STUDY & EVALUATION SCHEME
THREE YEAR DIPLOMA COURSE IN
INSTRUMENTATION AND CONTROL ENGINEERING
(2014 Scheme)

SEMESTER - VI

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
1	**Advanced Control System**	4	-	3	50	50	100	3	100	3	300
2	***Industrial Management and Enterpreneurship Development**	4	-	-	50	-	100	3	-	-	150
3	**Elective**	4	-	3	50	50	100	3	100	3	300
4	**Major Project**	-	-	3	-	50	-	-	100	3	150
5	***Microprocessor and System Design**	4	-	3	50	50	100	3	100	3	300
**	**Student Centered activities**	-	-	12	-	-	-	-	-	-	-
	TOTAL	16	-	24							1200

** Student centered activities will include: extension lectures, field visits, Soft Skills, seminars, debates, hobby clubs, library studies, awareness regarding ecology and environment, conservation of energy (Petroleum products, electricity etc), social service camps and other co-curricular activities including games. Advanced planning for each semester has got to be made

*Common with Digital/Medical Electronics

ELECTIVES:

a) Optical and Analytical Instrumentation
b) Robotics
c) Biomedical Instrumentation
d) Distributed Control System

ADVANCED CONTROL SYSTEM

L	T	P
4	-	3

Rationale:

This is an advanced subject covers the various modes of analysis and stability of control system. It deals with, optimal and adaptive control system, their compensation techniques. The practicals are performed using MATLAB which is a need of the industry.

DETAILED CONTENTS

1. **Analysis of non Linear Central System**
   Introduction to non linear control system, describing function and functional analysis of non linear control system

2. **State Variable characterisation**
   concept of state. matrix representation of state equation, state transition matrix, relation between state equation and transfer function.

3. **LIA Punov Stability. Analysis.**
   Introduction to stability.asymptotic stability and instability, second methods of liapunov. LIA PUNOV stability analysis of linear time invariant system, krasovskii's method.

4. **Optimal and Adaptive Control System. :**
   Controllability, observability, time optimal control system, definition of adaptive control system, representation of adapting control system, model reference control system.

5. **5. Compensation Techniques**
   Definition of system compensation, series and feed back compensation, effect of additional of zero's and pole lead compensation, lag compensation, lag-lead compensation, lead-lag compensation.

6. a) Introduction to descret time system, Z- transformation, solving differential equation by the Z-transformation, Block diagram of sampled data and its analysis with samples and Z.O.H. (zero order hold)

   b) Sampled Data System with digital computer:
   Introduction to difference equation, and analysis of stability in case of sampled data system.

   a) Stepper Motor
   Study of stepper motor variable reluctance stepper motor, permanent magnet stepper motor, important parameters of stepper motor operational features of stepper motor, interfacing of stepping motors to micro-processors.

LIST OF PRACTICAL (ADVANCE CONTROL SYSTEM)

1. Introduction to MATLAB and its various toolboxes.
2. Generation of test signals: Step, Ramp, Impulse, parabola using MATLAB.

3. To process data using MATLAB ,i.e, adding of two matrices, subtraction of two matrices, multiplication and division etc.
4. To generate x-y graph with the help of MATLAB.
5. To control the speed of stepper motor using MATLAB.
6. To find controllability and observability with MATLAB for a given system.
7. Study various types of stepper motors.
8. Test the stability of a given system using software by LIAPUNOV stability rule.

INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP DEVELOPMENT

L	T	P
4	-	-

RATIONALE

The knowledge of this subject is required for all engineering technicians, but it becomes more important for those who intend to choose industry for their career. This course is managements, role of worker, foreman and engineer, industrial safety, marketing, entrepreneurship, inventory control and industrial legislation.

DETAILED CONTENTS

1. Introduction (4 Hr)
   Pattern of economics i.e. socialistic economy, capitalistic economy and mixed economy. Industrial Growth in India.

