**MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI**

**TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES**

**COURSE NAME : DIPLOMA IN INSTRUMENTATION / DIPLOMA IN INSTRUMENTATION CONTROL**

**COURSE CODE : IS / IC**

**DURATION OF COURSE : 6 SEMESTERS** **WITH EFFECT FROM 2012-13**

**SEMESTER : SIXTH** **DURATION : 16 WEEKS**

**PATTERN : FULL TIME-SEMESTER** **SCHEME : G**

| SR. NO. | SUBJECT TITLE | Abbreviation | SUB CODE | TEACHING SCHEME | | | EXAMINATION SCHEME | | | | | | | | | SW (17600) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | PAPER HRS. | TH (1) | | PR (4) | | OR (8) | | TW (9) | | |
| | | | | TH | TU | PR | | Max | Min | Max | Min | Max | Min | Max | Min | |
| 1 | Management $ | MAN | 17601 | 03 | -- | -- | 03 | 100 | 40 | -- | -- | -- | -- | -- | -- | 50 |
| 2 | Process Control Systems | PCS | 17663 | 04 | | 02 | 03 | 100 | 40 | -- | -- | 25@ | 10 | -- | -- | |
| 3 | Industrial Automation | IAU | 17664 | 03 | -- | 04 | 03 | 100 | 40 | 25# | 10 | -- | -- | 25@ | 10 | |
| 4 | Embedded Systems β | ESY | 17658 | 03 | -- | 02 | 03 | 100 | 40 | 50# | 20 | -- | -- | 25@ | 10 | |
| 5 | **Elective (Any One)** | | | | | | | | | | | | | | | |
| | Process Automation System | PAS | 17665 | 03 | -- | 02 | 03 | 100 | 40 | -- | -- | -- | -- | 25@ | 10 | |
| | Biomedical Instrumentation | BIN | 17666 | 03 | -- | 02 | 03 | 100 | 40 | -- | -- | -- | -- | 25@ | 10 | |
| 6 | Simulation Software β | SSO | 17807 | -- | -- | 02 | -- | -- | -- | -- | -- | -- | -- | 25@ | 10 | |
| 7 | Industrial Project β | IPR | 17808 | -- | -- | 04 | -- | -- | -- | -- | -- | 50# | 20 | 50@ | 20 | |
| | | | **TOTAL** | **16** | **--** | **16** | **--** | **500** | **--** | **75** | **--** | **75** | **--** | **150** | **--** | **50** |

Student Contact Hours Per Week: **32 Hrs.**

**THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.**

Total Marks **: 850**

@- Internal Assessment, # - External Assessment, [redacted] No Theory Examination, $-Common to all branches, #*- Online Theory Examination,

β - Common to ET / EJ / EN / EX / IE / DE / EV / IU / ED / EI / MU

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work.

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subjects is to be converted out of 50 marks as sessional work (SW).
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code number for TH, PR, OR and TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

**Course Name : All Branches of Diploma in Engineering / Technology**

**Course Code : EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/CO/CM/IF/ CW/EE/EP/EU/CH/CT/PS/CD/ED/EI/CV/FE/IU/MH/MI/TX/TC/FG**

**Semester : Sixth for EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/ CO/CM/IF/CW/EE/EP/EU/CH/CT/PS/TX/TC/FG and Seventh for MH/MI/CD/ED/EI/ CV/FE/IU**

**Subject Title : Management**

**Subject Code : 17601**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| 03 | -- | -- | 03 | 100 | -- | -- | -- | 100 |

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

**Rationale:**

Management concepts are universal and it is a multidisciplinary subject. They are equally applicable to different types industries like Manufacturing, Service and Trade as well as different kind of business activities like industry, army, school, hospital, retail shops etc. Also, at the end of diploma course polytechnic students are expected to enter in to the Industrial Environment. This environment is altogether different and new to the students. A proper introduction and understanding of management fundamentals is therefore essential for all these students.

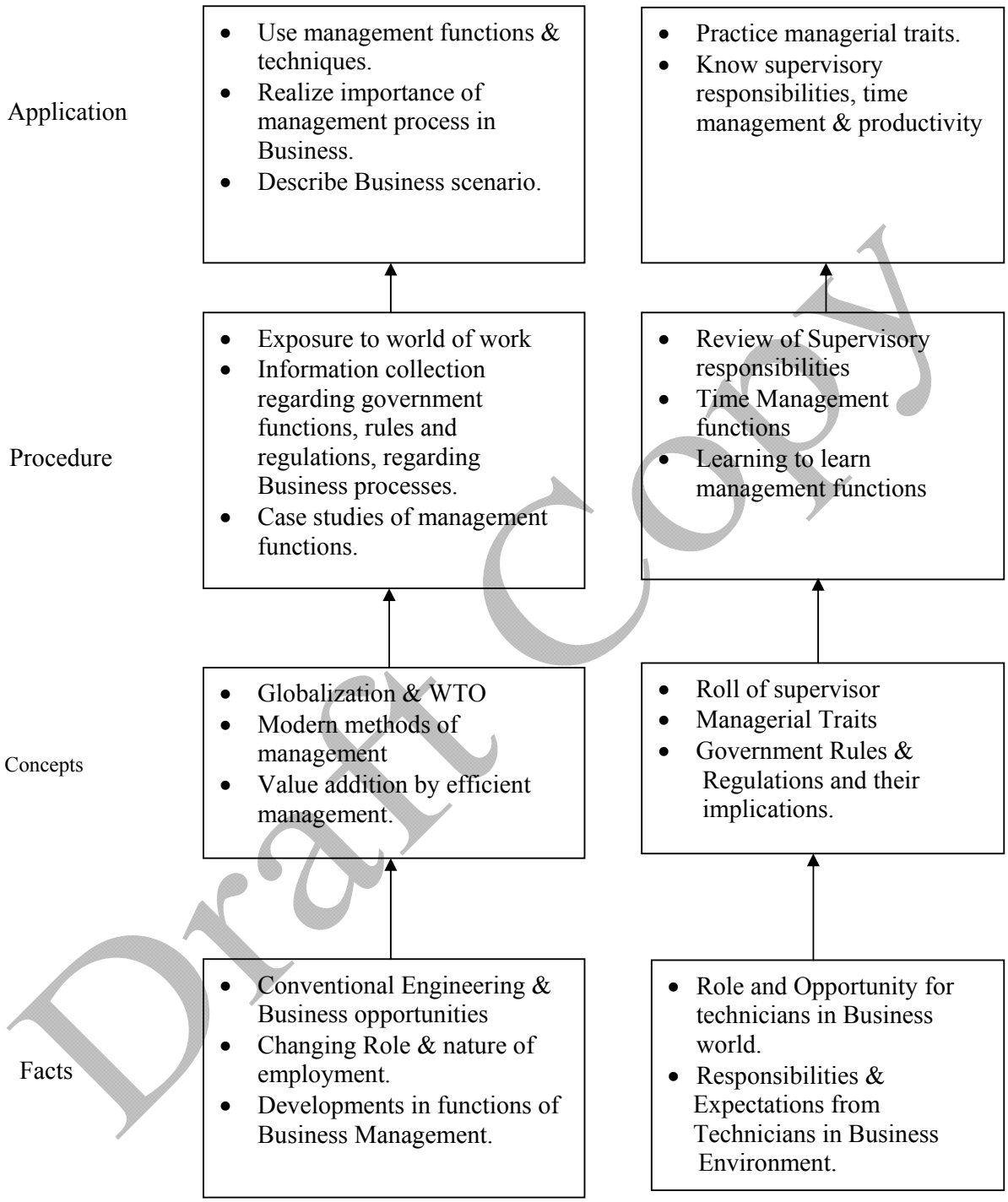
Contents of the this subject will enable the students to address various issues related to human resource, finance, materials, legislations etc. by use of basic principles of management. This will ensure that students will play their role effectively to enhance the quality of business output in total.

