

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B. TECH. FOOD TECHNOLOGY**  
**REGULATIONS 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**OPEN ELECTIVES (Offered by other Branches)**

**OPEN ELECTIVE I, SEMESTER V**

<b>S. No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>CATE GORY</b>	<b>CONTACT PERIODS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	OCY551	Advanced Engineering Chemistry	OE	3	3	0	0	3
2.	OCE551	Air Pollution and Control Engineering	OE	3	3	0	0	3
3.	OAT551	Automotive Systems	OE	3	3	0	0	3
4.	OIC551	Biomedical Instrumentation	OE	3	3	0	0	3
5.	OIT552	Cloud Computing	OE	3	3	0	0	3
6.	OEC551	Control Systems Engineering	OE	3	3	0	0	3
7.	OIT551	Database Management Systems	OE	3	3	0	0	3
8.	OME551	Energy Conservation and Management	OE	3	3	0	0	3
9.	OAI551	Environment and Agriculture	OE	3	3	0	0	3
10.	OCY552	Fuel Cell Chemistry	OE	3	3	0	0	3
11.	OCE552	Geographic Information System	OE	3	3	0	0	3
12.	OMD552	Hospital Waste Management	OE	3	3	0	0	3
13.	OCY553	Industrial Chemistry	OE	3	3	0	0	3
14.	OBM552	Medical physics	OE	3	0	0	0	3
15.	OML552	Microscopy	OE	3	3	0	0	3
16.	OAI552	Participatory Water Resources Management	OE	3	3	0	0	3
17.	OMF551	Product Design and Development	OE	3	3	0	0	3
18.	OAI553	Production Technology of Agricultural machinery	OE	3	3	0	0	3
19.	ORO551	Renewable Energy Sources	OE	3	3	0	0	3
20.	OAN551	Sensors and Transducers	OE	3	3	0	0	3
21.	OCS551	Software Engineering	OE	3	3	0	0	3
22.	OMD553	Telehealth Technology	OE	3	0	0	0	3

**OPEN ELECTIVE II, SEMESTER VII**

<b>S. No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>CATE GORY</b>	<b>CONTACT PERIODS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	OAI751	Agricultural Finance, Banking and Co-operation	OE	3	3	0	0	3
2.	OGI751	Climate Change and Its Impact	OE	3	3	0	0	3
3.	OCS751	Data Structures and Algorithms	OE	3	3	0	0	3
4.	OME751	Design of Experiments	OE	3	3	0	0	3
5.	OCE751	Environmental and Social Impact Assessment	OE	3	3	0	0	3
6.	OEN751	Green Building Design	OE	3	3	0	0	3
7.	OBM752	Hospital Management	OE	3	3	0	0	3
8.	OMT701	Industrial Robotics	OE	3	3	0	0	3
9.	OME754	Industrial Safety	OE	3	3	0	0	3
10.	OAI752	Integrated Water Resources Management	OE	3	3	0	0	3
11.	OMF751	Lean Six Sigma	OE	3	3	0	0	3
12.	OEC756	MEMS and NEMS	OE	3	3	0	0	3
13.	OCS752	Introduction to C Programming	OE	3	3	0	0	3
14.	OIE751	Robotics	OE	3	3	0	0	3
15.	OML753	Selection of Materials	OE	3	3	0	0	3
16.	OME752	Supply Chain Management	OE	3	3	0	0	3
17.	OML751	Testing of Materials	OE	3	3	0	0	3

**OBJECTIVES:**

- To make the students conversant with basics of polymer chemistry
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the students with the basics of nano materials, their properties and applications.

**UNIT I POLYMERS AND SPECIALITY POLYMER****9**

Polymers – Types of polymerization – degree of polymerization – plastics and types – mechanism of polymerization (free radical mechanism) properties of polymers -  $T_g$  and tacticity – compounding of plastics – fabrication of plastics – Blow and extrusion mouldings. Speciality polymers-conducting polymers: polyacetylene, polyaniline, synthesis, mechanism of conduction – applications of conducting polymers. Bio-degradable polymers: requirements, factors affecting degradation – PLA– preparation, properties –applications.

**UNIT II ELECTROCHEMISTRY, CORROSION AND PROTECTIVE COATINGS****9**

Electrode potential – Nernst equation, numerical problems – Emf series, applications, electrochemical cells, galvanic cells, electrolytic concentration cells – Emf measurement problems. Corrosion: dry & wet corrosion – mechanism, factors affecting corrosion - corrosion control, material selection and design aspects – corrosion protection – sacrificial anode and impressed current methods. Protective coatings: Metallic coatings – electroplating of Cu - electroless plating of Ni. Organic coatings: Paints - constituents and function, special paints – water repellent, heat resistant and luminous paints.

**UNIT III PHOTOCHEMISTRY & ANALYTICAL TECHNIQUES****9**

Photochemistry: Laws of photochemistry - Grothuss–Draper law, Stark–Einstein law and Beer-Lambert's Law. Quantum efficiency – determination - photophysical processes (Jablonski diagram) - photosensitization - chemiluminescence and bioluminescence. Analytical techniques: IR, UV – principle, Instrumentation and applications. Thermal analysis: TGA & DTA - principle, instrumentation and applications.

Chromatography: Basic principles of column & TLC – principles and applications.

**UNIT IV THERMODYNAMICS****9**

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function- Helmholtz and Gibbs free energy functions (problems); criteria of spontaneity; Gibbs- Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore (problems).

**UNIT V NANO CHEMISTRY****9**

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties (surface to volume ratio, melting point, optical and electrical). nanoparticles, nanocluster, nanorod, nanotube (CNT: SWNT and MWNT) and nanowire, synthesis - precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process and applications (electronic and biomedical). Fullerenes: Types -  $C_{60}$  - preparation, properties and applications.

**TOTAL: 45 PERIODS**

## OUTCOMES

- The knowledge gained on polymer chemistry, thermodynamics, spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

## TEXT BOOKS

1. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd., 2012.

## REFERENCES

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
3. B. K. Sharma, "Engineering Chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2012

**OCE551**

**AIR POLLUTION AND CONTROL ENGINEERING**

**L T P C**

**3 0 0 3**

## OBJECTIVE:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

## UNIT I INTRODUCTION

**7**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards.

## UNIT II METEOROLOGY

**6**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

## UNIT III CONTROL OF PARTICULATE CONTAMINANTS

**11**

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

## UNIT IV CONTROL OF GASEOUS CONTAMINANTS

**11**

Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

## UNIT V INDOOR AIR QUALITY MANAGEMENT

**10**

Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
- ability to identify, formulate and solve air and noise pollution problems
- ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipments.
- Ability to ensure quality, control and preventive measures.

**TEXTBOOKS:**

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

**REFERENCES:**

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
4. M.N Rao and HVN Rao, "Air Pollution",Tata Mcgraw Hill Publishing Company limited,2007.
5. C.S.Rao, "Environmental Pollution Control Engineering",New Age International(P) Limited Publishers,2006.

**OAT551****AUTOMOTIVE SYSTEMS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

**UNIT I          AUTOMOTIVE ENGINE AUXILIARY SYSTEMS****9**

Automotive engines- External combustion engines –Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system.

**UNIT II          VEHICLE FRAMES AND STEERING SYSTEM****9**

Vehicle construction and different Chassis layouts –classifications of chassis- types of frames- frameless chassis construction –articulated vehicles- vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system –conventional – sophisticated vehicle- and types of steering gear box-Power Steering- Steering geometry-condition for true rolling motion-Ackermann's- Devi's steering system - types of stub axle – Types of rear axles.

