

UNIT IV MYTHOLOGICAL FICTION**9**

Introduction to mythological retellings in fiction - novel, short story, flash fiction, Drabble, 55 fiction
- Text for study: Anand Neelakantan: *Asura: Tale of the Vanquished*.

UNIT V FICTION IN TRANSLATION**9**

Translation and intertextuality – adaptation, stylistic equivalence, transference of cultural information, literary conventions -Text for study: M.T. Vasudevan Nair: *Naalukettu: The House around the Courtyard* (translated by Gita Krishnankutty)

TOTAL: 45 PERIODS**LEARNING OUTCOMES**

Students will be able to

- read texts with insight into their meaning and context
- use different reading strategies to identify construction of narratives
- identify and use the literary tools and strategies used by writers to communicate their meaning
- collect, organize and present details about the writers, the historical and general contexts of the texts.
- discuss, analyse and argue about general issues related to society.

REFERENCES:

1. Barnett, Sylvan , William E. Burto , William E. Cain An Introduction to Literature (16th Edition), 2010
2. Kennedy & Gioia, Literature: An Introduction to Fiction, Poetry, Drama and Writing, Longman, 2015
3. Mays, Kelly J. (Ed) The Norton Introduction to Literature 2012
4. Mehrotra, Aravind Krishna. A Concise History of Indian Literature in English. New York: Palgrave Macmillan, 2009.
5. <http://opencourselibrary.org/engl-111-introduction-to-literature-i/>
6. <http://everyday-education.com/literature/eng1.shtml>
7. <http://oyc.yale.edu/english/engl-300/lecture-1>

OBJECTIVES:

- To give awareness about art as a fundamental human activity, its characteristics and ways in which it can be understood.
- To give familiarity with the vocabulary of art.
- To enable the appreciation of art in particular contexts of time and place.

UNIT I INTRODUCTION TO ART**7**

Origin and need of art. Art as representation and expression. Role of art. Forms and categories of art in terms of media and technique- painting, sculpture, etc., Explaining the terms form/vocabulary, content/meaning and context/situation as a means of understanding and appreciating art.

UNIT II VOCABULARY OF ART**9**

Introduction to the vocabulary of art constituted by elements (line, shape, form, space, colour, light, value, texture) and principles (unity, variety, harmony, rhythm, balance, proportion, emphasis, contrast, movement) with at least one illustrative example for each.

UNIT III APPRECIATING ART – FROM EARLY TIMES TO MODERN ART**11**

Appreciating art works in terms of visual vocabulary and contextual importance with at least one example from the following periods- Prehistoric Art, Art of River Valley Civilisations- Egypt, Mesopotamia, Indus Valley civilisation. Greek and Roman art. Medieval art. Islamic Art. Buddhist and Hindu art. Mughal and Rajput miniature art. Indian folk art. Renaissance and Baroque art, Romanticism, Realism.

UNIT IV APPRECIATING MODERN ART**11**

Birth of modern art and its reasons. Appreciation of art from following movements with at least one example from each- Impressionism, Post Impressionism, Fauvism, Expressionism, Modern art, Abstract/ Non Objective art, Cubism, Dadaism, Surrealism, Futurism, Constructivism, Suprematism, De Stijl, Abstract Expressionism, Pop art, Op art.

UNIT V APPRECIATING CONTEMPORARY ART**7**

Outline of new forms and media in art from late 20th century. Installation art, land art, experiential art, digital art, etc., At least one example for each. New trends in Art field.

TOTAL: 45 PERIODS**OUTCOMES:**

- An understanding of art as basic and varied human creation related to cognition and experience.
- Ability to appreciate art from different ages and contexts.

REQUIRED READING

1. Fred, S. Kleiner, 'Gardener's Art through Ages', Wadsworth Publishing, 2012.
2. Bernard S. Myers, 'Understanding the Arts', Holt Rinehart and Winston Inc, 1964.
3. H.H. Arnason, 'History of Modern Art', Thames and Hudson, 1977.
4. ParthaMitter, 'Indian Art', Oxford University Press, 2001.
5. Edith Tomory, 'A History of Fine Arts in India and the West', Orient Blackswan, 1989.

REFERENCES

1. Peter and Linda Murray, 'The Penguin Dictionary of Art and Artists', Penguin, 1989.
2. E.H. Gombrich, 'The Story of Art', Phaidon, 2002.
3. E.H. Gombrich, 'Art and Illusion', Phaidon, 2002.
4. 'Indian Art since the early 1940s- A Search for Identity', Artists Handicrafts Association of Cholamandal Artists Village, Madras, 1974.
5. A.K.Coomaraswamy, Fundamentals of Indian Art, Historical Research Documentation Programme, Jaipur, 1985.