2. Business Organisations (4 Hr)
   Salient features of sale proprietary, partnership private and public limited companies, cooperative societies and public sector. Role of public and private sectors in growth of economy and their social obligations towards society; monopoly and price restriction.

3. Entrepreneurship (4 Hr)
   Entrepreneurial qualities, selection of product, estimation of capital expenditure resources of capital financial agencies, procedural formalities for registrations of firm. Exposure to sales tax registration import export procedures and project report preparation.

4. Financial Management (4 Hr)
   Brief idea of money banking, international trade, foreign exchange, various taxes such as property, wealth company income, excise duty, sales tax, finance forecasting. Types of accounts and account books, trial balance, final accounts and statements.

5. Personnel Management (6 Hr)
   Duties and responsibilities of personnel department, manpower planning, sources of employment, recruitment selection, various methods of testing, training and development of workers and supervisors.Promotions, retirement, retrenchment. Industrial relations, discipline, industrial fatigue, leadership, attitudes and human behaviour, morale maintenance, motivation systems, payment of wages, personnel records.

6. Technician (2 Hr)
   Role of engineer and technician in the industry and in society: duties and responsibilities of a technician (foreman) towards management, workers and work.

7. Industrial Safety and House Keeping (4 Hr)
   Magnitude and cost of accidents, causes of accidents, job safety analysis, safety planning and its implementation safety education instructions and visual aids,

obligatory provisions, first aid, investigation of accidents, fire fighting, BIS standards, security watch and ward.

8. Marketing (4 Hr)

Importance of marketing, theory of demand and supply forecasting demand and supply, product pricing, branding and packaging, sales promotions, advertising and publicity, warranty, after sales service, product improvement and development, salesmanship, tenders and contracts, installations and commissioning, feedback invoicing and trade documents.

9. Industrial Legislation (4 Hr)

Important provisions of the following acts: Factory Act, ESI, GPF, Bonus, Trade Union, Industrial Dispute, Shop, Minimum Wages, Compensation, Apprenticeship, Payment of Wages act and Commercial Establishment Act.

MAJOR PROJECT

L	T	P
-	-	3

To be started after IInd year, the project should be based on design fabrication and testing preferably related to instrumentation & Control systems under the guidance of one faculty member of the institute.

ASSESSMENT:

Attendance and punctuality	20%
Problem solving skill	30%
Inter personal relation	10%
Live Demo	20%
Viva-Voce	10%
Report Writing	10%

Necessary Certificate Should be issued by Industry person / Internal fatuity member / guide should be attached in the report. There will be internal & external Assessments.

MICROPROCESSOR BASED SYSTEM DESIGN

L	T	P
4	-	3

RATIONALE

The microprocessor based system design deals with the applications of 8085 microprocessor, interfacing, constructing of prototypes, testing and integration of software and hardware. It helps students to learn the development tools, software tools and helps students to upgrade the knowledge regarding the case study of industrial control system and CNC machine control based system.

1. Block diagram of microprocessor-based system. Bus structure, selection criteria of microprocessor for different applications.
2. Review of 8085 microprocessor, its architecture, programming, model, addressing modes and instruction set.

   10%
3. Memory Interfacing: Characteristics, Timing consideration & Address decoding. Interfacing of static and dynamic RAMs. Interfacing of ROMs.
4. Peripheral Interfacing chips: Block diagram operation, programming and interfacing considerations of the following chips: 8255, 8253, 8251, 8259A, 8279 and 8237.
5. I/O interfacing: interfacing of keyboards, displays, A/D and D/A Converters.
6. System Design Considerations: Steps for design of Microprocessor based system. System specification and design constraints, Noise filtering & signal conditioning, cost effectiveness, system flow diagram & block diagram. Portioning of hardware & software and their trade-offs.
7. Working out the major devices & components and software routines construction and testing of prototype hardware. Debugging of the software. Integration of hardware and software. Analysis of system performance in real time systems.
8. Development Tools: Software Tools and Methods, Emulator, Simulator, Assembler, Debugger, MDS.
9. Interfacing Standards: RS232C, IEE488, Current loop.
10. Microprocessor Troubleshooting: Typical faults, instruments for fault finding: Logic pulser, logic probe, Logic analyser, Signature analyser.
11. Design examples and case studies e.g. multi channel DAS, temperature monitoring and control system, CNC machine control.