**UNIT III TRANSMISSION SYSTEMS 9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints – Hotchkiss Drive and Torque Tube Drive- rear axle-Differential-wheels and tyres.

**UNIT IV SUSPENSION AND BRAKES SYSTEMS 9**

Suspension Systems- conventional Suspension Systems -independent Suspension Systems –leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient .

**UNITV ALTERNATIVE ENERGY SOURCES 9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers -Engine emission control by three way catalytic converter system.

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

**TEXT BOOKS:**

1. Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2007.
2. Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.

**REFERENCES:**

1. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.
2. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.
3. Martin W, Stockel and Martin T Stockle , “Automotive Mechanics Fundamentals,” The Good heart –Will Cox Company Inc, USA ,1978.
4. Newton ,Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.

**OIC551**

**BIOMEDICAL INSTRUMENTATION**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples

- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

**UNIT I HUMAN BODY SUBSYSTEM AND TRANSDUCERS 9**

Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes.

**UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT 9**

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Blood Gas analysers, pH of blood – Measurement of blood pCO<sub>2</sub>, pO<sub>2</sub>.

**UNIT III ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY 9**

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current - Instruments for checking safety parameters of biomedical equipments.

**UNIT IV IMAGING MODALITIES AND BIO-TELEMETRY 9**

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems.

**UNIT V LIFE ASSISTING AND THERAPEUTIC DEVICES 9**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators - Heart Lung machine – Dialysers - Diathermy – Lithotripsy.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to understand communication mechanics in a biomedical system.
- Ability to understand and analyze measurement of certain electrical and non-electrical parameters.
- Ability to understand basic principles of imaging techniques, life assisting and therapeutic devices.

**TEXT BOOKS:**

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4<sup>th</sup> Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2<sup>nd</sup> Edition, 2003.

**REFERENCES:**

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2<sup>nd</sup> Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.

5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

**OIT552**

**CLOUD COMPUTING**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To learn about the concept of cloud and utility computing.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

**UNIT I INTRODUCTION TO CLOUD COMPUTING 9**

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

**UNIT II VIRTUALIZATION 9**

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Seven Layers of Virtualization – Types of Virtualization – Server, Desktop, Application Virtualization.

**UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9**

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

**UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9**

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security – Application Security – Virtual Machine Security.

**UNIT V CASE STUDIES 9**

Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**On Completion of the course, the students should be able to:**

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.
- Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

**TEXT BOOKS:**

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017.



**REFERENCES:**

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

<b>OEC551</b>	<b>CONTROL SYSTEMS ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

**UNIT I                    SYSTEMS COMPONENTS AND THEIR REPRESENTATION                    9**

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchros -Multivariable control system

**UNIT II                    TIME REPOSE ANALYSIS                    9**

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD,PI,PID control systems

**UNIT III                    FREQUENCY RESPONSE AND SYSTEM ANALYSIS                    9**

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

**UNIT IV                    CONCEPTS OF STABILITY ANALYSIS                    9**

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

**UNIT V                    CONTROL SYSTEM ANALYSIS USING STATE VARIABLE                    9**  
**METHODS**

State variable representation-Conversion of state variable models to transfer functions- Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

**TOTAL:45 PERIODS****OUTCOMES:**

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

- Identify the various control system components and their representations.
- Analyze the various time domain parameters.
- Analysis the various frequency response plots and its system.
- Apply the concepts of various system stability criterions.
- Design various transfer functions of digital control system using state variable models.

**TEXT BOOK:**

1. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

**REFERENCES**

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5 th Edition, 2007.
2. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
3. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
4. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.

**OIT551**

**DATABASE MANAGEMENT SYSTEMS**

**L T P C**

**3 0 0 3**

**OBJECTIVES**

- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

**UNIT I DBMS AND CONCEPTUAL DATA MODELING**

**9**

Purpose of Database System – Data independence - Data Models – Database System Architecture – Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases – Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.

**UNIT II DATABASE QUERYING**

**11**

Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries – joins - aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables with simple and complex queries.

**UNIT III DATABASE PROGRAMMING**

**7**

Database programming with function calls, stored procedures - views – triggers. Embedded SQL. ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM, implementing functions, views, and triggers in MySQL / Oracle.

**UNIT IV DATABASE DESIGN**

**9**

Functional Dependencies – Design guidelines – Normal Forms: first, second, third – Boyce/Codd Normal Form – Normalization algorithms. Design of a banking database system / university database system.

**UNIT V          ADVANCED TOPICS****9**

Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of the course, the students will be able to:**

- understand relational data model, evolve conceptual model of a given problem, its mapping to relational model and Normalization
- query the relational database and write programs with database connectivity
- understand the concepts of database security and information retrieval systems

**TEXT BOOKS:**

1. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition, Pearson, 2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill, 2011

**REFERENCES:**

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.

**OME551****ENERGY CONSERVATION AND MANAGEMENT****L T P C  
3 0 0 3****OBJECTIVES:**

At the end of the course, the student is expected to

- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

**UNIT I          INTRODUCTION****9**

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

**UNIT II          ELECTRICAL SYSTEMS****9**

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, 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 III          THERMAL SYSTEMS****9**

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

**UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 9**  
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

**UNIT V ECONOMICS 9**  
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students can able to analyse the energy data of industries.

- Can carryout energy accounting and balancing
- Can suggest methodologies for energy savings

**TEXT BOOKS:**

1. Energy Manager Training Manual (4 Volumes) available at [www.energymanagertraining.com](http://www.energymanagertraining.com), a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

**REFERENCES:**

1. Witte. L.C., 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. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

**OAI551 ENVIRONMENT AND AGRICULTURE L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.

**UNIT I ENVIRONMENTAL CONCERNS 8**  
Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

**UNIT II ENVIRONMENTAL IMPACTS 9**  
Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

**UNIT III CLIMATE CHANGE 8**  
Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.

**UNIT IV ECOLOGICAL DIVERSITY AND AGRICULTURE 10**  
Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

**UNIT V EMERGING ISSUES****10**

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Students will appreciate the role of environment in the current practice of agriculture and concerns of sustainability, especially in the context of climate change and emerging global issues.
- Ecological context of agriculture and its concerns will be understood

**TEXTBOOKS:**

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

**REFERENCES:**

1. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century : proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

**OCY552****FUEL CELL CHEMISTRY****L T P C****3 0 0 3****OBJECTIVES**

- To create awareness about alternate clean fuel available.
- To familiarize the students with the concepts and chemistry of fuel cell

**UNIT I INTRODUCTION****9**

Overview of fuel cells: Low and high temperature fuel cells; Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency.

**UNIT II FUEL CELL KINETICS****9**

Fuel cell reaction kinetics - electrode kinetics, overvoltage, Tafel equation, charge transfer reaction, exchange currents, electro catalysis - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.

**UNIT III CHARACTERIZATION TECHNIQUES****9**

Fuel cell characterization - in-situ and ex-situ characterization techniques, i-V curve, frequency response analysis; Fuel cell modeling and system integration: - 1D model – analytical solution and CFD models.

**UNIT IV RENEWABLE SOURCES****9**

Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation and life cycle analysis of fuel cells.