AR5792 INTRODUCTION TO LANDSCAPE AND LANDSCAPE DESIGN L T P/S C
3 0 0 3

OBJECTIVES:

- To give introduction to landscapes in history and enable their appreciation.
- To give familiarity about the elements in landscape design.
- To give knowledge about urban landscape.
- To give familiarity with plant material in local areas.

UNIT I LANDSCAPES IN HISTORY I 9

Human civilisations and attitude to nature and landscapes across history and cultures. Outline of Japanese, Italian Renaissance and English gardens.

UNIT II LANDSCAPES IN HISTORY II 9

Outline of landscape and garden design in Indian history. Gardens depicted in Sanskrit literature, Nandavanams and residential gardens of South India. Moghul gardens. Public parks and residential gardens of the colonial period.

UNIT III ELEMENTS IN LANDSCAPE DESIGN 9

Introduction to hard and soft landscape elements in the design of landscapes. Different types of hard landscape elements. Plant materials, water and landform.

UNIT IV URBAN LANDSCAPE 9

Urban open spaces and principle of urban landscape. Street landscaping, landscape design for waterfront areas and functional areas in urban centres. Sustainable principles in urban and regional landscapes.

UNIT V INTRODUCTION TO PLANT MATERIAL 9

Introduction to flora of regions. Outline of flora of Chennai and local neighbourhoods. Understanding of their characteristics and context of use. Relationship between Flora & Fauna.

TOTAL: 45 PERIODS

OUTCOME

- Knowledge about landscape and landscape design as well as ability to appreciate them.

REFERENCES

1. Boults, Elizabeth and Chip Sullivan, 'Illustrated History of Landscape Design', Hoboken, John Wiley and Sons, New Jersey, 2010.
2. Tobey George. 'History of Landscape Architecture, 'The Relation Of People To Environment', Elsevier And Co, New York, 1973
3. Motloch, J.L., 'An Introduction to Landscape Design', US: John Wiley and Sons, 2001.
4. Rahoul B Singh, 'Gardens of Delight- Indian Gardens through the Ages', Lustre Press, Roli Books, 2008.

AR5793 TRADITIONAL WATER MANAGEMENT SYSTEMS L T P C
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UNIT I INTRODUCTION 9

Introduction to concept of water management as a system as distinct from water harvesting. Importance of studying on a regional and watershed scale as the basis for water management systems. Introduction to traditional water management systems in India and the world. Types of traditional water management systems based on landform, vegetation and climate.

UNIT II GLOBAL PERSPECTIVES 9

Traditional water management systems of other parts of the world, specifically, study of those in Asia. Case studies of conservation, preservation and restoration of such systems in Srilanka, Indonesia, China and Australia.

UNIT III COMPONENTS AND PROCESSES**9**

Components of traditional water managements systems, Role of communities in these, including regulation of use, conservation of water storage areas, religious protection and practices. Community participation, role of hereditary regulators, and agricultural practices

UNIT IV NORTH INDIAN SCENARIO**9**

Identification of Problems in Watershed Development Plan. Strategies for improvement of Watersheds. Concept of Priority Watersheds. Role of Agroforestry, Grassland Management & Wasteland Management, Watershed Approach in Government Programmes. Developing Collaborative know how for People's Participation. Tools and Standards for evaluation of Watershed Management.

UNIT V SOUTH INDIAN SCENARIO**9**

Restoration of Traditional Eri Systems of Tamilnadu. Role of Government agencies and NGOS challenges faced in the conservation and preservation of the Eri's and Kulams. Government initiatives and schemes, case studies.

TOTAL: 45 PERIODS**REQUIRED READING :**

1. Kalyan Kumar Chakravarty, Gyani Lal Badam & Vijay Paranjpye,. Traditional Water Management Systems of India, 2006, Aryan Books International & Indira Gandhi Rashtriya Manav Sangrahalaya.
2. Nitya Jacob, Jalyatra : Exploring India's traditional water management systems, 2008, Penguin publications.
3. Village Tanks of South Asia, Papers and proceedings of the Regional workshop, Madurai, India, 2002.
4. S.M. Ratnavel, P.Gomathinayagam, In search of Ancient wisdom –Irrigation Tanks, 2006, DHAN foundation.
5. A.Vaidyanathan, Tanks of South India, 2001, Centre for Science and Environment.

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1. Arun De Souza, Water and Development- Forging green communities for watersheds, 2010, Orient Blackswan.
2. Asit K.Biswas, R.Rangachari, Cecilia Tortajada, Water Resources of the Indian Subcontinent, 2009, Oxford, India.