LIST OF PRACTICALS (MICROPROCESSOR BASED SYSTEM DESIGN):

1. Interface 8 LEDs and display the LEDs alternatively with a delay of 1 sec.
2. Interface 8 LEDs and 8 switches and display the status of switches in the LEDs.
3. Interface a common anode type seven segment display and display 0 to 9 with delay of 1 sec in between.
4. Interface 8 bit DAC and display sawtooth wave form and rectangular waveforms under program control.
5. Interface a 3 kg-Torque steeper motor and vary the speed under program control.
6. Interface an 8 bit ADC (like ADC0808) and select different channels and read analog voltage applied in these channels.
7. Interface a hexadecimal keyboard and display the keypress in a seven segment display.
8. Interface an LED matrix and display any alphanumeric character in the display.
9. Design a temperature control system. The system should sense temperature and switch off the heat source if temperature exceed the set limit. If the temperature fall below the set limit the system should turn on the heat source.
10. Transfer one byte of data from a memory location of one system to another using serial data transfer facility. Use SID line to receive data and SOD line to send data. (Asynchronous serial transfer format can be used)

REFERENCES

1. Brey, Bary B. Microprocessor/Hardware Interfacing & Applications CBS Publishers & Distributor, Delhi.
2. Botton A. Microprocessor Based Systems Level-IV, Technical Education Council in Association with Hutchinson

(Elective) OPTICAL & ANALYTICAL INSTRUMENTATION

L	T	P
4	-	3

RATIONAL

The syllabus has been designed to give an opening to a student to make up a topic of his choice for specialization Optical and analytical instrument branch is used in the industries for checking and testing in-coming or final product for quality techniques such as lasers, radioactive isotopes etc. have been used.

Detailed Contents

1. **Ultraviolet and visible absorption instrumentation, terminology, Basic components**: source of radiant energy, Detectors, indicators, Associated optics, Dispersing devices such as **Filters**:- composite filters, interference filter, wage filter, **Prism**:- Dispersive power, resolving power and mounting of prism, **Gratings**:- plane, concave, reflection, echelon transmission grating, resolving power of grating, order of interference, **Production of grating**:- direct ruling, replication, holographic, **Comparison of grating and prism spectra. Instruments**: Visual comparators, filter photometers, single beam and double beam spectrometers, dual wave length spectrometers.
2. **Ultraviolet and visible absorption methods**: Fundamental laws of photometry.
3. **Infrared spectrophotometry.**
4. **Spectrometry**: N.M.R , ESR, mass, emission and raman, theory instrumentation and applications.
5. **Gas-Liquid chromatography**: Theory , components and applications, types of detectors.
6. **pH measurements:** Principle, reference and measuring electrodes, instrumentation and applications.
7. **Nuclear Instrumentation:** Ionization chamber, G.M counter, proportional counter, liquid seintillation counter.
8. **Gas analysers:** Thermal analysis, O_2 and CO_2, oxides of nitrogen , ozone and SO_2.
9. **Density Measurements:** Hygrometer, density of gases, specific gravity measuring system , viscometers(differential pressure capillary type).
10. **X-Ray methods:** Introduction to X-rays, concept of X-ray tube and its schematic, types of X-ray tubes, concept of X-ray absorption methods, Bragg's law.
11. Electrical conductivity analysers for a liquid.

ROBOTICS

L	T	P
4	-	3

RATIONALE:

This is an advanced subject of robotics mainly covers the anatomy, kinematies, drives, movements of the robotics. Robot are used in an industry and are contolled using computers and software. Students after the study may be able to work on the applications of the robotics in an industry.

