6.1   VLSI SYSTEM DESIGN

L T P
4 - 3

RATIONALE

Now-a-days thousands of Digital ICs are embedded on one single chip with the help of VLSI technology. With the help of this technology the Power Consumption of ICs can be reduced (as some devices even works on IV).The size of the overall circuit reduced due to embedding of thousand of Digital IC on one VLSI chip. The VLSI chips are 100 times faster than microprocessors. Every Industry is using this technology. So student should have some knowledge about this technology.

LEARNING OUTCOMES

After completion of the course, the learner will be able to:

- Design different gates(AND, OR, XOR) using VHDL
- Design 2:1 multiplexer, priority encoder, and decoder circuit using VHDL
- Design different arithmetic circuits(half adder, full adder, half subtractor, full subtractor) using VHDL
- Design 4 Bit Binary to Grey code Converter using VHDL
- Demonstrate working of different programmable logic devices(ROM, PLA, GAL, PEEL, CPLDs, FPGA, FPAA)

DETAILED CONTENTS

1. Overview of VLSI: (10 hrs)

   Introduction to Computer-aided design tools for digital systems. Hardware-description languages, Introduction to VHDL, Data objects, Classes and data types, Operators, Overloading, Logical operators. Types of delays, Entity and Architecture declaration. Introduction to behavioural, dataflow and structural models.

2. VHDL Statements: (10 hrs)

   Assignment statements, sequential Statements and process, Conditional statements, Case statements, concept and use of Concurrent statements.

3. Combinational Circuit Design: (12 hrs)

   VHDL models and simulation of combinational circuits such as Multiplexers, Encoders, Decoders, Code converters, Comparators, Implementation of Boolean functions etc.

4. Sequential Circuit Design: (12 hrs)

VHDL Models and simulation of sequential circuits, Shift registers, Counters etc.

5. Introduction to CPLDs and FPGAs: (10 hrs)

Programmable logic devices: ROM, PLAs, GAL, PEEL, CPLDs and FPGA. FPAA (Field Programmes Analog Array)

6. Design Flow: (10 hrs)

The conventional ASIC design flow, Introduction to design methodology challenges (Wire load models, Design verification, floor-planning, placement and routing, power, parasitic extraction.)

LIST OF PRACTIALS

Combinational Design Exercises

1. VHDL Design of Logic Gates
2. Design of XOR gate using other basic gates
3. Design of 2:1 Mux using other basic gates
4. Design of 2 to 4 Decoder
5. Design of Half-Adder, Full Adder, Half Substractor, Full Substractor
6. Design of Synchronous 8-bit Johnson Counter
7. Design of ALU (Additional, subtraction, Multiplication, Division)
8. CMOS schematic design of logic gates.
9 Layout design simulation of logic gates.

RECOMMENDED BOOKS:

1. VLSI Technologies by SZE, Tata McGraw Hill Education Pvt Ltd , New Delhi
2. IEEE Standard VHDL Language Reference Manual(1993)
3. "Digital System Design using VHDL":Charles. H. Roth; PWS(1998)
4. VHDL-IV Edition: Perry; Tata McGraw Hill Education Pvt Ltd , New Delhi
5. VLSI Design for Analog by Geiger, Tata McGraw Hill Education Pvt Ltd , New Delhi
6. Principles of CMOS VLSI Design by *Weste* and Kamran Eshraghian.

Recommended Software:

Xilinx Synthesis Software (web pack) freely available on internet. On Xilinx.com
VLSI System Design is wind software for designing (System Designing).
VLSI Learning Resource like Ex-VLSI

INSTRUCTIONAL STRATEGY

This subject is very important for designing Digital Systems. For this, the students need to have strong base understanding of fundamental concepts of digital electronics. The teacher is required to lay more emphasis on programming practice in VHDL.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (%)
1	10	15
2	10	15
3	12	20
4	12	20
5	10	15
6	10	15
Total	**64**	**100**

6.2   MICROWAVE AND RADAR ENGINEERING

L T P
4 - 3

RATIONALE

This subject includes an exposure to microwaves engineering, radar systems, fibre optics and satellite communication. In microwaves industry, job opportunities are available in the area of assembly, production, installation, repair and maintenance of microwave transmitters and receivers. The knowledge of radar systems allows opportunities with civil and defence organizations dealing with aircraft and shipping. Fibre optics is the latest thrust area in communication with vast opportunities in the private sector.