**Objective:**

The students will able to:

1. Get familiarized with environment related to business processes.
2. Know the management aspects of the organisations.
3. Understand Role & Responsibilities of a Diploma engineer.
4. Understand importance of quality improvement techniques.
5. Appreciate need and importance of safety in industries.
6. Understand process of Industrial finance and its management.
7. Know the latest trends in industrial management.

**Learning Structure:**



**Contents: Theory**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1: Overview of Business**<br><br>**Specific Objectives**<br>➢ State various business types and sectors<br>➢ Describe importance of globalisation<br>1.1. Types of Business<br>• Service<br>• Manufacturing<br>• Trade<br>1.2. Industrial sectors Introduction to<br>• Engineering industry<br>• Process industry<br>• Textile industry<br>• Chemical industry<br>• Agro industry<br>• IT industry<br>• Banking, Insurance, Retail, Hospitality, Health Care<br>1.3 Globalization<br>• Introduction<br>• Advantages & disadvantages with respect to India | 02 | 06 |
| **Topic 2: Management Process**<br><br>**Specific Objectives**<br>➢ State various management principles<br>➢ Describe different management functions<br>2.1 What is Management?<br>• Evolution<br>• Various definitions of management<br>• Concept of management<br>• Levels of management<br>• Administration & management<br>• Scientific management by F.W.Taylor<br>2.2 Principles of Management (14 principles of Henry Fayol)<br>2.3 Functions of Management<br>• Planning<br>• Organizing<br>• Directing<br>• Controlling<br>• Decision Making | 08 | 16 |
| **Topic 3: Organisational Management**<br><br>**Specific Objectives**<br>➢ Compare different forms of organisation, ownership for a specific business<br>➢ Describe types of departmentation<br>3.1 Organization :<br>• Definition | 08 | 16 |

| | | |
|---|---|---|
| • Steps in organization<br>3.2 Types of organization<br>• Line<br>• Line & staff<br>• Functional<br>• Project<br>3.3 Departmentation<br>• By product<br>• By process<br>• By function<br>3.4 Principles of Organisation<br>• Authority & Responsibility<br>• Span of Control<br>• Effective Delegation<br>• Balance ,stability and flexibility<br>• Communication<br>3.5 Forms of ownership<br>• Proprietorship<br>• Partnership<br>• Joint stock<br>• Co-operative Society<br>• Govt. Sector | | |
| **Topic 4: Industrial Safety and Legislative Acts**<br><br>**Specific Objectives**<br>➢ Describe types of accidents & safety measures<br>➢ State provisions of industrial acts.<br>4.1 Safety Management<br>• Causes of accidents<br>• Types of Industrial Accidents<br>• Preventive measures<br>• Safety procedures<br>4.2 Industrial Legislation - Necessity of Acts<br>Important Definitions & Main Provisions of following acts:<br>• Indian Factory Act<br>• Workman Compensation Act<br>• Minimum Wages Act | 08 | 14 |
| **Topic 5: Financial Management (No Numerical)**<br><br>**Specific Objectives**<br>➢ Explain functions of financial management<br>➢ State the sources of finance & types of budgets.<br>➢ Describe concepts of direct & indirect taxes.<br>5.1 Financial Management- Objectives & Functions<br>5.2 Capital Generation & Management<br>• Types of Capitals - Fixed & Working<br>• Sources of raising Capital - Features of Short term, Medium Term & Long Term Sources<br>5.3 Budgets and accounts | 08 | 16 |

| | | |
|---|---|---|
| • Types of Budgets<br>• Fixed & Variable Budget - Concept<br>• Production Budget - Sample format<br>• Labour Budget - Sample format<br>• Profit & Loss Account & Balance Sheet - Meaning, sample format, meaning of different terms involved.<br>5.4 Meaning & Examples of :<br>• Excise Tax<br>• Service Tax<br>• Income Tax<br>• Value Added Tax<br>• Custom Duty | | |
| **Topic 6: Materials Management** (No Numerical)<br><br>**Specific Objectives**<br>➢ Describe concept of inventory, ABC analysis & EOQ.<br>➢ Describe purchase functions & procedures<br>➢ State features of ERP & MRP<br>6.1. Inventory Concept, its classification, functions of inventory<br>6.2 ABC Analysis - Necessity & Steps<br>6.3 Economic Order Quantity Concept, graphical representation, determination of EOQ<br>6.4 Standard steps in Purchasing<br>6.5 Modern Techniques of Material Management<br>• Material Resource Planning (MRP) - Functions of MRP, Input to MRP, Benefits of MRP<br>• Enterprise Resource Planning (ERP) - Concept, list of modules, advantages & disadvantages of ERP | 08 | 16 |
| **Topic 7: Quality Management**<br><br>**Specific Objectives**<br>➢ State Principles of Quality Management<br>➢ Describe Modern Technique & Systems of Quality Management<br>7.1 Meaning of Quality<br>Quality Management System - Activities, Benefits<br>Quality Control - Objectives, Functions, Advantages<br>Quality Circle - Concept, Characteristics & Objectives<br>Quality Assurance - Concept, Quality Assurance System<br>7.2 Meaning of Total Quality and TQM<br>Components of TQM - Concept, Elements of TQM, Benefits<br>7.3 Modern Technique & Systems of Quality Management like Kaizen,5'S',6 Sigma<br>7.4 ISO 9001:2000 - Benefits, Main clauses. | 06 | 16 |
| **Total** | **48** | **100** |

**Learning Resources:**
**Books:**

| Sr. No | Author | Name of Book | Publisher |
|---|---|---|---|
| 01 | Dr. O.P. Khanna | Industrial Engineering & Management | Dhanpat Rai & Sons New Delhi |
| 02 | Banga & Sharma | Industrial Engineering & Management | Khanna Publication |
| 03 | Dr. S.C. Saksena | Business Administration & Management | Sahitya Bhavan Agra |
| 04 | W.H. Newman<br>E. Kirby Warren<br>Andrew R. McGill | The process of Management | Prentice- Hall |

**E Source:**

- nptel.iitm.ac.in
- http://iete-elan.ac.in/subjects/amIndustrialMgmt.htm

**Course Name : Diploma in Instrumentation / Diploma in Instrumentation Control**

**Course Code : IS/IC**

**Semester : Sixth for IS/IC**

**Subject Title : Process Control System**

**Subject Code : 17663**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| 04 | -- | 02 | 03 | 100 | -- | 25@ | -- | 125 |

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

**Rationale:**

Process control system deals with the control of industrial processes where raw materials are procured, separated or purified to get the useful output product.