**UNIT V APPLICATIONS OF FUEL CELL****9**

Fuel cell power plants: fuel processor, fuel cell power section (fuel cell stack), power conditioner; automotive applications, portable applications

**TOTAL: 45 PERIODS****OUTCOME**

- Students will be aware of alternate energy sources and its importance of it.

**TEXTBOOKS**

1. Gregor Hoogers, "Fuel Cell Technology Handbook", CRC Press, 2003.
2. R.P. O'Hayre, S. Cha, W. Colella, F.B. Prinz, "Fuel Cell Fundamentals", Wiley, 2006.
3. A. J. Bard, L. R. Faulkner, "Electrochemical Methods", Wiley, 2004.

**REFERENCES**

1. S. Basu, "Fuel Cell Science and Technology", Springer, 2007.
2. H. Liu, "Principles of Fuel Cells", Taylor & Francis, 2006.

**OCE552****GEOGRAPHIC INFORMATION SYSTEM****L T P C****3 0 0 3****OBJECTIVES :**

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output processes.

**UNIT I FUNDAMENTALS OF GIS****9**

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

**UNIT II SPATIAL DATA MODELS****9**

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.

**UNIT III DATA INPUT AND TOPOLOGY****9**

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input – Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

**UNIT IV DATA ANALYSIS****9**

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Elevation models - 3D data collection and utilisation.

**UNIT V APPLICATIONS****9**

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

**TOTAL: 45 PERIODS****OUTCOME:**

This course equips the student to

- Have basic idea about the fundamentals of GIS.
- Understand the types of data models.
- Get knowledge about data input and topology.
- Gain knowledge on data quality and standards.
- Understand data management functions and data output

**TEXT BOOKS:**

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

**REFERENCE:**

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

**OMD552**

**HOSPITAL WASTE MANAGEMENT**

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

**OBJECTIVES:**

**The student should be made to:**

- Know about the healthcare hazard control and accidents
- Understand biomedical waste management
- Learn the facility guidelines, infection control and patient safety.

**UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9**

Healthcare Hazard Control: Introduction, Hazard Control: Management & Responsibilities, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, Accident Analysis, Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

**UNIT II BIOMEDICAL WASTE MANAGEMENT 9**

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal.

**UNIT III HAZARDOUS MATERIALS 9**

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.

**UNIT IV FACILITY SAFETY 9**

Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground Maintenance, Fleet and Vehicle Safety.

**UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY 9**

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Healthcare-Associated Infections, Medication Safety.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- After successful completion of the course, the students will be able to know the concepts of healthcare waste management, its prevention and safety.

**REFERENCES:**

1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press\_Taylor and Francis (2014).
2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).

**OCY553**

**INDUSTRIAL CHEMISTRY**

**L T P C**

**3 0 0 3**

**OBJECTIVES**

- Elaborate study of fuels-introduction – classification, preparation, properties - alternate fuels.
- To get introduced to high polymers such as rubber and plastics and to industrial importance of cementing materials.
- To get introduction on the chemistry of various industrial processes such as sugar and leather processing.

**UNIT I INORGANIC CEMENTING MATERIALS**

**9**

Introduction - Lime and its manufacture - Gypsum plaster - cement - types of cement, chemical composition-manufacture of Portland cement - chemical composition of Portland cement - setting and hardening of Portland cement. Heat of hydration of cement - special cement - concrete and RCC - decay of concrete-glass and ceramics - Introduction - manufacture of glass - varieties of glasses- plasticity of clay - white wares, glazing- applications - Earthenware's and stoneware's - optical fibers.

**UNIT II FUELS AND COMBUSTION**

**9**

Introduction - classification of fuels - calorific value - gross calorific value and net calorific value - characteristics of a good fuel. theoretical calculation of calorific value of a fuel - solid fuels – wood-coal - classification of coal by rank - selection of coal - analysis of coal and its significance -types of coking - types of carbonization of coal - role of sulphur in coal - role of ash in coal. Gaseous fuels - producer gas - water gas - natural gas - oil gas - biogas - components - composition-preparation - advantages- disadvantages and applications of coal gas.

**UNIT III RUBBER AND PLASTICS**

**9**

Introduction to rubber - latex - processing latex - mastication - compounding of rubber - vulcanizations of rubber - engineering polymers thermoforming - degradation stability and environment- synthetic rubbers - preparation and applications of SBR - butyl rubber - nitrile rubber - neoprene and silicone rubber- plastic materials - classification of plastics (or resins) - moulding constituents of a plastic - fabrication techniques used for thermoplastic resin (moulding process)-important thermoplastic resins- natural resins - celluloses - polyethylene – PVC.

**UNIT IV PAINTS, PIGMENTS AND INSULATING MATERIALS**

**9**



Paints - ingredients and their functions required properties of a paint - paint constituents and their functions - manufacture of paint- types of pigments - characteristics of pigment - oils - uses in paint - emulsion paints - special paints - paint remover. varnishes - lacquers – enamels-electrical insulating materials - dielectric properties - requirements of an electrical insulating material - classification of insulating material - electrical rigid insulations.

## **UNIT V SUGAR AND LEATHER CHEMISTRY**

**9**

Sugar Chemistry - introduction - manufacture of cane sugar - recovery of sugar from molasses - preparation of celotex - manufacture of sucrose from beat root - testing and estimation of sugar-leather chemistry - introduction - manufacture of leather preparation of hides for tanning - vegetable, chrome and oil tanning - byproduct.

**TOTAL: 45 PERIODS**

### **OUTCOMES**

- Will have knowledge about adsorption and oxidation process.
- Will gain idea about various methods available for water treatment.
- Will appreciate the necessity of water and acquire knowledge of preliminary treatment.

### **TEXTBOOKS:**

1. B.K. Sharma, "Industrial chemistry, Krishna Prakashan Media (p) Ltd"., 2011.
2. K. Bagavathi, "Sundari Applied Chemistry", 1<sup>st</sup> Ed., MJP Publishers, , 2006.
3. Jayashree Ghosh, "Fundamental Concept of Applied Chemistry", S. Chand & Company Ltd., 2006.

### **REFERENCES:**

1. A. Heaton, "An Introduction to Industrial Chemistry. 3<sup>rd</sup> Ed., Chapman and Hall, New York, 1996.
2. H.L. White, "Introduction to Industrial Chemistry", 1<sup>st</sup> Ed., John Wiley, 2015.

**OBM552**

**MEDICAL PHYSICS**

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

### **OBJECTIVES:**

- To study the complete non-ionizing radiations including light and its effect in human body.
- To understand the principles of ultrasound radiation and its applications in medicine.
- To learn about radioactive nuclides and also the interactions of radiation with matters and how isotopes are produced.
- To study the harmful effects of radiation and radiation protection regulations.

## **UNIT I NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS**

**9**

Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermography.

## **UNIT II ULTRASOUND IN MEDICINE**

**9**

Ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission- Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications- Ultrasonography.

**UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES AND DECAY 9**

Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture- Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide: fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide - Radionuclide Generator-Techneium generator.

**UNIT IV INTERACTION OF RADIATION WITH MATTER 9**

Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production- Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

**UNIT V RADIATION EFFECTS AND REGULATIONS 9**

Classification of Radiation Damage, Stochastic and Deterministic Effects, Acute Effects of Total Body Irradiation, Long-Term Effects of Radiation, Risk Versus Benefit in Diagnostic Radiology and Nuclear Medicine, Risk of Pregnant Women, Nuclear Regulatory Commission, ALARA Program, Medical Uses of Radioactive Materials, Survey for Contamination and Exposure Rate, Dose Calibrators and Survey Meters, Bioassay, Radioactive Waste Disposal.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasound wave.
- Explain the process of radioactive nuclide production using different techniques
- Analyze radiation mechanics involved with various physiological systems
- Outline the detrimental effects of radiation and regulations for radiation safety.