LEARNING OUTCOMES

After completion of the course, the learner should be able to:

- Identify, explain and demonstrate construction, characteristics, operating principles and typical applications of Multicavity Klystron, Reflex Klystron, Magnetron, Travelling Wave Tube, GUNN diode, IMPATT diode
- Measure electronics and mechanical tuning range of a reflex klystron
- Measure VSWR of a given load
- Measure the Klystron frequency by slotted section method
- Measure the directivity and coupling of a directional coupler
- Plot radiation pattern of a horn antenna in horizontal and vertical planes
- Demonstrate the properties of magic tee
- Identify the block diagram and explain the operating principles of CW(Doppler), FMCW, MTI radar
- Interpret radar display PPI
- Describe the working principles of microwave communication link

DETAILED CONTENTS

1.   Introduction to Microwaves   (05 hrs)

Introduction to microwaves and its applications, Classification on the basis of its frequency bands (HF, VHF, UHF, L, S, C, X, KU, KA, SUB, mm)

2.   Microwave Devices   (14 hrs)

Construction,   characteristics,   operating   principles   and   typical applications of the following devices   (No mathematical treatment)

-        Multi cavity klystron
-        Reflex klystron

- Multi-cavity magnetron
- Traveling wave tube
- Gunn diode and
- Impatt diode

3. Wave guides   (10 hrs)

Rectangular and circular wave guides and their applications. Mode of wave guide; Propagation constant of a rectangular wave guide, cut off wavelength, guide wavelength and their relationship with free space wavelength (no mathematical derivation). Impossibility of TEM mode in a wave guide.

4. Microwave Components   (10 hrs)

Constructional features, characteristics and application of tees, bends, matched termination, twists, detector, mount, slotted section, directional coupler, fixed and variable attenuator, isolator, circulator and duplex, coaxial to wave guide adapter.

5. Microwave Communication systems   (10 hrs)

Block diagram and working principles of microwave communication link.

6. Radar Systems   (15 hrs)

- Introduction to radar, its various applications, radar range equation (no derivation) and its applications.
- Block diagram and operating principles of basic pulse radar. Concepts of ambiguous range, radar area of cross-section and its dependence on frequency.
- Block diagram and operating principles of CW (Doppler) and FMCW radars, and their applications.
- Block diagram and operating principles of MTI radar.
- Radar display- PPI

LIST OF PRACTICALS

1. To measure electronics and mechanical tuning range of a reflex klystron

2. To measure VSWR of a given load.

3. To measure the Klystron frequency by slotted section method

4. To measure the directivity and coupling of a directional coupler.

5. To plot radiation pattern of a horn antenna in horizontal and vertical planes.

6. To verify the properties of magic tee.

NOTE:

Visit to the appropriate sites of microwave industries, radar installations and communication stations should be made to understand their working. A comprehensive report must be prepared by all the students on these visits, especially indicating the dates and locations of their visits.

INSTRUCTIONAL STRATEGY

Microwave and radar engineering is very important subject and requires both theoretical as well as practical exposure. The teaching should be supplemented by visits to the microwave stations and using suitable audio visual aids.