This subject deals with the arrangement of processing units such as heat exchanger, evaporators, boilers, dryers, distillation column etc. Using different instrumentation system, process variable involved in the above process are controlled.

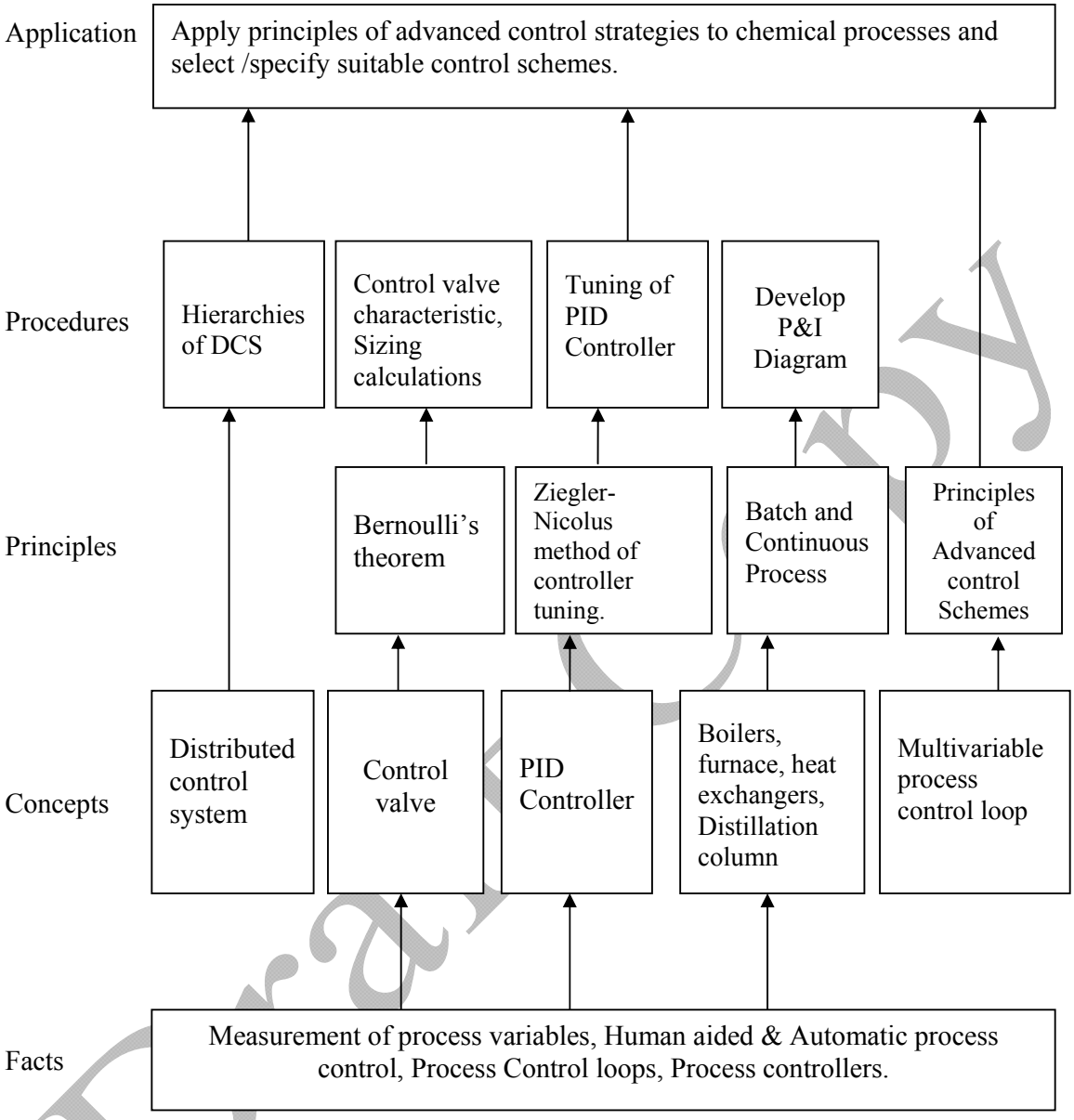
The role of instrumentation engineers include the understanding of different control schemes such as feedback, feed forward, ratio, adaptive etc. and the selection of the appropriate controllers & control scheme for the process.

**General Objectives:**

The student will be able to:

1. Know about Process Control systems in industry.
2. Understand P & I diagram for different processes.
3. Understand control valves, controllers & DCS system.
4. Understand and differentiate between different advanced control schemes.
5. Understand different unit operations in industry.

**Learning Structure:**



**Contents Theory:**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1: Process Control System**<br>**Specific Objectives:**<br>➢ Develop control system for process<br>➢ Construct P & I diagram for process<br>➢ Discriminate human aided & automatic process control<br><br>**Contents:**<br>• **Process Control:** Process control principle-Process, Human aided control, Automatic control, Block diagram of process control system, Identification of elements, Benefits.<br>• **P & ID symbols:** Diagram & their examples. | 06 | 12 |
| **Topic 2: Control Valves**<br><br>**Specific Objectives:**<br>➢ Define control valve for process<br>➢ Differentiate different flow characteristics<br>➢ Select & specify the control valve<br>➢ Identify valve positioners<br>2.1 [16]<br>• **Control valve:** principles & construction, Flow characteristics, Control valve selection & sizing, noise-Cavitations & flashing, remedies<br>• **Different types control valve** (Ball valve, Globe valve, Butterfly valve, Solenoid Valve): Construction & working,<br>2.2 [08]<br>• **Valve positioners**-Definition, Necessity, types | 16 | 24 |
| **Topic 3: Advance Control System**<br>**Specific Objectives:**<br>➢ Select advance control system for suitable process<br>➢ Classify different advance control system<br><br>**Different types of Advance control system**<br>**(**Block/schematic diagrams and Examples)<br><br>• Feed forward control-comparison with feedback control<br>• Cascade control<br>• Ratio control<br>• Selective control<br>•<br>• Split range control Adaptive control | 08 | 08 |

| | | |
|---|---|---|
| **Topic 4: Unit Operations**<br>**Specific Objectives:**<br>➢ Know different processes in Industry<br>➢ Select control system for processes<br>➢ Differentiate between different processes<br><br>4.1 **Different Unit Operations:** (diagrams, principle and types) [12]<br>• Heat exchanger process<br>• Evaporation process<br>• Boiler process<br>• Drying process<br>• Distillation column<br>• Batch process / continuous process<br><br>4.2. [08]<br>• **Use of feedback, feed forward & cascade control scheme for above processes** | 14 | 20 |
| **Topic 5: Project Engineering**<br>**Specific Objectives:**<br>➢ Specify Scope of Process Engineering<br>➢ Prepare Project Document<br><br>**Contents:**<br>• Basic Engineering- Control Loop designing, Documentation , IO listing, Instrument Index Sheet, Data Sheet<br>• Drawing of P & I Diagrams for Boiler Instrumentation or any other Unit Operation | 08 | 12 |
| **Topic 6: Distributed Control System**<br>**Specific Objectives:**<br>➢ Select/Specify DCS system for process control application<br>➢ Know different process displays<br><br>6.1<br>• **DCS:** History of development, Architecture of DCS-Bock diagram, Hierarchies of DCS, Process displays (Object, graphic, group, alarm, event & trend display), Selection criteria of DCS system, advantages of DCS system<br>6.2<br>• **Communication Methods**-Mod bus, Profibus, Control net, Ethernet<br>• **Application of DCS** in Cement & Thermal power industry (Explanation with block diagrams). | 12 | 24 |
| **Total** | **64** | **100** |