1. Introduction to robotics:
   Laws of robotics, robot definitions, Robotics Systems and Robot Anatomy, Specifications of Robots ; Safety measures in robotics
2. Robot kinematics:
   Forward and reverse kinematics of three degrees of freedom Robot arm, Forward & Reverse Transformation of a four degrees of freedom manipulator in 3-D, Homogeneous Transformation, kinematic equations using homogeneous transformations.
3. Robot drives, Actuators and control:
   Functions of drive systems, Electrical drives, DC motors and transfer functions, Stepper motor.
4. Robot end effectors:
   Classification, mechanical grippers, magnetic grippers, vacuum grippers, adhesive grippers, hooks, scoops and other devices.
5. Robot sensors and vision system:
   Need for sensing systems, sensory devices, types of sensors, robot vision system.
6. Robot languages and Programming:
   Languages and its classification, computer control and robot software, VAL system and language.
7. Applications of robots:
   Capabilities of robots, robotic applications, obstacle avoidance, other uses of robots.

Recommended Books

Robotics technology and flexible automation by S.R .DEB , Tata Mc graw-hill

List of Practical

Minimum eight experiments to be performed on an articulated scorbot.

LIST OF PRACTICALS (OPTICAL & ANALYTICAL INSTRUMENTATION)

1. pH measurement using pH measuring equipment and identification of its parts.
2. To find the impurity contents in the gases such as CO2, SO3, SO2.
3. To find out the conductivity of a liquid by electrical conductivity analyser.
4. To find out the humidity content in the room and RH by hygrometer.
5. To generate monochromatic light and to check its range.
6. To use laser for testing and checking different parameters ,i.e, size and sampling etc.

Reference Books

(1) Instrumental methods of analysis by williard, merritt and dean.

(2) Instrumental methods of chemical analysis by E.W ewings.

BIO-MEDICAL INSTRUMENTATION

L	T	P
4	-	3

RATIONALE

The knowledge of subject is required as the basic input for specialization in Bio- medical equipments& instruments. The students will be made aware of various types of basic tools &equipments such as Electrodes, Transducers, Wave form display Devices, Circulatory, Respiratory & therapeutic equipments.

DETAILED CONTENTS

1. **OVER VIEW OF MEDICAL ELECTRONIC EQUIPMENTS:** 10%
   Classification application and specification of Diagnostic, Therapeutic & Clinical laboratory equipments.

2. **ELECTRODES :**
   Elementary idea of cell structure, Bio electric signals.Bio- electrode. Electrode - Tissue interface. Contact impedance. Types of electrodes. Electrodes for ECG, EMG and EEG. 10%

3. **TRANSDUCER:**
   Typical signal from physiological parameter. Pressure transducer- types of pressure transducers. Flow Transducer, Temperature transducer, Thermocouples, Thermister. Pulse sensors, Respiration sensors. 10%

4. **WAVE FORM DISPLAY DEVICES**
   PMMC Instruments.Servo – Recorders & Recording Potentiometers.Dot matrix analog recorders. Oscilloscope - medical oscilloscope, Bed side monitor, multi beam oscilloscope, non fade oscilloscope, Modern oscilloscope designs 10%

5. **CIRCULATORY SYSTEM & CARDIAC EQUIPMENTS :** 15%
   The heart.Electro conduction system of heart. ECG wave form. The standard lead system. ECG machine- block diagram, working principles. Defibrillator types, circuit & testing of defibrillator.Pace maker – operation & classification.Heart lung machine.

6. **RESPIRATORY SYSTEM & RELATED EQUIPMENTS:** 15%
   The human respiratory system. Internal & external respiration. Organs of respiratory system. Mechanics of breathing. Parameters of respiration & their measurements. Impedance Pneumograph. Spiro meters.

7. **THERAPEUTIC EQUIPMENTS:**
   Intermittent Positive Pressure Breathing (IPPB) Respirator. Functional block diagram.Artificial Ventilators, Humidifiers & Nebulizers. 10%

8. NERVOUS SYSTEM & RELATEDE EQUIPMENTS: 10%
The Neuron Structure & Function of Central Nervous System.Cerebral Angiography.Electroencephalography .EEG electrode system. EEG amplitude& frequency bands. EEG system block diagram. Multi channel EEG recording system & typical external control system.