RECOMMENDED BOOKS

1. Microwave Devices and Components by Sylio, Prentice Hall of India, New Delhi

2. Electronics Communication by Roddy and Coolen

3. Electronics Communication System by KS Jamwal, Dhanpat Rai and Sons, Delhi

4 Microwave Engineering by Das, Tata McGraw Hill Education Pvt Ltd , New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	05	06
2.	14	20
3.	10	16
4.	10	16
5.	10	17
6.	15	25
Total	**64**	**100**

6.3   WIRELESS AND MOBILE COMMUNICATION

L T P
4 - 3

RATIONALE

The wireless/mobile communication technology though complex but is spreading at a very fast rate. People use more of mobile phones in comparison to land line phones. It is expected that within very short period, almost every body will be using mobile communication. Technology is also changing very fast. Therefore, the students should know the functioning of wireless/mobile system/equipment to keep themselves abreast of this latest application of communication.

LEARNING OUTCOMES

After completion of the course, the learner should be able to:

- Identify and explain the features, specification and working of cellular mobile
- Measure and analyse the signal strength at various points from a transmitting antenna/cordless phone
- Describe and analyse different Multiple Access Techniques for Wireless Communication(FDMA, TDMA, CDMA, SSMA, FHSS)
- Describe different Mobile Communication Systems(GSM and CDMA)
- Demonstrate call processing on a GSM and CDMA trainer Kit
- Troubleshoot GSM and CDMA mobile phones

DETAILED CONTENTS

1.   Wireless Communication   (12 hrs)

1.1   Basics

1.2   Advantages of wireless communication

1.3   Electromagnetic waves.

1.4   Frequency Spectrum used.

1.5   Cellular Network Systems.

1.6   Propagation considerations

a) Range
b) Atmospheric Effect
c) Geographic Effect
d) Fading
e) Doppler Effect
f) Multipath Effect

2. Cellular Concept   (12 hrs)

    2.1   Cell area

    2.2   Cell Site Structure

    2.3   Capacity of cell

    2.4   Frequency Response (ARFCN Concepts)

    2.5   Interference (Co-channel, Adjacent channel)

    2.6   Power Control for reducing Interference

    2.7   Fundamentals of cellular network planning

           a) Coverage planning

           b) Capacity planning

3. Multiple Access Techniques for Wireless Communication   (16 hrs)

    3.1   Introduction to Multiple Access.

    3.2   Frequency Division Multiple Access (FDMA)

    3.3   Time Division Multiple Access (TDMA)

    3.4   Code Division Multiple Access (CDMA), WCDMA

    3.5   Spread Spectrum Techniques.

4. Mobile Communication Systems   (16 hrs)

    4.1   Introduction of Global Systems for Mobile Communication (GSM) and its
           architecture, Introduction of CDMA System, comparison of CDMA and
           GSM Systems

    4.2   Introduction of GPRS and EDGE.

5. Introduction to 3G & 4G   (08 hrs)

    5.1   Introduction to Architecture and Features of UMTS
    5.2   HSPA (High Speed Packet Access).
    5.3   Features and Architecture of LTE (Long Term Evolution).

LIST OF PRACTICALS

1. Study the features, specification and working of cellular mobile

2. Measurement of signal strength at various points from a transmitting antenna/cordless phone

3. Demonstration of Base Trans Receiver(BTS) with nearby cellular tower

4. Observing call processing of GSM trainer Kit.

5. Practice of setting GPRS on Mobile phone

6. Repair of a (GSM) mobile phones

INSTRUCTIONAL STRATEGY

Wireless and Mobile Communication is heaving significant impact in Electronics Market. For the proper awareness of this subject, it is must to provide the students the detailed functioning of wireless/mobile system/equipment. For this, visits must be arranged to BTS/MSC (Mobile Switching Centre) providers. The theory classes need to be application based in addition to industrial visits in the BSNL, Vodafone, Airtel, SPICE , TATA indicom etc