**Practical:**
**Skills to be developed:**

**Intellectual Skills**:

1. Selection of appropriate control system
2. Use of ISA standards
3. Specifying control scheme for process
4. Calculation of I/O for process

**Motor Skills:**

1. Drawing skills
2. Connection of inputs to DCS system

**List of Practicals:**

1. Identify the elements of any process feedback loop
2. Sketch Cut-Sections of various Control valves and Describe its working.
3. Plot Control valve characteristics using trainer set-up.
4. Calculation of CV for valve sizing.
5. Measurement & control of any process parameter with Proportional controller
6. Measurement & control of any process parameter with PID controller
7. Tuning of PID controller by process reaction curve method
8. Understand the working of cascade control/feed-forward using trainer setup
9. Draw control scheme for any one process using P & ID symbol
10. Observe and describe DCS system using trainer or simulation software and draw its block diagram.

**List of Laboratory Equipment:**

1. Cut - Sections of different Control valves
2. Control Valve characteristics trainer set-up
3. CV Calculation Trainer Set-up.
4. PID Controller Trainer Set-up.
5. Cascade or Feed forward Control trainer Set-up.
6. DCS Trainer Set-up or Simulation Software.

**List of Assignments:**

Visit a process industry and write a report on it.

**Learning Resources:**

**Books:**

| Sr. No. | Author | Title | Publisher |
|---|---|---|---|
| 1 | S. K. Singh | Industrial Instrumentation & Control | Mc Graw Hill |
| 2 | C. D. Johnson | Process Control Instrumentation Technology | Prentice Hall of India |
| 3 | Beta Liptak | Process Control | Chilton Book Company |
| 4 | Andrew Williams | Process Control | Gulf Publication |
| 5 | George Stepunopolis | Chemical Process Control | Prentice Hall of India |
| 6 | Krishnakant | Computer based industrial Control | Prentice Hall of India |

**Websites:**

http://www.engr.uconn.edu/~ewebhk/buttons/data/control/ch1.pdf
http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm
wikipedia.org/wiki/Instrumentation

**Course Name : Diploma in Instrumentation / Diploma in Instrumentation Control**

**Course Code : IS/IC/IE/IU**

**Semester : Sixth for IS/IC/IE and Seventh for IU**

**Subject Title : Industrial Automation**

**Subject Code : 17664**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| 03 | -- | 04 | 03 | 100 | 25# | -- | 25@ | 150 |

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

**Rationale:**

The subject is classified under applied technology group. It teaches the students Programmable Logic Controller (PLC) system used in automation industries for application such as pick and place, welding, spray painting, cutting, drilling, transportation of the objects etc.

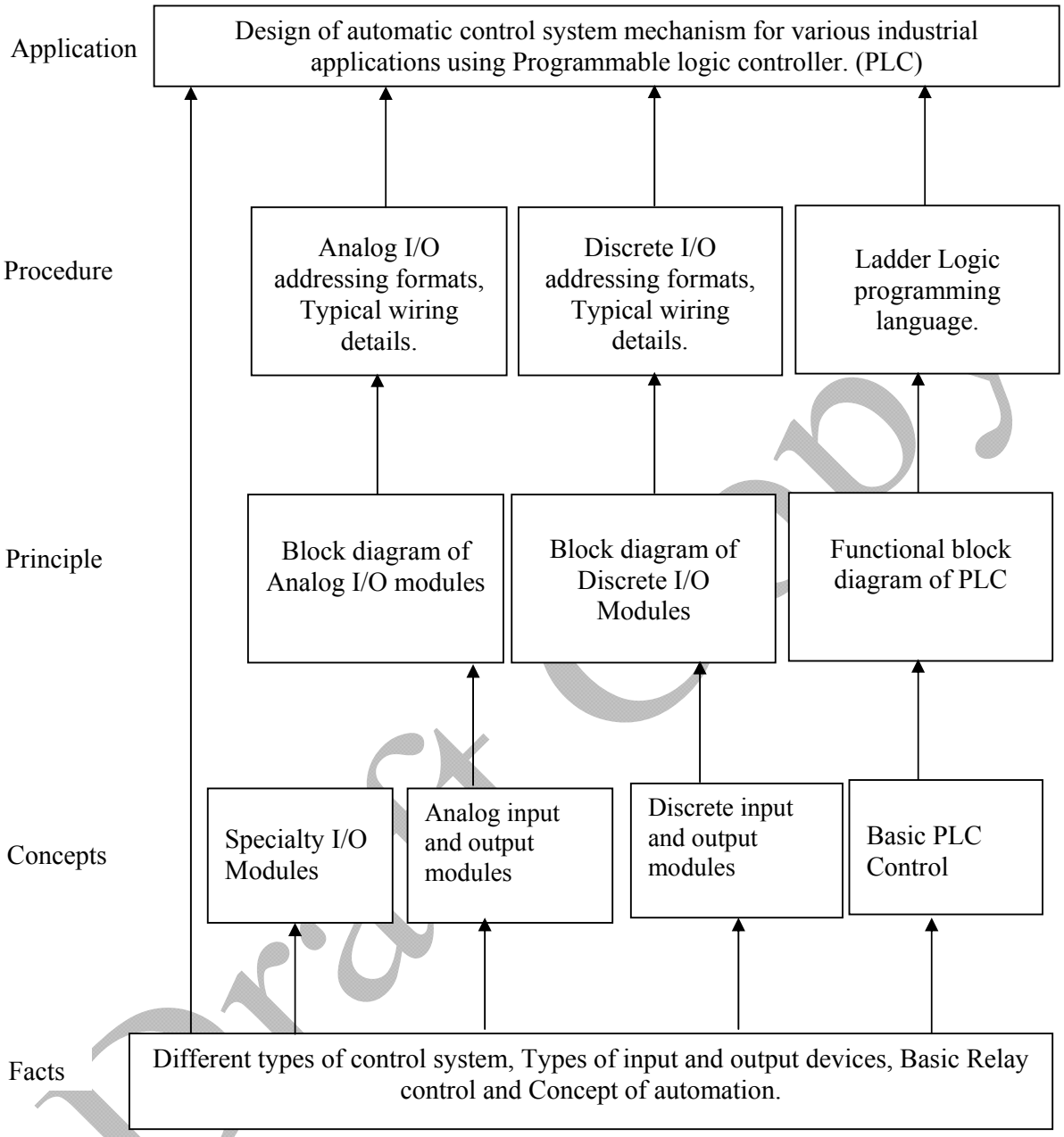
This subject will explore what a PLC is , operation, usage, Instructions, hardware selection and configuration, applications, introductory programming examples and exercises and some troubleshooting hints of PLC system.

**General Objectives:**

The student will be able to:

1. Know the new advanced system used in industrial as well as at domestic level.
2. Identify and understand different parts of PLC and different languages used in PLC.
3. Select PLC hardware configuration for given application.
4. Prepare a Ladder logic Program for a given applications.