9. **MUSCULATORY SYSTEM & RELATED EQUIPMENTS:** 10%
Muscle action EMG Machine- -Different unit & working principle. Physiotherapy-short wave Diathermy Ultrasonic Diathermy.Micro wave Diathermy unit.Stimulators-types & Application.

LIST OF PRACTICALS (BIO-MEDICAL INSTRUMENTATION)

1. Measurement of skin contact impedance & technique to reduce it.
2. Determine the contact impedance of following electrodes- ECG, EEG, EMG.
3. Study of ECG machine & taking ECG of subject & observing artifacts in ECG recording.
4. Measurement of heart rate/pulse rate, blood pressure monitoring , respiration monitoring through multi para monitor digital machine.
5. Direct blood pressure measurement (under normal & stimulated condition)
6. Study of different units of EEG machines & placement of EEG electrodes.
7. Taking EEG of a subject & observing artifacts in EEG recording.
8. Study of EMG machine- different control, units & placement of electrodes
9. Constructional study, use & trouble shooting of Defibrillator.
10. Constructional study, use & trouble shooting of artificial electronic/digital Ventilators.
11. Study of respiration parameters with the help of Spiro meters & troubleshooting

DISTRIBUTED CONTROL SYSTEM

L	T	P
4	-	3

Rationale

A distributed control system (DCS) refers to a control system usually of a manufacturing system, process or any kind of dynamic system, in which the controller elements are not central in location by are distributed throughout the system with each component sub-system controlled by one or more controllers. The entire system of controllers is connected by networks for communication and monitoring. DCS is a very broad term used in a variety of industries, to monitor and control distributed equipment. It helps students to acquire skill latest knowledge in the manufacturing environment.

1. DISTRIBUTED SYSTEMS: What? Why? And Where?
   Definition of a distributed System (What?): Enslow's model, our model; The objectives of Distribution (Why?): Motivation, Objectives, Advantages of Centralization (Why not Distribution?)
   Distributed Processing Applications Overview (Where?): Data Communication, Resource sharing, Process Control and laboratory automation, Distributed Data bases.
2. OVERVIEW OF DCS : Basic DCS , Operator Console, Video Display, Keyboard, Information Displays : Group Displays, Overview Displays, Detail Displays, Graphic displays, Trend Displays.
3. DISTRIBUTED SYSTEM ARCHITECTURE
   Overall Structure: Layers, protocols and Interfaces
   The Architecture Layers: Application Layer, DOS, Local Management, kernel, Hardware Environment, communication system.
   The Communication System structure: The ISO reference model- Application Layer, presentation Layer, Session Layer, Transport Layer, Network's Layer, Data-Link Layer, Physical Layer.
4. SOFTWARE STRUCTURE:- Components and their interconnections , DCS software **Configuration** - operating system configuration, controller function configuration, Algorithm Libraries.
5. COMMUNICATION SYSTEM:- Evolution, functions, Networks, ISO Terminology, Classification of communication services and Protocols- Connectionless services, connection oriented services, Protocols, Relationship between services and protocols.
6. DCS SUPERVISORY COMPUTER TASK:- Supervisory Control and optimization, Production monitoring and control, on-line information system, Supervisory Control Algorithms.

7. LOCAL AREA NETWORKS:- LAN Layers, Token Ring, Slotted Ring, Buffer insertion Ring, Carrier Sense Multiple Access BUSES, Ethernet, Token Passing Serial Bus.

8. DCS INTEGRATION with PLC's and Computers:- MMI, Integration with PLC's. Integration with Computers, Features and Advantages of DCS.

Recommended Books:

1. Industrial Instrumentation And Control, 2nd Edition, Tata Mc Graw-Hill by SK Singh
2. Distributed Computer Control for Industrial Automation by Popovic and Bhatkar
3. Industry Manual

PRACTICALS

Minimum 8 experiments to be performed by the students using DCS trainer:-