RECOMMENDED BOOKS

1.   Wireless Communications, Principles and Practice, by Thedore S.Rappaport.

2.   Wireless Communications by Singal, Tata McGraw Hill Education Pvt Ltd , New Delhi

3.   Wireless Communications by Misra, Tata McGraw Hill Education Pvt Ltd , New Delhi

4.   Introduction to Wireless and Mobile Systems, by Dharma Prakash Agarwal, Qing-An zeng.

5.   Wireless Communications and Networking, by William Stallings.

6.   Mobile and Personal Communication Systems and Services, by Raj Pandya, Prentice Hall of India, New Delhi

7.   Mobile Communication by John Schiller, Prentice Hall of India, New Delhi

8.   Wireless Communications by Pahalwan, Pearson Publishers

9.   Wireless and Mobile Communication VK Sangar, Ishan Publications.

SUGGESTED DISTRIBUTION OF MARKS:

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	12	20
2.	12	20
3.	16	25
4.	16	25
5.	08	10
Total	**64**	**100**

6.4   BASICS OF MANAGEMENT

L T P
3 - -

RATIONALE

The diploma holders are generally expected to take up middle level managerial positions, their exposure to basic management principles is very essential. Topics like Structure of Organization, Leadership, Motivation, Ethics and Values, Marketing management, Financial management, Customer Relationship Management (CRM) & Total Quality Management (TQM), etc. have been included in the subject to provide elementary knowledge about these management areas.. This course explores cyber-security measures and the different forms of cybercrime and emergent forms of cyber-warfare.

LEARNING OUTCOME

After undergoing the subject, the student will be able to:

- Explain the principles of management including its functions in an organisation.
- Have insight into different types of organizations and their structures.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organisation.
- Use marketing skills for the benefit of organization .
- Maintain books of accounts and take financial decisions.
- Undertake store management.
- Use modern concepts like TQM, TPM and CRM.
- Distinguish and classify the forms of cybercriminal activity and the technological and 'social engineering' methods used to undertake such crimes.
- Analyse and assess the impact of cybercrime on government, businesses, individuals and society.

DETAILED CONTENTS

1.   Principles of Management   (06 hrs)

1.1.   Introduction, importance and general functions of management.
1.2.   Concept and Types of an organization - Sole trading ,partnership, companies, corporation, PSU's and cooperative societies.
1.3.   Structure of an organisation -
a) Line organization
b) Staff organisation
c) Functional organization
d) Line and staff organization

1.4. Hierarchical Management Structure
- Top, middle and lower level management
1.5. Departmentalization
- Introduction and its advantages.

2. Leadership and Motivation (06 hrs)

2.1 Leadership
a) Definition and Need of Leadership
b) Qualities of a good leader
c) Manager vs. leader
d) Theories of leadership –trait theory and Behaviour theory.
2.2 Motivation
e) Definition and characteristics of motivation
f) Factors affecting motivation
g) Maslow's Need Hierarchy Theory of Motivation and X&Y need Hierarchy theory of motivation.

3. Work Culture (06 hrs)

3.1. Introduction and importance of Healthy Work Culture in organization
3.2. Components of Culture
3.3. Importance of attitude, values and behaviour
Behavioural Science – Individual and group behavior.
3.4. Professional ethics – Concept and need of Professional Ethics and human values.

4. HRM and its functions (04 hrs)

4.1 Human Resource Management
- Manpower Planning, recruitment and selection
- Training and development of work force at the shop-floor.
- Performance appraisal
- Wages, salary and incentive schemes

5. Marketing and sales (06 hrs)

5.1 Marketing
- Introduction, importance and its functions
- Marketing mix for industries and service sector
- Basic Marketing strategies
5.2 Sales
- Difference between marketing and selling
- Advertisement- print media and electronic media
- Market-Survey and Sales promotion.