**Learning Structure:**



**Theory:**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1: Introduction to Automation**<br><br>Specific Objectives:<br>➢ Understand the need of automation in industries<br>➢ Understand different automation tools.<br><br>Contents:<br><br>1.1 **Automation** – Definition, Need, Benefits, Different tools for automation [04 Marks] | 02 | 04 |
| **Topics 2: PLC Fundamentals**<br>➢ Know about basics of PLC.<br>➢ Understand functions diff. parts of PLC.<br>➢ Understand working of diff. specialty modules.<br><br>2.1 Evolution of PLC in automation, difference between relay control and PLC Control. [02 Marks]<br>2.2 **Block diagram and description of different parts**: [10 Marks]<br><br>• **CPU** - Function, scanning cycle, speed of execution.<br>• **Power supply**- function, Block diagram.<br>• **Memory** – function & organisation of ROM & RAM<br>• **Input modules**- function, diff. input devices used with PLC(only name & their uses)<br>• **Output modules**- function, diff. output devices used with PLC(only name & their uses)<br>• Fixed and Moduler PLCs & their types.<br><br>2.3 [04 Marks]<br>• **Specialty I/O modules**: communication module, high speed encoder, RTD input module, stepper motor control module, thermocouple module.<br>• Redundancy in PLC modules. | 08 | 16 |

| | | |
|---|---|---|
| **Topics 3: PLC Hardware**<br>➢ Understand the details of diff. I/O modules of PLC.<br>➢ Understand their wiring connections.<br>➢ Select a proper type of module for specific application.<br><br>**3.1** [10 Marks]<br>• **Discrete input modules:**<br>➢ **AC input modules** - block diagram, description, typical wiring details, specifications.<br>➢ **DC input modules** - block diagram, description, typical wiring details, sinking and sourcing concept & specifications.<br>• **Analog input modules**- block diagram, description, typical interfacing of input devices & specifications.<br>**3.2** [12 Marks]<br>• **Discrete output modules:**<br>➢ **AC output modules** - block diagram, description, typical wiring, and specifications.<br>➢ **DC output modules** - block diagram, description, typical wiring details, sinking and sourcing connections & specifications.<br>➢ Relay and Isolated o/p modules. (Only Description)<br>• **Analog output modules**- block diagram, description, typical wiring details & specifications.<br>• I/O module selection criterion. | 10 | 22 |
| **Topics 4: PLC Instruction Set**<br>➢ Get familiar with the instruction set of PLC system.<br>➢ Understand the I/O addressing of PLC.<br><br>**4.1** [04 Marks]<br>• I/O addressing of PLC.<br>• **Relay type instructions** - NO, NC, One shot, Latch, and Unlatch.<br>**4.2** [08 Marks]<br>• **Timer instructions** - On delay timer, off delay timer, Retentive timer, and Timer reset.<br>• **Counter instructions** - up counter, down counter, high speed counter, counter reset.<br>**4.3** [04 Marks]<br>• **Comparison instructions** – Equal, Not equal, Greater, Greater than equal, Less, Less than equal.<br>• **Data handling instructions** – Move, Masked Move, and Limit test.<br>• **Logical instructions** – AND, OR, EX-OR, NOT.<br>**4.4** [06 Marks]<br>• **Miscellaneous instructions** – Sequencer instructions, scale with parameter, subroutine and PID instructions. | 10 | 22 |
| **Topic 5: PLC Programming and Applications**<br><br>➢ Understand different programming languages of PLC<br>➢ Develop programming skills using simple programming examples.<br>➢ Prepare ladder program for different industrial applications.<br>**5.1** [04 Marks]<br>• Different PLC programming languages (only introduction) - FBD, Instruction list, structured text, sequential function chart, and ladder | 12 | 24 |

| | | |
|---|---|---|
| logic.<br>**5.2** [08 Marks]<br>• Simple programming examples using ladder programming language based on relay, timer, counter, logical, comparison, Data handling and miscellaneous instruction.<br>**5.3** [12 Marks]<br>• Application development based on description such as-<br>➢ Motor sequence control.<br>➢ Traffic light control.<br>➢ Elevator control.<br>➢ Tank level control.<br>➢ Reactor control.<br>➢ Conveyor system.<br>➢ Stepper motor control. (Any specific application can be considered in each above area to develop a ladder program)<br>• Speed Control of AC/ DC Motor using Programmable Drives | | |
| **Topics 6: Installation and Troubleshooting**<br>➢ To understand installation details of PLC system.<br>➢ To troubleshoot the PLC system for different faults.<br>**6.1** [06 Marks]<br>• PLC installation- enclosures, rack, master control relay, grounding, noise suppression, maintenance guidelines.<br>**6.2** [06 Marks]<br>• PLC troubleshooting- input and output troubleshooting using module LED status, troubleshooting of ladder program. | 06 | 12 |
| **Total** | **48** | **100** |

**Practical:**
**Skills to be developed:**

**Intellectual Skills**:
1. To understand PLC structure.
2. To interpret the results from observations and calculations.
3. Logical thinking
4. Software development
5. Programming using ladder language

**Motor Skills:**
1. Proper handling of instruments.
2. Measuring physical quantities accurately.
3. Observational Skills

**List of Practical:**
1. Verify functions of logic gates by using PLC.
2. Ladder program for Start stop logic using two inputs.
3. Ladder program for push to start and push to stop. (Use single Push Button)
4. Ladder program for blinking of LED's.
5. Write and verify ladder program for sequential ON-Off control of Lamps.
6. Write and verify ladder program for sequential control of DC motors.
7. Write and verify ladder program for stepper motor.

8. Use of Timers for Traffic Control.
9. Use of counters for pulse counting using limit switch/ proximity sensor.
10. Interfacing of thermocouple/RTD as an analog sensor with PLC.
11. Design of temperature On-Off control loop using PLC.
12. Use of PID control for Temperature control loop.
13. Use of sequencer instructions for stepper motor control.
14. Development of ladder program for washing system.
15. Development of ladder program for automated parking system.
16. Design of PLC based application using conveyor system.
17. Design of PLC based application using Elevator system.
18. Development of ladder program for security Gate to record entry and exit of employee and visitors
19. Speed Control of AC/DC Motor using Programmable drives

**List of Laboratory equipment:**

- Programmable Logic controllers from standard vendors.
- IEC 1131-3 compatible programming software.
- Limit switches, proximity switches, push buttons, Relays, Lamps.
- Single phase motor, 24V-DC motor, solenoid Valve, Fan, Heater.
- Setup for actual working processes (No simulation)
  a) Temperature control loop b) conveyor system

**List of Assignments:**

- Simple and Application programming examples from Chapter 5.

**Learning Resources:**
**Books:**

| Sr. No. | Author | Title | Publisher |
|---|---|---|---|
| 1 | Gary Dunning | Intro. To Programmable logic control | Cenage Learning |
| 2 | F.D. Petruzella | Programmable logic controllers (Third edition) | Tata- McGraw-Hill |
| 3 | NIIT | Programmable Logic control principles and applications. | PHI learning pvt.ltd. |
| 4 | John Hackworth and Federic Hackworth | Programmable logic controllers | Pearson education |
| 5 | Jon Stenerson | Industrial automation and process control | Prentice Hall |
| 6 | V. R. Jadhav | Programmable logic controllers | Khanna Publishers |

**Websites:**

- www.learningpit.com - for download of trial version of PLC simulation software.
- www.plctutor.com - for PLC tutorials.