**TEXT BOOKS:**

1. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2<sup>nd</sup> Edition, IOP Publishers.2001. (Unit I & II)
2. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4<sup>th</sup> Edition, Springer, 2013. (Unit III & IV)
3. R.Hendee and Russell Ritenour “Medical Imaging Physics”, Fourth Edition William, Wiley-Liss, 2002. (Unit V)

**REFERENCES:**

1. S.Webb “ The Physics of Medical Imaging”, Taylor and Francis, 1988
2. HyltonB.Meire and Pat Farrant “Basic Ultrasound” John Wiley & Sons, 1995
3. John R Cameran , James G Skofronick “Medical Physics” John-Wiley & Sons. 1978
4. W.J.Meredith and J.B. Massey “ Fundamental Physics of Radiology” Third edition ,Varghese Publishinghouse. 1992

**OBJECTIVE:**

- This course will cover the basic principles and techniques of optical and electron microscopy. This course also deals with the sample preparation techniques for the microstructural analysis.

**UNIT I INTRODUCTION****9**

History of Microscopy, Overview of current microscopy techniques. Light as particles and waves, Fundamental of optics: Diffraction and interference in image formation, real and virtual images, Resolution, Depth of field and focus, Magnification, Numerical aperture, Aberration of lenses. Components of Light Microscopy, Compound light microscopy and its variations.

**UNIT II MICROSCOPY****9**

Phase contrast microscopy: optical design, theory, image interpretation, Dark-field microscopy: optical design, theory , image interpretation, Polarization Microscopy: Polarized light, optical design, theory , image interpretation, Differential Interference Contrast (DIC): equipment and optics, image interpretation, Modulation contrast microscopy: contrast methods using oblique illumination.

**UNIT III ELECTRON MICROSCOPY****9**

Interaction of electrons with matter, elastic and inelastic scattering, secondary effects, Components of electron microscopy: Electron sources, pumps and holders, lenses, apertures, and resolution. Scanning Electron and Transmission Electron Microscopy: Principle, construction, applications and limitations.

**UNIT IV SAMPLE PREPARATION FOR MICROSTRUCTURAL ANALYSIS****9**

Optical Microscopy sample preparation: Grinding, polishing and etching, SEM sample preparation: size constrains, TEM sample preparation: Disk preparation, electro polishing, ion milling, lithography, storing specimens.

**UNIT V CHEMICAL ANALYSIS****9**

Surface chemical composition (Principle and applications) - Mass spectroscopy and X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy. Electron spectroscopy for chemical analysis (ESCA), Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES)- Applications.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Able to understand the physics behind the microscopy.
- Ability to describe the principle, construction and working of light microscopy.
- Ability to appreciate about electron microscopy.
- Ability to understand about the important of sample preparation technique.
- Ability to identify the appropriate spectroscopy technique for chemical analysis.

**TEXT BOOKS**

1. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA

- David B. Williams and C. Barry Carter, Transmission Electron Microscopy-A Textbook for Materials Science, Springer US, 2nd edition, 2009.

**REFERENCES:**

- Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.
- Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation", Ninth Edition, ASM international, USA, 1986.
- Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.

**OAI552                      PARTICIPATORY WATER RESOURCES MANAGEMENT                      L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To gain an insight on local and global perceptions and approaches on participatory water resource management

**UNIT I                      FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH                      6**  
 Sociology – Basic concepts – Perspectives- Social Stratification – Irrigation as a Socio technical Process - Participatory concepts– Objectives of participatory approach

**UNIT II                      UNDERSTANDING FARMERS PARTICIPATION                      10**  
 Farmers participation –need and benefits – Comparison of cost and benefit -Sustained system performance - Kinds of participation – Context of participation, factors in the environment – WUA - Constraints in organizing FA – Role of Community Organiser – Case Studies.

**UNIT III                      ISSUES IN WATER MANAGEMENT                      9**  
 Multiple use of water – Issues in Intersectoral Water Allocation - domestic, irrigation, industrial sectors - modernization techniques – Rehabilitation – Command Area Development - Water delivery systems

**UNIT IV                      PARTICIPATORY WATER CONSERVATION                      10**  
 Global Challenges -Social – Economic – Environmental - Solutions –Political - Water Marketing – Water Rights -Consumer education – Success Stories Case Studies

**UNIT V                      PARTICIPATORY WATERSHED DEVELOPMENT                      10**  
 Concept and significance of watershed - Basic factors influencing watershed development – Principles of watershed management - Definition of watershed management – Identification of problems - Watershed approach in Government programmes – People’s participation – Entry point activities - Evaluation of watershed management measures.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Gain knowledge on various processes involved in participatory water resource management.
- Understand farmers participation in water resources management.
- Aware of the issues related to water conservation and watershed development
- Get knowledge in participatory water conservation
- Understand concept , principle , approach of watershed management.

**TEXTBOOKS:**

- Sivasubramaniyan, K. Water Management, SIMRES Publication, Chennai, 2011

2. Uphoff.N., Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, No.11, Westview press, Boulder,CO, 1986.
3. Tideman, E.M., “Watershed Management”, Omega Scientific Publishers, New Delhi, 1996.

**REFERENCE:**

1. Chambers Robert, Managing canal irrigation, Cambridge University Press, 1989

**OMF551**

**PRODUCT DESIGN AND DEVELOPMENT**

**L T P C**

**3 0 0 3**

**OBJECTIVE:**

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

**UNIT I INTRODUCTION**

**9**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

**UNIT II CONCEPT GENERATION AND SELECTION**

**9**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

**UNIT III PRODUCT ARCHITECTURE**

**9**

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

**UNIT IV INDUSTRIAL DESIGN**

**9**

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

**UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT**

**9**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

**TOTAL: 45 PERIODS**



Numerical control (NC) machine tools - CNC: types, constitutional details, special features - design considerations of CNC machines for improving machining accuracy - structural members - slide ways - linear bearings - ball screws - spindle drives and feed drives. Part programming fundamentals - manual programming.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Upon completion of this course, the students can able to apply the different manufacturing process and use this in industry for component production.

**TEXTBOOKS:**

1. "Manufacturing Engineering and Technology", Kalpakjian and Schmid, Pearson, 2010.
2. Hajra Choudry, "Elements of workshop technology - Vol II", Media promoters, 2002.

**REFERENCES:**

1. Gupta. K.N., and Kaushik, J.P., 1998, Workshop Technology Vol I and II, New Heights, Daryaganj, New Delhi.
2. Arthur. D., et. al. 1998, General Engineering Workshop Practice, Asia Publishing House, Bombay.
3. Chapman W.A.J., Workshop Technology, 1992, Part I, II, III, E.L.B.S. and Edward Arnold Publishers Ltd, London.

**ORO551**

**RENEWABLE ENERGY SOURCES**

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

**OBJECTIVES:**

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

**UNIT I PRINCIPLES OF SOLAR RADIATION**

**10**

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

**UNIT II SOLAR ENERGY COLLECTION**

**8**

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS**

**7**

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

**UNIT IV WIND ENERGY**

**10**





Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

**UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclometers.

**UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

**UNIT V SIGNAL CONDITIONING and DAQ SYSTEMS 9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students will be able to

- CO1.** Expertise in various calibration techniques and signal types for sensors.
- CO2.** Apply the various sensors in the Automotive and Mechatronics applications
- CO3.** Study the basic principles of various smart sensors.
- CO4.** Implement the DAQ systems with different sensors for real time applications

**TEXT BOOKS:**

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12<sup>th</sup> edition, Dhanpat Rai & Co, New Delhi, 2013.