6.   **Basic of Accounting and Finance**   (06 hrs)

    6.1   Basic of Accounting:
-    Meaning and definition of accounting
-    Double entry system of book keeping
-    Trading account, PLA account and balance sheet of a company

    6.2   Objectives of Financial Management
-    Profit Maximization v/s Wealth Maximization

7.   **Material and Stores Management**   (04hrs)

-    Introduction, functions and objectives of material management
-    Purchasing: definition and procedure
-    Just in time (JIT)

8.   **TQM , TPM**   (02 hrs)

Total Quality Management (TQM) and Total Preventive Maintenance (TPM) - Concepts and importance

9.   **Customer Relationship management (CRM)**   (02 hrs)

Customer Relationship management - Concepts and importance

10.   **Cyber Security**   (06 hrs)

-Introduction to Cyberspace and Cyber Law, Pros and Cons of social media.
-Different Components of cyber Laws; Cyber Law and Netizens
- Categories of Cyber Crime: Personal, Business, Financial, Office Security
-Cyber Crime – Complete transparency, hacking/cracking, denial of service, IP piracy,   phrasing, hetaerism etc. Cyber Attack – cyber attackers.
-Introduction to IPR, copyright & patent

INSTRUCTIONAL STRATEGY

It is observed that the diploma holders generally take up middle level managerial positions, therefore, their exposure to basic management principles is very essential. Accordingly students may be given conceptual understanding of different functions related to management. Some of the topics may be taught using question answer, assignment or seminar method. The teacher will discuss success stories and case studies with students, which in turn, will develop appropriate managerial qualities in the students. In addition, expert lectures may also be arranged from within the institutions or from management organizations. Appropriate extracted reading material and handouts may be provided.

RECOMMENDED BOOKS

1. Principles of Management by Philip Kotler TEE Publication

2. Principles and Practice of Management by Shyamal Bannerjee: Oxford and IBM Publishing Co, New Delhi.

3. Modern Management Techniques by SL Goel: Deep and Deep Publications Pvt Limited , Rajouri Garden, New Delhi.

4. Management by James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr. : Prentice Hall of India Pvt Ltd, New Delhi.

5. Essentials of Management by H Koontz, C O' Daniel , McGraw Hill Book Company, New Delhi.

6. Intellectual Property Rights and the Law by Dr. GB Reddy.

7. Service Quality Standards, Sales & Marketing Department, Maruti Udyog Ltd.

8. Nandan Kamath, A Guide to Cyber Laws & IT Act 2000 with Rules & Notification

9. Keith Merill & Deepti Chopra (IK Inter.), Cyber Cops, Cyber Criminals & Internet

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	06	12
2.	06	12
3.	06	12
4.	04	9
5.	06	12
6.	06	12
7.	04	9
8.	02	05
9.	02	05
10.	06	12
Total	**48**	**100**

ELECTIVE
6.5.1   DIGITAL SIGNAL PROCESSING

$$\begin{array}{ccc} \textbf{L} & \textbf{T} & \textbf{P} \\ \textbf{4} & \textbf{-} & \textbf{-} \end{array}$$

RATIONALE

Digital signal processing (DSP) is an emerging area, which has a great scope and a lot of job potential in the industry. DSP chips are being widely used in communication industry, consumer electronics etc.

LEARNING OUTCOME

After undergoing the subject, student will be able to:

- Explain basic elements of a digital signal processing system and their classification
- Prepare block diagram representation of discrete time system and implement it
- Apply and transform to LTI system
- Design filter structures
- Describe discrete fourier transformer and use it in linear filtering
- Apply DSP processor in various fields of communication industry

DETAILED CONTENTS

1.   Introduction   (08 hrs)

Signals systems, basic elements of a digital signal processing system. Classification of signals, continuous time versus discrete time signals. Concept of frequency in continuous time and discrete time signals

2.   Discrete time signals and systems: Block diagram representation of discrete time systems, Linearity, Stability and Causality. Convolution and correlation of signals.
                                                                                                         (8 hrs)

3.   Implementation of discrete time systems, Recursive and non-recursive FIR systems. Introduction to IIR and FIR filters,

                                                                                                         (10 hrs)

4.   Z-transform and its application to LTI systems: Direct and inverse Z transform, properties of Z transform.   (10 hrs)