**Course Name : Electronics Engineering Group**

**Course Code : ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU/IU/ED/EI**

**Semester : Sixth for ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU and Seventh for IU/ED/EI**

**Subject Title : Embedded System**

**Subject Code : 17658**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| 03 | -- | 02 | 03 | 100 | 50# | -- | 25@ | 175 |

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

**Rationale:**

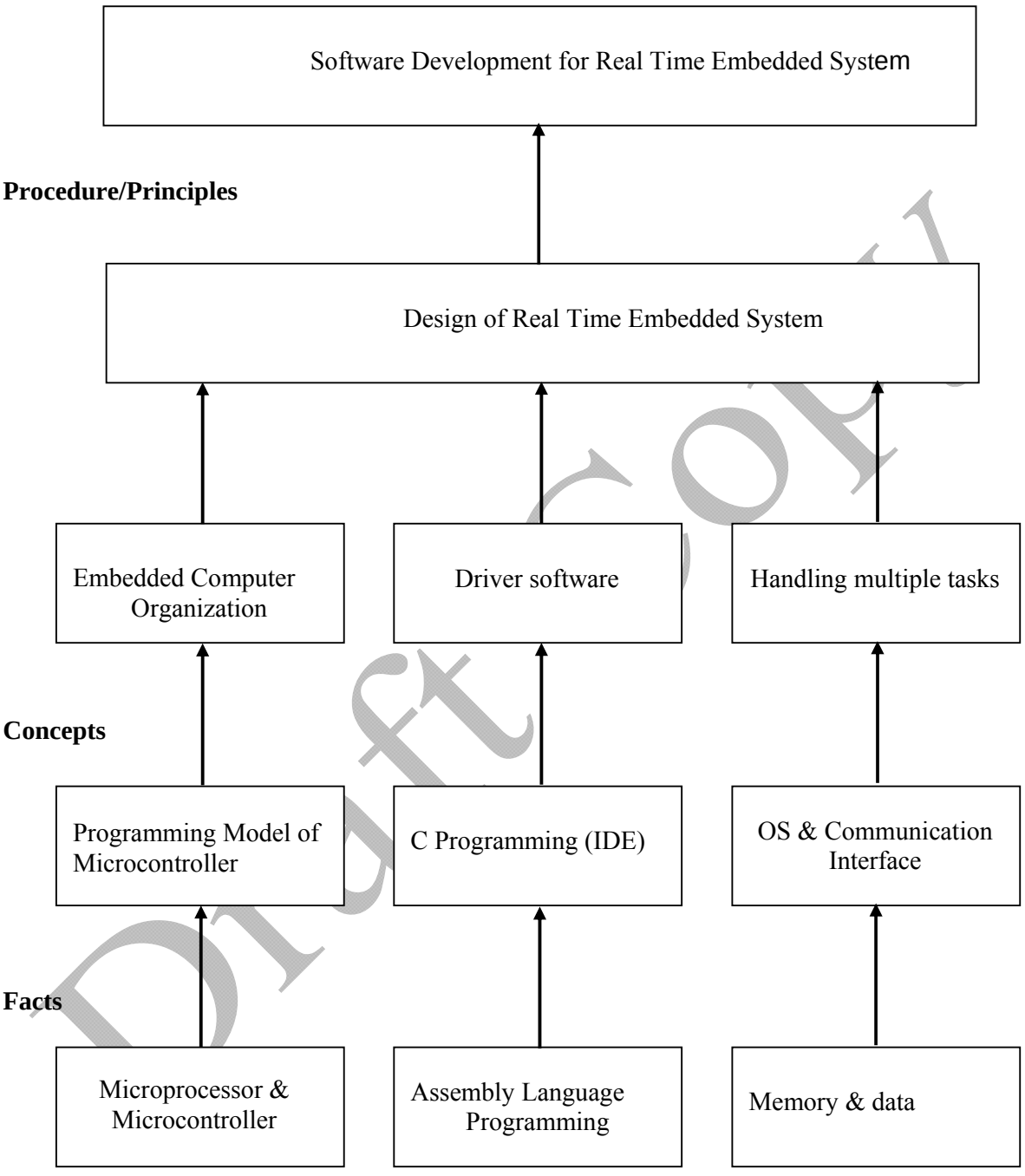
In the age of computer we are surrounded by the Embedded System - at home, office, colleges, canteen, toys, cell phones, transit, aerospace technology, military application. Out of millions of processor manufactured every year, nearly 95% processors are used in Embedded System. The Embedded Systems design is with or without OS. Most of them are Real Time Embedded Systems.

Due to such tremendous growth of Embedded Systems in recent years, one needs to be familiar with its design aspects, characteristics. Also the knowledge and programming of Real Time Embedded System is must. This subject is the advanced part of the subject Microcontroller.

**General Objectives:**

1. Differentiate and decide the architectures of processors for application.
2. Define communication media.
3. Design and development of small Embedded Systems.
4. Development of software.
5. Understand architecture of RTOS.

**Learning Structure:**



**Theory:**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1: Architecture of Microprocessor and Microcontroller**<br>**Specific Objectives:**<br>➢ Study of Architecture of microcontroller 89C51.<br>➢ Distinguish Microprocessor and Microcontroller architectures.<br>**Contents:**<br>1.1 Architecture of Microcontroller 89C51<br>GPR, SFR<br>• Address, Data & Control bus generation.<br>• Memory structure (Data and Program memory)<br>• IO Ports, Interrupts,<br>• Timer/Counter, Serial Communication<br>1.2 Block diagram and description of architectures of Processors:<br>• Von Neumann<br>• Harvard<br>• RISC<br>• CISC<br>• DSP<br>• Multi Core Processor | 08 | 08 |
| **Topic 2: Programming Microcontroller 89C51 with 'C'**<br>➢ Use Integrated Development Tools<br>➢ Develop Program logic with 'C'.<br>**Contents:**<br>2.1 Software Development Tools: Operation and selection (08 Marks)<br>• Integrated Development Environment (IDE): Cross-Complier, Emulator and Flash/OTP Programmer.<br>• In-Circuit Emulator (ICE), debugger, JTAG port<br>• Embedded C: Assembly Language V/S Embedded C.<br>• Programming Microcontroller 89C51 with C.<br>• 'C' Compiler for Microcontroller 89C51: SPJ Systems, Keil<br>• Program downloading tools: ISP/IAP<br>2.2 Programming with 'C': (16 Marks)<br>• Input/output operation.<br>• Bit/Byte operations.<br>• Arithmetic and Logical operations on data.<br>• Time delay routines.<br>• Timer/Counter operations.<br>• Generation of patterns on port lines.<br>• Serial Communication.<br>• Use of Assembly Instruction in 'C' program. | 12 | 24 |
| **Topic 3: Communication Protocols**<br>➢ Use of communication modes and protocols.<br>**Contents:**<br>• Need of communication interface in embedded system.<br>• Serial V/S Parallel Communication, Synchronous V/S Asynchronous Communication<br>• RS232: DB9-pin functions, MAX 232, MAX 233, Microcontroller 8051 connection with RS232 and RS485<br>• Communication protocols | 06 | 16 |