**REFERENCES**

1. Patranabis D, “Sensors and Transducers”, 2<sup>nd</sup> Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2<sup>nd</sup> edition, CRC Press, 2015.

**OCS551**

**SOFTWARE ENGINEERING**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To understand the phases in a software development project
- To learn project management concepts
- To understand the concepts of requirements analysis and modeling.
- To understand software design methodologies
- To learn various testing methodologies
- To be familiar with issues related to software maintenance

<b>UNIT I</b>	<b>SOFTWARE PROCESS</b>	<b>9</b>
Introduction to Software Engineering, scope – software crisis – principles of software engineering - Software process – Life cycle models – Traditional and Agile Models - Team organization.		
<b>UNIT II</b>	<b>PLANNING AND ESTIMATION</b>	<b>9</b>
Planning and the software process – cost estimation: LOC, FP Based Estimation, COCOMO I & II Models – Duration estimation and tracking – Gantt chart - Software Project Management – plan – risk analysis and management.		
<b>UNIT III</b>	<b>REQUIREMENTS ANALYSIS AND SPECIFICATION</b>	<b>9</b>
Software Requirements: Functional and Non-Functional, Software Requirements specification– Structured system Analysis – modeling: UML based tools, DFD - Requirement Engineering Process.		
<b>UNIT IV</b>	<b>SOFTWARE DESIGN AND IMPLEMENTATION</b>	<b>9</b>
Design process – Design principles and guidelines – design techniques – coupling and cohesion - metrics – tools. Implementation: choice of programming language, programming practices – coding standards – code walkthroughs and inspections.		
<b>UNIT V</b>	<b>TESTING AND MAINTENANCE</b>	<b>9</b>
Software testing fundamentals- Testing techniques: white box, black box, glass box testing - unit testing – integration testing –system testing – acceptance testing – debugging. Post-delivery maintenance: Types – objectives - metrics - Reverse Engineering.		
		<b>TOTAL: 45 PERIODS</b>

**OUTCOMES:**

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

- Understand different software life cycle models.
- Perform software requirements analysis
- Apply systematic methodologies for software design and deployment.
- Understand various testing approaches and maintenance related issues.
- Plan project schedule, and estimate project cost and effort required.

**TEXT BOOKS:**

1. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education Asia, 2011.

**REFERENCES:**

1. Rajib Mall, “Fundamentals of Software Engineering”, Third Edition, PHI Learning Private Limited, 2009.
2. Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 2010.
3. Kelkar S.A., “Software Engineering”, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, “Software Engineering”, Tata McGraw-Hill Publishing Company Limited,2007.
5. <http://nptel.ac.in/>.

**OBJECTIVES:**

The student should be made to:

- Learn the key principles for telemedicine and health.
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and its applications

**UNIT I TELEMEDICINE AND HEALTH 9**

History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

**UNIT II TELEMEDICAL TECHNOLOGY 9**

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.

**UNIT III TELEMEDICAL STANDARDS 9**

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to be followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine

**UNIT IV MOBILE TELEMEDICINE 9**

Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system

**UNIT V TELEMEDICAL APPLICATIONS 9**

Telemedicine – health education and self care. Introduction to robotics surgery, Telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects - Project planning and costing, Usage of telemedicine.

**OUTCOMES:**

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

- Apply multimedia technologies in telemedicine.
- Explain Protocols behind encryption techniques for secure transmission of data.
- Apply telehealth in healthcare.

**TEXT BOOK:**

1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002

**REFERENCES:**

1. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006

2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.
3. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.
4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.
5. Bemmell, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997
6. Mohan Bansal " Medical Informatics", Tata McGraw-Hill, 2004.

**OAI751      AGRICULTURAL FINANCE, BANKING AND CO-OPERATION      L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To make the students aware about the agricultural Finance, Banking and Cooperation.
- To acquaint the students with the basic concepts, principles and functions of management.
- To understand the process of finance banking and cooperation.

**UNIT I      AGRICULTURAL FINANCE - NATURE AND SCOPE      9**

Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural Credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - Institutional agencies: Advantages and Disadvantages - Rural indebtedness: consequences of rural indebtedness - History and Development of rural credit in India.

**UNIT II      FARM FINANCIAL ANALYSIS      9**

Principles of Credit - 5C's, 5R's and 7P's of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow statement - Financial Ratio Analysis.

**UNIT III      FINANCIAL INSTITUTIONS      9**

Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural Development Branches - Area Approach - Priority Sector Lending - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and its role in poverty alleviation - Self-Help Groups - Non -Governmental Organizations - Rural credit policies followed by State and Central Government - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).

**UNIT IV      CO-OPERATION      9**

Co-operation: Philosophy and Principles - History of Indian Cooperative Credit Movement: Pre and Post-Independence periods and Cooperation in different plan periods - Cooperative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of cooperative credit system, Policies for revitalizing cooperative credit: Salient features of Vaithiyanathan Committee Report on revival of rural cooperative credit institutions, Reorganisation of Cooperative credit structure in Andhra Pradesh and single window system and successful cooperative credit systems in Gujarat, Maharashtra, Punjab etc, - Special

cooperatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd., (NAFSCOB) - Objectives and Functions.

## **UNIT V            BANKING AND INSURANCE**

**9**

Negotiable Instruments: Meaning, Importance and Types - Central Bank: RBI - functions - credit control - objectives and methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial inclusion and Exclusion: Credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non - Banking Financial Institutions (NBFI) - Assessment of crop losses, Determination of compensation - Crop insurance: Schemes, Coverage, Advantages and Limitations in implementation - Estimation of crop yields - Livestock, insurance schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

**TOTAL: 45 PERIODS**

### **OUTCOME:**

After completion of this course, the students will

- Be familiar with agricultural finance, Banking, cooperation and basic concepts, principles and functions of management.

### **REFERENCES:**

1. Muniraj, R., 1987, Farm Finance for Development, Oxford & IBH, New Delhi
2. Subba Reddy. S and P.Raghu Ram 2011, Agricultural Finance and Management, Oxford & IBH, New Delhi.
3. Lee W.F., M.D. Boehlje A.G., Nelson and W.G. Murray, 1998, Agricultural Finance, Kalyani Publishers, New Delhi.
4. Mammoria, C.B., and R.D. Saxena 1973, Cooperation in India, Kitab Mahal, Allahabad.