5.   Design of Filter structures-Direct Form I, II, cascade and Parallel form.   (10 hrs)

6.   Introduction to Fourier Transform. Discrete Fourier transform, properties of DFT (No proof), Multiplication of time DPTS and circular convolution, use of DFT in linear filtering. Fast Fourier transforms: Efficient computation of DFT; FFT, DIT algorithm   (10 hrs)

7.   Application of DSP processor   (08 hrs)

INSTRUCTIONAL STRATEGY

The subject requires both theory and practical emphasis simultaneously, so that the students can understand the practical significance of various areas like filter design, wireless communication, analog circuit design. The teacher should follow the learning resources for the lectures. Visits to the industry may also be arranged.

RECOMMENDED BOOKS

1. Digital Signal Processing (Principles, Algorithms and Appications) by John G Proakis and G Monolakis; Prentice Hall of India
2. Digital Signal Processing by AV Oppenheim and RW Ronald W Schafer; Prentice hall of India
3. DSP a computer based approach Mitra Sanjit TMH Publication
4. Digital Signal Processing Using MATLAB by Vinay K Ingle and John G Proakis; Vikas Publishing House, New Delhi
5. Theory and Applications of Digital Signal Processing by Rabiner and Gold; Prentice Hall of India
6. DSP a Practical approach by Ifeachor, Emmanuel Pearson Education

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (%)
1.	8	13
2.	8	13
3.	10	15
4.	10	15
5.	10	15
6.	10	15
7.	8	14
Total	**64**	**100**

ELECTIVE
6.5.2   MEDICAL ELECTRONICS

L   T   P
4   -   -

RATIONALE

A large number of electronic equipment s are being used in hospitals for patient care and diagnosis or carry out advanced surgeries. This subject will enable the students to learn the basic principles of different instruments used in medical science.

LEARNING OUTCOME

After undergoing the subject, student will be able to:

- Describe various medical electronics equipment and their uses
- Use electrodes for various purposes
- Classify the transducers and use them
- Prepare block diagrams of biomedical recorders i.e. ECG, EEG and EMG machines
- Maintain various electronics patient monitoring systems
- Measure current leakage with the help of safety analyzer

DETAILED CONTENTS

1. Overview of Medical Electronics Equipment, classification, application and specifications of diagnostic, therapeutic and clinical laboratory equipment, method of operation of these instruments   (08 hrs)

2. Electrodes   (10 hrs)

   Bioelectric signals, Bio electrodes, Electrode, Electrode tissue interface, contact impedance, Types of Electrodes, Electrodes used for ECG , EEG

3. Transducers   (10 hrs)

   Typical signals from physiological parameters, pressure transducer, flow transducer, temperature transducer, pulse sensor, respiration sensor,

4. Bio Medical Recorders   (12 hrs)

   Block diagram description and application of following instruments
   - ECG Machine
   - EEG Machine
   - EMG Machine

5.   Patient Monitoring Systems   (12 hrs)

- Heart rate measurement
- Pulse rate measurement
- Respiration rate measurement
- Blood pressure measurement
- Principle of defibrillator and pace mark

6.   Safety Aspects of Medical Instruments   (12 hrs)

- Gross current shock
- Micro current shock
- Special design from safety consideration8.
- Safety standards.

Note: Students must be taken for a visit to hospital for exposure of various medical electronics related equipments like ventilator, boyles apparatus, pulse ox meters, defibrillators, bedside monitor and x-ray equipment etc.

INSTRUCTIONAL STRATEGY

The teacher has to play a proactive role in arranging visits to hospitals and well equipped laboratories to reinforce theory. The apparatus and equipment available should be shown to students so that they can understand where and how the various biomedical instruments are used. Various charts and models be used for demonstration. Exposure to Spectrometer and UV Spectrometer must be given to students in addition to arranging visits to biomedical industries.