| | | |
|---|---|---|
| • Serial Communication Protocol: I2C, CAN, USB, Serial Peripheral Interface **(**SPI), Synchronous Serial Protocol (SSP).<br>• Parallel Communication Protocol: PCI, PCI-X<br>• Wireless Communication Protocol: IrDA, Bluetooth, Zigbee, IEEE802.11 | | |
| **Topic 4: I/O Interfacing**<br>➢ Interface different devices to Microcontroller 89C51.<br>➢ Develop logic of program to work with different devices.<br>**Contents:**<br>**Interfacing:**<br>• Interfacing Keys, LEDs and relay and its programming with 'C'.<br>• Interfacing matrix keyboard and its programming with 'C'.<br>• Interfacing LCD and its programming with 'C'.<br>• Interfacing ADC and its programming with 'C'.<br>• Interfacing DAC and its programming with 'C' for generation of different patterns.<br>• Interfacing Stepper Motor and its programming with 'C'.<br>• Interfacing DC Motor and its programming with 'C'. | 10 | 24 |
| **Topic 5: Embedded System Design**<br>➢ Classify and specify characteristics of embedded system.<br>**Contents:**<br>• Embedded System: Introduction, block diagram, applications, advantages and disadvantages.<br>• Classification of Embedded System: Small scale, medium scale, sophisticated, stand-alone, reactive/real time (soft and hard real time), Networked, Mobile, Single functioned, Tightly constrained,<br>• Design Metrics/Specifications/Characteristics of Embedded System: Processor power, memory, operating system, Reliability, performance, power consumption, NRE cost, unit cost, size, flexibility, time-to-prototype, time-to-market, maintainability, correctness and safety. | 06 | 12 |
| **Topic 6: Real Time Operating System**<br>➢ Define, understand and classify operating system.<br>➢ Define, describe and applications of real time operating system.<br>**Contents:**<br>**Operating System:**<br>• Operating System, functions of operating system.<br>• Architecture of Real Time Operating System (RTOS).<br>• Scheduling architecture.<br>• Multitasking.<br>• Share data problem.<br>• Semaphore.<br>• Dead lock.<br>• Inter-task Communication. | 06 | 16 |
| **Total** | **48** | **100** |

**Intellectual Skills**:

1) Use IDE for Microcontroller programming with 'C'.
2) Develop Logic of program.
3) Write 'C' Program.

**Motor Skills:**

1) Use of IDE for Microcontroller programming.
2) Interface Microcontroller Evaluation boards & peripherals.

**List of Practical:**

**Write and execute 'C' Programs:**

1) Input and output operation via ports.
2) Arithmetic and logic operations on data.
3) Use of assembly language instruction in 'C' program.
4) Generation of pulse/square wave on port line/s.
5) Reading key status and LED ON/OFF.
6) Operating Relay to activate connected devices to relay.
7) Reading matrix keyboard.
8) Read ADC and display it on LCD.
9) Generating different patterns with DAC
10) Running Stepper motor with different speed (CW/CCW).

**Learning Resources:**

**1. Books:**

| Sr. No. | Author | Title | Publisher |
|---|---|---|---|
| 1 | Frank Vahid & Tony Givargis | Embedded System Design A Unified Hardware/Software Introduction | Wiley |
| 2 | Raj Kamal | Embedded System Architecture, Programming and Design | Tata McGraw Hill |
| 3 | Dr K.V.K.K. Prasad | Embedded/Real-Time Systems: Concept, Design & Programming | Dreamtech Press |
| 4 | Jean J Labrosse | Micro C/OS-II The Real Time Kernel | CPM Books |
| 5 | Mazidi, Mazidi & McKinlay | The 8051 Microcontroller and Embedded System Using Assembly and C | Prentice Hall |
| 6 | Ajay V. Deshmukh | Microcontrollers (Theory and Applications) | Tata McGraw Hill |

**2. Websites:**

1) http://developer.apple.com/documentation/mac/devices-313.html
2) http://en.wikipedia.org/wiki/Integrated_development_environment.
3) http://en.wikipedia.org/wiki/communication_protocol.
4) http://en.wikipedia.org/wiki/RS-232.
5) http://en.wikipedia.org/wiki/Embedded_system.
6) http://en.wikipedia.org/wiki/Real_time_operating_system.

**Course Name : Diploma in Instrumentation / Diploma in Instrumentation Control**

**Course Code : IS/IC**

**Semester : Sixth**

**Subject Title : Process Automation System (Elective)**

**Subject Code : 17665**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| 03 | -- | 02 | 03 | 100 | -- | -- | 25@ | 125 |

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

**Rationale:**

The technology is changing very fast & it is essential that the subject content should keep pace with it. Contents of this subject are focused on advances in process automation system in general and DCS and SCADA in particular.

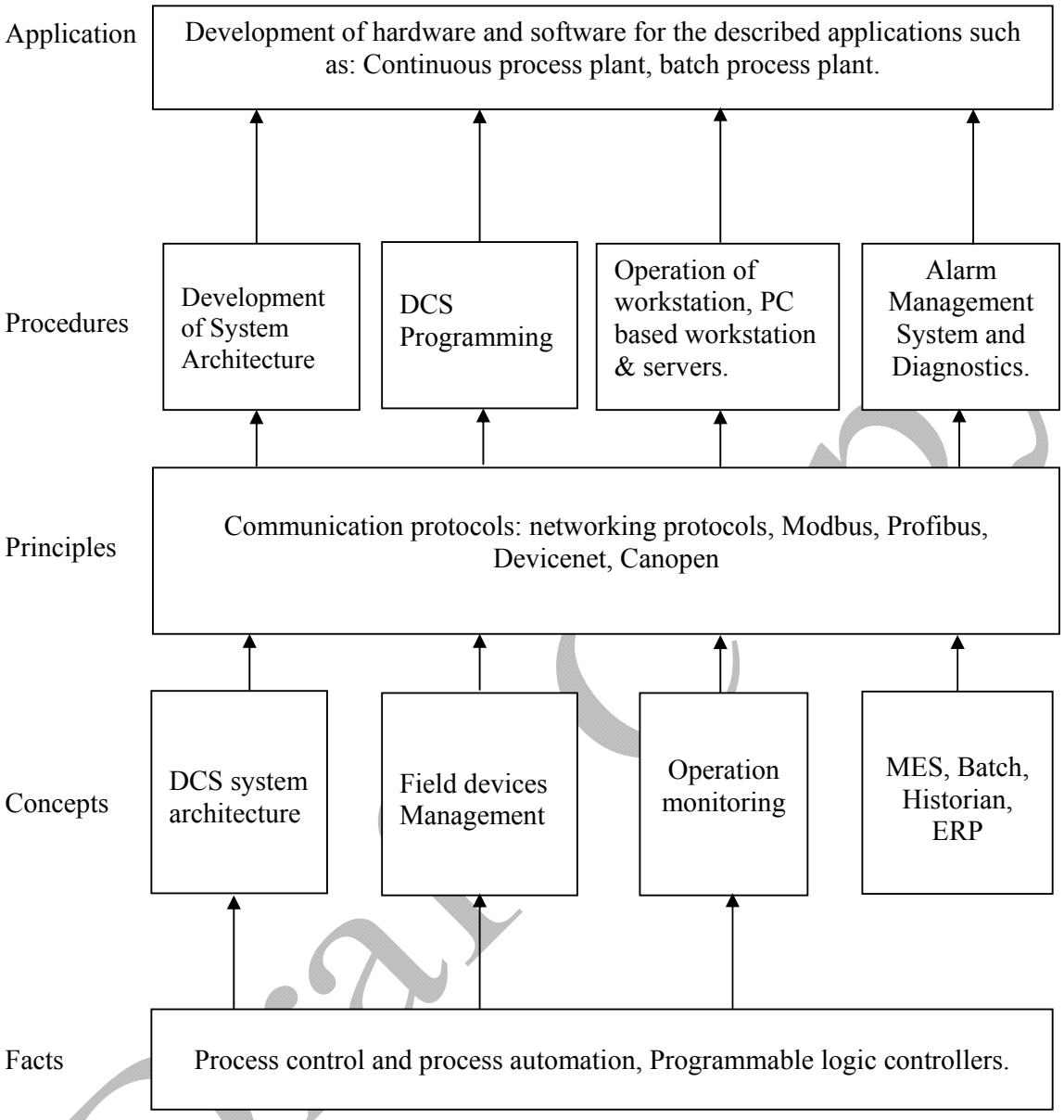
The architecture developed for process control over the years includes distributed digital control, distributed SCADA system, multiprocess architecture with network concepts. Beyond this, modern process control system present a wealth of further functions which allows the safe, secure and efficient operation of an automated plant and which deliver significant benefits to the plant owner and operator. For Instrumentation and Electronics students, modern process control system offers a variety of valuable career options, hence the subject Distributed Control System is introduced. Knowledge of PLC and Process control is essential to understand the subject.