**OGI751**

## **CLIMATE CHANGE AND ITS IMPACT**

**L T P C**

**3 0 0 3**

### **OBJECTIVES:**

- To understand the basics of weather and climate
- To have an insight on Atmospheric dynamics and transport of heat
- To develop simple climate models and evaluate climate changes using models

## **UNIT I            BASICS OF WEATHER AND CLIMATE:**

**9**

Shallow film of Air– stratified & disturbed atmosphere – law – atmosphere Engine. Observation of parameters: Temperature – Humidity – Wind - Pressure – precipitation-surface – networks. Constitution of atmosphere: well stirred atmosphere – process around turbopause – in dry air – ozone – carbon Dioxide – Sulphur Dioxide– Aerosol - water. Evolution of Atmosphere. State of atmosphere: Air temperature – pressure – hydrostatic – Chemistry – Distribution – circulation

## **UNIT II            ATMOSPHERIC DYNAMICS:**

**9**

Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion - solving and forecasting. Forces – Relative and absolute acceleration – Earth's rotation *coriolis* on sphere – full equation of motion – Geostrophy;- Thermal winds –departures – small-scale motion. Radiation, convection and advections: sun & solar radiation – energy balance – terrestrial radiation and the atmosphere – Green house effect- Global warming - Global budget – radiative fluxes - heat transport. Atmosphere and ocean systems convecting & advecting heat. Surface and boundary layer – smaller scale weather system – larger scale weather system.

**UNIT III GLOBAL CLIMATE 9**

Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation - latitude – longitude dependence of climate features. Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean *thermohaline* circulation – land surface processes – carbon cycle.

**UNIT IV CLIMATE SYSTEM PROCESSES 9**

Conservation of motion: Force – *coriolis* - pressure gradient- velocity equations – Application – geotropic wind – pressure co-ordinates. Equation of State – atmosphere – ocean. Application: thermal circulation – sea level rise. Temperature equation: Ocean – air – Application – decay of sea surface temperature. Continuity equation: ocean – atmosphere. Application: coastal upwelling – equatorial upwelling – conservation of warm water mass. Moisture and salinity equation: conservation of mass – moisture. Source & sinks – latent heat. Moist processes – saturation – convection – Wave processes in atmosphere and ocean.

**UNIT V CLIMATE CHANGE MODELS 9**

Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming – climate change observed to date. .

**TOTAL:45 PERIODS**

**OUTCOMES:**

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

- The concepts of weather and climate
- The principles of Atmospheric dynamics and transport of heat and air mass
- The develop simple climate models and to predict climate change

**TEXTBOOKS:**

1. Fundamentals of weather and climate (2<sup>nd</sup> Edition) Robin Moilveen (2010), Oxford University Press
2. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.

**OCS751 DATA STRUCTURES AND ALGORITHMS L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the various algorithm design and analysis techniques
- To learn linear data structures – lists, stacks, and queues
- To learn different sorting and searching algorithms
- To understand Tree and Graph data structures

**UNIT I ALGORITHM ANALYSIS, LIST ADT 11**

Algorithms: Notation - analysis – running time calculations. Abstract Data Types (ADTs): List ADT – array-based implementation – linked list implementation – singly linked lists- applications of lists: Polynomial Manipulation. Implementation of List ADT using an array and using a linked list in C.

<b>UNIT II</b>	<b>STACKS AND QUEUES</b>	<b>7</b>
Stack ADT - Applications - Evaluating arithmetic expressions- Conversion of Infix to Postfix- Recursion. Queue ADT – Priority Queue - applications of queues. Implementation of Stack ADT and palindrome checking using C. Implementation of Queue operations using arrays in C.		
<b>UNIT III</b>	<b>SEARCHING AND SORTING ALGORITHMS</b>	<b>10</b>
Divide and conquer methodology - Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort. Analysis of searching and sorting techniques. Implementation of linear search, binary search, insertion sort, merge sort and quick sort algorithms in C.		
<b>UNIT IV</b>	<b>TREES</b>	<b>9</b>
Tree ADT – tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees. Heap – applications of heap. Implementation of Binary search tree and its operations, tree traversal methods, finding height of the tree using C. Implementation of heap and heap sorting using arrays in C.		
<b>UNIT V</b>	<b>GRAPHS</b>	<b>8</b>
Definition – Representation of Graph – Breadth-first traversal - Depth-first traversal – Dynamic programming Technique – Warshall’s and Floyd’s algorithm – Greedy method - Dijkstra’s algorithm – applications of graphs. Implementation of graph, graph traversal methods, finding shortest path using Dijkstra’s algorithm in C		

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- Implement linear data structures and solve problems using them.
- Implement and apply trees and graphs to solve problems.
- Implement the various searching and sorting algorithms.

**TEXT BOOKS:**

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2<sup>nd</sup> Edition, Pearson Education, 1997.
2. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, Pearson Education, 1988.

**REFERENCES:**

1. Aho, Hopcroft and Ullman, “Data Structures and Algorithms”, Pearson Education, 1983.
2. S.Sridhar, “Design and Analysis of Algorithms”, First Edition, Oxford University Press. 2014
3. Byron Gottfried, Jitender Chhabra, “Programming with C” (Schaum’s Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010
4. Yashvant Kanetkar, “Data Structures Through C”, BPB publications, II edition, 2003

<b>OME751</b>	<b>DESIGN OF EXPERIMENTS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To impart knowledge on various types of experimental designs conduct of experiments and data analysis techniques.

<b>UNIT I</b>	<b>FUNDAMENTALS OF EXPERIMENTAL DESIGNS</b>	<b>9</b>
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test,		

terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

**UNIT II SINGLE FACTOR EXPERIMENTS 9**

Completely Randomized Design- effect of coding the observations- model adequacy checking- estimation of model parameters, residuals analysis- treatment comparison methods-Duncan's multiple range test, Newman-Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design –Applications.

**UNIT III FACTORIAL DESIGNS 9**

Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares-  $2^k$  Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

**UNIT IV SPECIAL EXPERIMENTAL DESIGN 9**

Blocking and Confounding in  $2^k$  Designs- blocking in replicated design-  $2^k$  Factorial Design in two blocks- Complete and partial confounding- Confounding  $2^k$  Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of  $2^k$  Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of  $2^k$  Design

**UNIT V TAGUCHI METHODS 9**

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Able to apply experimental techniques to practical problems to improve quality of processes / products by optimizing the process / product parameters.

**TEXT BOOK:**

1. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.

**REFERENCES:**

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2005
2. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

**OCE751 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT L T P C  
3 0 0 3**

**OBJECTIVE:**

- To impart the knowledge and skills to identify, assess and mitigate the environmental and social impacts of developmental projects

**UNIT I INTRODUCTION 9**



Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework.

**UNIT II ENVIRONMENTAL ASSESSMENT 9**

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction.

**UNIT III ENVIRONMENTAL MANAGEMENT PLAN 9**

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Public Hearing-Environmental Clearance

**UNIT IV SOCIO ECONOMIC ASSESSMENT 9**

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis-

**UNIT V CASE STUDIES 9**

EIA case studies pertaining to Infrastructure Projects – Roads and Bridges – Mass Rapid Transport Systems - Airports - Dams and Irrigation projects - Power plants.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- carry out scoping and screening of developmental projects for environmental and social assessments
- explain different methodologies for environmental impact prediction and assessment
- plan environmental impact assessments and environmental management plans
- evaluate environmental impact assessment reports

**TEXTBOOKS:**

1. Canter, R.L, “Environmental impact Assessment “, 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, “Environmental Impact Assessment for Developing Countries in Asia”, Volume 1 – Overview, Asian Development Bank, 1997.
3. Peter Morris, Riki Therivel “Methods of Environmental Impact Assessment”, Routledge Publishers, 2009.