RECOMMENDED BOOKS

1.   Handbook of Biomedical Instrumentation by RS Khandpur,Tata McGraw Hill

        Education Pvt Ltd, New Delhi

2.   Biomedical Instrumentation by Cromwell,

3.   Modern Electronics Equipment by RS Khandpur, TMH, New Delhi

4.   Introduction to Biomedical Electronics by Edward J. Perkstein; Howard Bj, USA

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (%)
1	08	12
2	10	14
3	10	14
4	12	20
5	12	20
6	12	20
Total	**64**	**100**

ELECTIVE
6.5.3   INTRODUCTION TO ROBOTICS

L T P
4 - -

RATIONALE

Today's industrial assembly line is equipped with robots and man vs. machine interface has been replaced by automation. Most of the machines including our automobiles are available with variety of models and controls. We see luxury cars around us and simply dream of having one. These luxury cars offer varied and many features including safety (central lock, parking assistance, air bags etc.), economy (at times) and comfort as per buyer's criteria. It is therefore need of the day for students to learn Robotics.

LEARNING OUTCOME

After undergoing the subject, student will be able to:

- Identify a Robot for a specific application.
- Interface various Servo and hardware components with Controller based projects.
- Identify parameters required to be controlled in a Robot.
- Maintain various Robotic control features

DETAILED CONTENTS

1.   Basic Components of Robotics Systems   (12 hrs)

   1.1   Definition, need, brief history, social justification
   1.2   Basic Robot terminology configuration and its working
   1.3   Robot components (Anatomy)– manipulator, end effects, drive system, controller, sensors (Optical, Proximity, LVDT, Thermocouple-RTD-Thermistor, Force sensing – strain gaugepiezoelectric, Acoustic)
   1.4   Basic structure of a Robot and Classification – Cartesian, cylindrical, spherical, horizontal articulated(SCARA), Mechanical arm, Degree of freedom, Links and joints, Wrist rotation, Mechanical transmission-pulleys, belts, gears, harmonic drive
   1.5   Linear and rotary motion and its devices
   1.6   Robot configurations: (1) stand above (2) in line (3) cycle independent
   1.7   Selection criteria for robot
   1.8   Robot machine vision

2.   Servo Mechanism and Motion Systems   (20 hrs)

    2.1   ROBOTIC CONTROLS-Purpose and Levels- Device controller, Work cell controller, Area controller, Plant host

    2.2   Servo and non servo control systems – Types, basic principles and block diagram

    2.3   Types, working (with diagrams), and applications of various controls- Computed torque technique, New minimum time control, Variable structure control Non linear decoupled feedback control, Resolved motion control , Adaptive control

    2.4   Types, electrical hardware, programming languages used, advantages, limitations and specific examples of control systems.

    2.5   Robot as work cell controller-PLC

    2.6   Work cell control with local area networking, Multiple network level

    2.7   Level of Robot controller

    2.8   Robot path control (Point to point, Continuous path, Sensor based path)

    2.9   Controller programming

    2.10   Actuators: DC servo motors, Stepper motor, Hydraulic and pneumatic drives

    2.11   Feedback devices

    2.12   Microprocessor based control system

3.   Sensors and Actuators   (20 hrs)

    3.1   Concept of general measurement system and difference between Mechanical and electrical/electronics instruments

    3.2   Measurement of Pressure : Working of Thermocouple vacuum gauge And Pirani vacuum gauge

    3.3   Measurement of Flow: Hot wire Anemometer, Ultrasonic flow meter

    3.4   Measurement of Speed: Contact less electrical tachometer, Inductive, Capacitive type tachometer, Stroboscope

    3.5   Electrical method for moisture measurement

    3.6   Basic requirement of Sensors, Functions

    3.7   Applications and Circuitry arrangement of various Sensors such as Mass Air flow rate sensor, Exhaust gas Oxygen concentration, Throttle plate angular position, Crankshaft angular position, Coolant temperature, Intake air temperature, Manifold absolute pressure (MAP), Vehicle speed Sensor. Transmission gear selector position, Methanol sensor, Rain Sensor; Sensor Calibration

