## V Semester
### Open Elective – I

<table>
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<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Contact Periods</th>
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<td>1.</td>
<td>ORO551</td>
<td>Renewable Energy Sources</td>
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## VII Semester
### Open Elective – II

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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

UNIT V GEOTHERMAL ENERGY: 9
Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

OUTCOMES:

- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXT BOOKS:

TOTAL : 45 PERIODS
REFERENCES:

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
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

UNIT III ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY
UNIT IV IMAGING MODALITIES AND BIO-TELEMETRY 9

UNIT V LIFE ASSISTING AND THERAPEUTIC DEVICES 9

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:

REFERENCES:
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

UNIT II CONCEPT GENERATION AND SELECTION

UNIT III PRODUCT ARCHITECTURE

UNIT IV INDUSTRIAL DESIGN

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

TOTAL: 45 PERIODS

OUTCOME:
- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.
TEXT BOOK:

REFERENCES:

OAT552 INTERNAL COMBUSTION ENGINES  L T P C  3 0 0 3

OBJECTIVE:
- To impart the basic fundamental knowledge on IC engines and its working along with some of the recent trends in IC engine

UNIT I INTRODUCTION IC ENGINE  9
Introduction, Types of IC engines, Constructional details IC engine, working, principles – 2 & 4 stroke engines, Cycles – Air standard cycles, Fuel air cycles and actual cycles, Actual Indicator diagram for four stroke and two stroke engines, General fuel properties, ignition properties – octane and cetane rating, Materials for engine components

UNIT II PETROL ENGINES  9
Working and constructional details of petrol engines, Carburetor – constructional and working, types of carburetors, additional features in modern carburetor, A/F ratio calculation, Petrol Injection - introduction, Ignition – introduction and requirements, Battery and magneto coil ignition system, Electronic ignition system, Stages of combustion in petrol engines, Combustion chambers for petrol engine, formation of knock in petrol engine

UNIT III DIESEL ENGINES  9
Working and constructional details of diesel engines, fuel injection – requirements, types of injection systems – inline, distributor pumps, unit injector, Mechanical and pneumatic governors. Fuel injector, Types of injection nozzles, Spray characteristics. Injection timing, Split and multiple injection, Stages of combustion in Diesel engines, direct and indirect combustion chambers for diesel engine, knocking in diesel engine, Introduction on supercharging and turbocharging
UNIT IV  COOLING AND LUBRICATION  9
Requirements, Types- Air cooling and liquid cooling systems, forced circulation cooling system, pressure and Evaporative cooling systems, properties of coolants for IC engine. Need of lubrication, Lubricants for IC engines - Properties of lubricants, Types of lubrication – Mist, Wet and dry sump lubrication systems.

UNIT V  MODERN TECHNOLOGIES IN IC ENGINES  9
HCCI Engines – construction and working, CRDi injection system, GDI Technology, E Turbocharger, Variable compression ratio engines, variable valve timing technology, Fuel cell, Hybrid Electric Technology

TOTAL:45 PERIODS

TEXT BOOKS:

REFERENCES:

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

UNIT II  SPATIAL DATA MODELS  9
UNIT II DATA INPUT AND TOPOLOGY

UNIT IV DATA ANALYSIS
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT V APPLICATIONS

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:

REFERENCE:
UNIT III  COMFORTS IN BUILDING

UNIT IV  UTILITY OF SOLAR ENERGY IN BUILDINGS

UNIT V  GREEN COMPOSITES FOR BUILDINGS

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

OEI751  INTRODUCTION TO EMBEDDED SYSTEMS  L T P C
3 0 0 3

OBJECTIVES:
- To introduce the Building Blocks of Embedded System
- To Educate in Various Embedded Development Strategies
- To Introduce Bus Communication in processors, Input/output interfacing.
- To impart knowledge in Various processor scheduling algorithms.
- To introduce Basics of Real time operating system and example tutorials to discuss on one real-time operating system tool

UNIT I  INTRODUCTION TO EMBEDDED SYSTEMS
UNIT II  EMBEDDED NETWORKING

UNIT III  EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT IV  RTOS BASED EMBEDDED SYSTEM DESIGN
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, μC/OS-II, RT Linux.

UNIT V  EMBEDDED SYSTEM APPLICATION DEVELOPMENT
Case Study of Washing Machine- Automotive Application- Smart card System Application..

TOTAL: 45 PERIODS

OUTCOMES:
• Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End 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 Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III  SENSORS AND MACHINE VISION  12

UNIT IV  ROBOT KINEMATICS AND ROBOT PROGRAMMING  13
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V  IMPLEMENTATION AND ROBOT ECONOMICS  5
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics
TEXT BOOKS:

REFERENCES:

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

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
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

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:
   2007.

REFERENCES:
2. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society
   of Metals, Metals Park, Ohio, USA.

OBT751 ANALYTICAL METHODS AND INSTRUMENTATION

UNIT I SPECTROMETRY
Properties of electromagnetic radiation- wave properties – components of optical instruments–
Sources of radiation – wavelength selectors – sample containers – radiation transducers –
Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal
to noise - types of optical instruments – Applications.

UNIT II MOLECULAR SPECTROSCOPY
Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer’s
law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence –Theory of
Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman
spectroscopy – Instrumentation – applications.

UNIT III NMR AND MASS SPECTROMETRY
Theory of NMR — chemical shift- NMR-spectrometers – applications of 1H and 13C NMR-
Molecular mass spectra – ion sources. Mass spectrometer. Applications of molecular mass -
Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS
General description of chromatography – Band broadening and optimization of column
performance- Liquid chromatography – Partition chromatography – Adsorption chromatography
– Ion exchange chromatography -size exclusion chromatography- Affinity chromatography-
principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode
– ion selective and molecular selective electrodes – Instrument for potentiometric studies –
Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces –
Scanning probe microscopes – AFM and STM.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of

REFERENCES:
1. Sharma, B.K. “Instrumental Methods of Chemical Analysis : Analytical Chemistry”