**REFERENCES:**

1. Becker H. A., Frank Vanclay, “The International handbook of social impact assessment” conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, “Environmental Impact Assessment Training Resource Manual”, United Nations Environment Programme, 2002.
3. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I and II”, Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

OEN751

**GREEN BUILDING DESIGN**

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

**UNIT I ENVIRONMENTAL IMPLICATIONS OF BUILDINGS**

**9**

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

**UNIT II IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS**

**9**

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

**UNIT III COMFORTS IN BUILDING**

**9**

Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

**UNIT IV UTILITY OF SOLAR ENERGY IN BUILDINGS**

**9**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

**UNIT V GREEN COMPOSITES FOR BUILDINGS**

**9**

Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
2. Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

**REFERENCES:**

1. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
2. Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

OBM752

**HOSPITAL MANAGEMENT**

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

**OBJECTIVES:**

- To understand the fundamentals of hospital administration and management.
- To know the market related research process
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

<b>UNIT I</b>	<b>OVERVIEW OF HOSPITAL ADMINISTRATION</b>	<b>9</b>
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning		
<b>UNIT II</b>	<b>HUMAN RESOURCE MANAGEMENT IN HOSPITAL</b>	<b>9</b>
Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.		
<b>UNIT III</b>	<b>RECRUITMENT AND TRAINING</b>	<b>9</b>
Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.		
<b>UNIT IV</b>	<b>SUPPORTIVE SERVICES</b>	<b>9</b>
Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.		
<b>UNIT V</b>	<b>COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL</b>	<b>9</b>
Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.		
		<b>TOTAL : 45 PERIODS</b>

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Explain the principles of Hospital administration.
- Identify the importance of Human resource management.
- List various marketing research techniques.
- Identify Information management systems and its uses.
- Understand safety procedures followed in hospitals

**TEXT BOOKS:**

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

**REFERENCES:**

1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, "Handbook of Health Care Human Resources Management", 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman "Health Sector Reform in Developing Countries" - Harvard University Press, 1995.
4. William A. Reinke "Health Planning For Effective Management" - Oxford University Press.1988
5. Blane, David, Brunner, "Health and SOCIAL Organization: Towards a Health Policy for the 21<sup>st</sup> Century", Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", 6th Edition Cengage Learning, 2011.

OMT701

**INDUSTRIAL ROBOTICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To introduce the basic concepts, laws, parts of robots, end effectors, sensors, programming methods, various applications of robots, justification and implementation of robot.

**UNIT I INTRODUCTION**

**9**

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space - accuracy-resolution–repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives

**UNIT II ROBOT END EFFECTORS**

**9**

Introduction- Classification of end effectors – Tools as end effectors. Drive system for grippers- Mechanical - adhesive-vacuum-magnetic grippers. Hooks & scoops. Gripper force analysis and gripper design. Active and passive grippers.

**UNIT III SENSORS**

**9**

Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors.

**UNIT IV ROBOT PROGRAMMING**

**9**

Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages.

**UNIT V FIELD APPLICATIONS OF ROBOTICS**

**9**

Material transfer, Machine loading, Assembly, inspection, processing operations and service robots, Delivery Robots – Intelligent vehicles – Survey and inspection robots – Space Robots – Autonomous aircrafts – Underwater Inspection – Agriculture and Forestry – Military robots

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

**CO1:** Express the basic concepts, laws, components and parameters of robots

**CO2:** Explain the types of grippers and its functions.

**CO3:** Summarize and determine various types of sensors involved in controlling the robots.

**CO4:** Describing the various programming techniques used in industrial robots

**CO5:** Use of robots in various field of applications

**TEXT BOOKS:**

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2nd Edition, 2012
2. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, "Introduction to autonomous mobile robots", 2nd edition, MIT Press, 2011.

**REFERENCES:**

1. John.J.Craig, " Introduction to Robotics: Mechanics & control"Pearson Publication, Fourth edition, 2018.

2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.
3. Saeed B Niku, 'Introduction to Robotics, Analysis, Control, Applications, Wiley India Pvt Ltd publication, 2nd Edition, 2011.

**OME754**

**INDUSTRIAL SAFETY**

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

**OBJECTIVES :**

- To impart knowledge on safety engineering fundamentals and safety management practices.

**UNIT I INTRODUCTION**

**9**

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

**UNIT II CHEMICAL HAZARDS**

**9**

Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

**UNIT III ENVIRONMENTAL CONTROL**

**9**

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

**UNIT IV HAZARD ANALYSIS**

**9**

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment

**UNIT V SAFETY REGULATIONS**

**9**

Explosions – Disaster management – catastrophe control, hazard control ,Safety education and training - Factories Act, Safety regulations Product safety – case studies.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Students must be able to identify and prevent chemical, environmental mechanical, fire hazard through analysis and apply proper safety techniques on safety engineering and management.

**TEXT BOOK:**

1. John V.Grimaldi, "Safety Management", AITB S Publishers, 2003.

**REFERENCES:**

1. Safety Manual, "EDEL Engineering Consultancy", 2000.
2. David L.Goetsch, "Occupational Safety and Health for Technologists", 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

**OAI752**

**INTEGRATED WATER RESOURCES MANAGEMENT**

**L T P C**

**OBJECTIVE:**

- To introduce the students to the interdisciplinary analysis of water and conceptual design of intervention strategies.
- To develop a knowledge-base on capacity building on IWRM.

**UNIT I IWRM FRAMEWORK 9**

Definition – Objectives – Principles - Evolution of IWRM - IWRM relevance in water resources management – Paradigm shift : Processes and prospective outcomes

**UNIT II CONTEXTUALIZING IWRM 9**

UN formulations - SDG goals - IWRM in Global, Regional and Local water partnership – Institutional transformation - Bureaucratic reforms - Inclusive development

**UNIT III EMERGING ISSUES IN WATER MANAGEMENT 9**

Emerging Issues – Drinking water management in the context of climate change - IWRM and irrigation - Flood – Drought – Pollution – Linkages between water, health and poverty

**UNIT IV IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA 9**

Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security

**UNIT V ASPECTS OF INTEGRATED DEVELOPMENT 9**

Capacity building - Conceptual framework of IWRM – Problems and policy issues - Solutions for effective integrated water management - Case studies

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

- Understand objectives, principles and evolution of integrated water resources management.
- Have an idea of contextualizing IWRM
- Gain knowledge in emerging issues in water management, flood, drought, pollution and poverty.
- Understand the water resources development in India and wastewater reuse.
- Gain knowledge on integrated development of water management.

**TEXTBOOKS:**

1. Mollinga P. *et al.* "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
2. Sithamparanathan, Rangasamy, A., and Arunachalam, N., "Ecosystem Principles and Sustainable Agriculture", Scitech Publications (India) Pvt.Lt, Chennai, 1999.

**REFERENCES:**

1. Cech Thomas V., Principles of Water Resources: History, Development, Management and Policy. John Wiley and Sons Inc., New York. 2003.
2. Murthy, J.V.S., "Watershed Management in India", Wiley Eastern Ltd., New York, 1995.
3. Dalte, S.J.C., "Soil Conservation and Land Management", International Book Distribution, India, 1986.

**OBJECTIVE:**

- To gain insights about the importance of lean manufacturing and six sigma practices.