    3.8   Task oriented controls and sequencing, Robotic conventions

4.   Programming and Application in Manufacturing   (12 hrs)

    4.1   Methods of robot programming : Manual Teaching, Lead through

    4.2   Programming languages, Programming with graphics

    4.3   Types, features and applications of various programming languages

4.4   Simulation for robot movements
4.5   Applications of robots (including special types)
4.6   Robot maintenance: Need and types
4.7   Common troubles and remedies in robot operation
4.8   General safety norms, aspects and precautions in robot handling

INSTRUCTIONAL STRATEGY

The course content should be taught and implemented with the aim to develop required skills in the students so that they are able to acquire competency of maintaining various Robotic controls features.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	12	20
2.	20	30
3.	20	30
4.	12	20
Total	**64**	**100**

6.6   PROJECT WORK

L   T   P
-   -   8

RATIONALE

Major Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

LEARNING OUTCOMES

After undergoing the project work, students will be able to:

Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place the learner for project oriented practical training in actual work situation for the stipulated period with a view to:

- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study

- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.

- Develop first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.

- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

General Guidelines

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work **should not be considered** as merely conventional industrial training in which students are sent at work places with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

Some of the project activities are given below:

- Projects related to designing small electronic equipment / instruments.
- Projects related to increasing productivity in electronic manufacturing areas.
- Projects related to quality assurance.
- Projects connected with repair and maintenance of plant and equipment.
- Projects related to design of PCBs.
- Projects related to suggesting substitutes of electronics components being used.
- Projects related to design of small oscillators and amplifier circuits.
- Projects related to design, fabrication, testing and application of simple digital circuits and components.
- Projects related to microprocessor/microcontroller based circuits/ instruments.

Some of the projects based on above areas are listed below for the benefit of students:

1. Microprocessor/Microcontroller based rolling display/bell and calendar
2. Microprocessor based stepper motor control.
3. Speed control of DC Machines by Microprocessor/Microcontrollers
4. Temperature monitoring using Microprocessor/Microcontroller based systems.
5. Microprocessor/Microcontroller based liquid level indicator and control
6. Fabrication and assembling of digital clock.
7. Fabrication of PCB circuits using ORCAD/ EAGLE Software.
8. Fabrication of ON line/OFF line UPS of different ratings and inverters
9. Design, fabrication and testing of different types of experimental boards
10. Repair of oscilloscope, function generator
11. Design and developing web sites of organizations
12. Installation of computer network (LANS).
13. Microprocessor/Microcontroller based solar tracking system

14.   GSM based car or home security system

15.   Bank token display using microcontroller

16.   Printer sharing unit

17.   Microprocessor/Microcontroller Based A/D converter

18.   Microprocessor/Microcontroller Based D/A converter

19.   Simulation of half wave and full wave rectifiers using Simulation Software

20.   Simulation of class A, Class B, Class AB and Class C amplifiers

21.   Simulation of different wave forms like sine, square, triangular waves etc.

22.   GPS based vehicle tracking system

23.   Calculate BER(Bit Error Rate) of various modulation techniques

24.   Design ALU using CPLD/FPGA

25.   Design Display System using CPLD/FPGA

26.   Electronic Weighing Machines

NOTE:

The list is only the guideline for selecting a project; however a student is at liberty to select any other related project of his choice independently under guidance of his teacher.

A suggestive criterion for assessing student performance by the external (person from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance Criteria	Max.** Marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9	Viva voce	10%	10	8	6	4	2

Total marks	100	100	80	60	40	20

The overall grading of the practical training shall be made as per following table.

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

	Range of maximum marks	Overall grade
i)	More than 80	Excellent
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

Important Notes

1. **This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.**

2. **The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**

3. **The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**

4. **It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations in such an exhibition.