**UNIT I LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS 9**

Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions

**UNIT II THE SCOPE OF TOOLS AND TECHNIQUES 9**

Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

**UNIT III SIX SIGMA METHODOLOGIES 9**

Design For Six Sigma (DFSS), Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder

**UNIT IV SIX SIGMA IMPLEMENTATION AND CHALLENGES 9**

Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics

**UNIT V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS 9**

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

**TOTAL: 45 PERIODS****OUTCOME:**

- The student would be able to relate the tools and techniques of lean sigma to increase productivity

**REFERENCES:**

- Michael L.George, David Rowlands, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
- Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000

3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003

**OEC756**

**MEMS AND NEMS**

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

**OBJECTIVES:**

- To introduce the concepts of micro and nano electromechanical devices
- To know the fabrication process of Microsystems
- To know the design concepts of micro sensors and micro actuators
- To introduce the concepts of quantum mechanics and nano systems

**UNIT I INTRODUCTION TO MEMS AND NEMS 9**

Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

**UNIT II MEMS FABRICATION TECHNOLOGIES 9**

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

**UNIT III MICRO SENSORS 9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester

**UNIT IV MICRO ACTUATORS 9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.

**UNIT V NANO DEVICES 9**

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**On successful completion of this course, the student should be able to:**

- Interpret the basics of micro/nano electromechanical systems including their applications and advantages
- Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.
- Analyze the key performance aspects of electromechanical transducers including sensors and actuators
- Comprehend the theoretical foundations of quantum mechanics and nanosystems

**REFERENCES:**

1. Marc Madou, "Fundamentals of Microfabrication", CRC press 1997.
2. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers,2001



3. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill, 2002.
4. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006,
5. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002

**OCS752**

**INTRODUCTION TO C PROGRAMMING**

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

**OBJECTIVES**

- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions and structures

**UNIT I INTRODUCTION**

**9**

Structure of C program – Basics: Data Types – Constants –Variables - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision-making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process – Exercise Programs: Check whether the required amount can be withdrawn based on the available amount – Menu-driven program to find the area of different shapes – Find the sum of even numbers

Text Book: Reema Thareja (Chapters 2,3)

**UNIT II ARRAYS**

**9**

Introduction to Arrays – One dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Traversal, Insertion, Deletion, Searching - Two dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Read – Print – Sum – Transpose – Exercise Programs: Print the number of positive and negative values present in the array – Sort the numbers using bubble sort - Find whether the given is matrix is diagonal or not.

Text Book: Reema Thareja (Chapters 5)

**UNIT III STRINGS**

**9**

Introduction to Strings - Reading and writing a string - String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings – Introduction to Pointers – Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.

Text Book: Reema Thareja (Chapters 6 & 7)

**UNIT IV FUNCTIONS**

**9**

Introduction to Functions – Types: User-defined and built-in functions - Function prototype - Function definition - Function call - Parameter passing: Pass by value - Pass by reference - Built-in functions (string functions) – Recursive functions – Exercise programs: Calculate the total amount of power consumed by ‘n’ devices (passing an array to a function) – Menu-driven program to count the numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace the punctuations from a given sentence by the space character (passing an array to a function)

Text Book: Reema Thareja (Chapters 4)

**UNIT V STRUCTURES**

**9**

Introduction to structures – Declaration – Initialization – Accessing the members – Nested Structures – Array of Structures – Structures and functions – Passing an entire structure – Exercise programs: Compute the age of a person using structure and functions (passing a structure to a function) – Compute the number of days an employee came late to the office by considering his arrival time for 30 days (Use array of structures and functions)

Text Book: Reema Thareja (Chapters 8)

**TOTAL:45 PERIODS**

## **OUTCOMES**

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

- Develop simple applications using basic constructs
- Develop applications using arrays and strings
- Develop applications using functions and structures

## **TEXT BOOK**

1. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016

## **REFERENCES:**

1. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
2. Paul Deitel and Harvey Deitel, “C How to Program”, Seventh edition, Pearson Publication
3. Juneja, B. L and Anita Seth, “Programming in C”, CENGAGE Learning India pvt. Ltd., 2011
4. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009

**OIE751**

**ROBOTICS**

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

## **OBJECTIVES:**

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

### **UNIT I FUNDAMENTALS OF ROBOT**

**6**

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load-Robot Parts and their Functions-Need for Robots-Different Applications.

### **UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS**

**9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers,

Vacuum Grippers; Two Fingere and Three Fingere Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

### **UNIT III SENSORS AND MACHINE VISION**

**12**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of



Introduction – classification of engineering materials – selection of materials for engineering purposes –selection of materials and shape –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials,-non metallic materials- smart materials - physical, metrical properties of metals

**UNIT II MATERIAL PROPERTIES 9**

Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties - Magnetic Properties - Fabrication Properties –electrical , optical properties - Environmental Properties , Corrosion properties –shape and size - Material Cost and Availability– failure analysis

**UNIT III MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS 9**

Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes - Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials

**UNIT IV MATERIALS SELECTION CHARTS AND TESTING 9**

Ashby material selection charts-Testing of Metallic Materials - Plastics Testing - Characterization and Identification of Plastics - Professional and Testing Organizations - Ceramics Testing - Nondestructive Inspection.

**UNIT V APPLICATIONS AND USES 9**

Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Materials Selection for Wear Resistance - Advanced Materials in Telecommunications - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Understand different types of availability materials
- Easy and effective way to select required materials
- Ability to identify the material properties

**TEXT BOOKS:**

1. Ashby, M. F. Materials selection in mechanical design, 3rd edition. Elsevier, 2005.
2. Ashby, M. F. and Johnson, K. Materials and design – the art and science of material selection in product design. Elsevier, 2002.

**REFERENCES:**

1. Charles, J. A., Crane, F. A. A. and Furness, J. A. G. Selection and use of engineering materials, 3rd edition. Butterworth-Heinemann, 1997
2. Handbook of Materials Selection. Edited by Myer Kutz2002 John Wiley & Sons, Inc., NewYork.

**OME752**

**SUPPLY CHAIN MANAGEMENT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>
Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.		
<b>UNIT II</b>	<b>SUPPLY CHAIN NETWORK DESIGN</b>	<b>9</b>
Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.		
<b>UNIT III</b>	<b>LOGISTICS IN SUPPLY CHAIN</b>	<b>9</b>
Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.		
<b>UNIT IV</b>	<b>SOURCING AND COORDINATION IN SUPPLY CHAIN</b>	<b>9</b>
Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.		
<b>UNIT V</b>	<b>SUPPLY CHAIN AND INFORMATION TECHNOLOGY</b>	<b>9</b>
The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.		

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The student would understand the framework and scope of supply chain networks and functions.

**TEXTBOOK:**

1. Sunil Chopra, Peter Meindl and Kalra, “Supply Chain Management, Strategy, Planning, and Operation”, Pearson Education, 2010.

**REFERENCES:**

1. Jeremy F.Shapiro, “Modeling the Supply Chain”, Thomson Duxbury, 2002.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, “Logistics”, PHI 2002.
4. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press, 2000.

**OML751**

**TESTING OF MATERIALS**

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

**OBJECTIVE:**

- To understand the various destructive and non destructive testing methods of materials and its industrial applications.

**UNIT I INTRODUCTION TO MATERIALS TESTING**

**9**

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

## **UNIT II MECHANICAL TESTING**

**9**

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

## **UNIT III NON DESTRUCTIVE TESTING**

**9**

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

## **UNIT IV MATERIAL CHARACTERIZATION TESTING**

**9**

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

## **UNIT V OTHER TESTING**

**9**

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

- Identify suitable testing technique to inspect industrial component
- Ability to use the different technique and know its applications and limitations

### **TEXT BOOKS:**

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Cullity, B. D., “Elements of X-ray diffraction”, 3<sup>rd</sup> Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7<sup>th</sup> Edition, Cousens Press, 2007.

### **REFERENCES:**

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9<sup>th</sup> Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA, 1986.