**General Objectives:**

The student will be able to:

1. Understand modern process automation system.
2. Know the functions of Distributed Control System.
3. Develop the system architecture (Hardware and software)
4. Understand the use of networking and communication in process automation.

**Learning Structure:**



**Theory:**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1: Evolution of Process Automation System**<br>Specific Objectives:<br>➢ Identify process control system.<br>➢ Explain the role of PLC, SCADA and DCS.<br><br>**Contents:**<br>• Process Control & Process Automation – Scope and Application<br>• Evolution of PLC, Supervisory Control and Data Acquisition (SCADA) and Distributed Control System (DCS.)<br>• Evolution of Process Automation System. | 04 | 10 |
| **Topic 2: System Architecture**<br>➢ Use of MES, Batch, and Historian.<br>➢ Compare Different internationally recognized process automation systems.<br><br>**Specific Objectives:**<br>• DCS System architecture of a typical process automation system.<br>• Study of functions of each block.<br>• Field device management-transmitters, motors, energy monitoring.<br>• Process operation monitoring, process Automation, process control.<br>• Plant –MES, Batch, Historian.<br>• Enterprise- Integration with Enterprise Resource Planning (ERP).<br>• Comparative study of any three internationally recognized Process automation systems. | 08 | 16 |
| **Topic 3: Field Device Management**<br>**Specific Objectives:**<br>➢ Describe intelligent transmitters and Buses.<br>➢ Program for intelligent motor control.<br>➢ Interface of final control element and DCS<br><br>• Intelligent transmitters – Field buses –HART, foundation fieldbus, Profibus PA, Modbus, Asi bus.(Defination, features and applications )<br>• Intelligent motor control-Modbus, can open, Profibus DP, Device net.(concept)<br>• Energy monitoring-Power monitors, intelligent relays.<br>• Final control elements - On-Off valves, control valves, VFD's(interface of these devices with process automation software) | 08 | 16 |
| **Topic 4: Controllers and I/O**<br>**Specific Objectives:**<br>➢ Select appropriate CPU<br>➢ Explain Safety controllers.<br>➢ Identify in-rack and remote I/O<br><br>• Selection criteria for CPU based on Execution speed, memory, I/O Handling Capacity, Networking capabilities, communication.<br>• Concept of Hot standby architecture. | 04 | 10 |

| | | |
|---|---|---|
| • Safety controllers-SIL<br>• In-rack and remote I/O<br>• Features of Input and output devices used in hazardous areas. | | |
| **Topic 5: Control System Networks**<br>**Specific Objectives:**<br>➢ differentiate between proprietary and open network<br>➢ Identify different network components.<br>➢ Select network components and appropriate topologies.<br><br>• Proprietary and open networks<br>• Profibus, Controlnet, Ethernet TCP/IP, Wireless**.**<br>• Ethernet network topologies- Bus, Star and Ring.<br>• Network cabling- Copper, co axial, fiber optics.<br>Features and characteristics of all above | 08 | 16 |
| **Topic 6: Engineering and Operating Workstations**<br>**Specific Objectives:**<br>➢ Draw and explain schematic of PC workstations, servers and operating systems<br>➢ Interpret process visualization(graphical representation)<br>➢ Identify techniques for data handling.<br>➢ Use system diagnostics and security features.<br>➢ Program for DCS system<br><br>**DCS Programming ( Using IEC 1131-3 Compatible Software):**<br>• Functions of engineering and operating stations.<br>• PC based workstations and servers, operating systems.<br>• Local operator stations for use in safe and hazardous area<br>• Process visualization(graphic displays)<br>• Alarm management<br>• Real time and historical trending.<br>• Event logs<br>• System Diagnostics<br>• Security levels for Access | 12 | 20 |
| **Topic 7: Applications in Process Industry**<br>**Specific Objectives:**<br>➢ Develop system architecture using system description.<br>• Continuous process plant - Refinery, petrochemical<br>• Batch process plant - Food and beverage<br><br>Develop the modular programs for different stages for above processes | 04 | 12 |
| **Total** | **48** | **100** |

**Practical:**
**Skills to be developed:**

**Intellectual Skills**:

1. Understanding the DCS structure.
2. Interpretation of results from observations and calculations.
3. Development of simple programs for DCS applications.

**Motor Skills:**

1. Configuration of Controller.
2. Interconnection of various DCS components.
3. Software troubleshooting.

**List of Practical:**

1. Learning of DCS Software (IEC1131-3compatible) architecture - Basic functions and utililities.
2. Learning of DCS software configuration for programming and communication.
3. Temperature control loop using FBD programming.
4. Motor Speed control using FBD programming.
5. SFC programming for Temperature control loop.
6. Instruction listing for Temperature control loop.
7. SFC programming for Motor speed control.
8. Instruction listing for Motor speed control.
9. Exercise on alarm management.
10. Exercise on DCS report generation.

**List of Assignments:**

1. Develop system architecture for a given application.
2. Study of communication cables, their construction, adapters, and connections techniques for different types of buses.

**Learning Resources:**
**Books:**

| Sr. No. | Author | Title | Publisher |
|---|---|---|---|
| 01 | -- | Practical Distributed control system (DCS) for Engineers and technicians. | IDC Technologies. www.idc-online.com |
| 02 | Martin Hollender | Collaborative Process Automation Systems | ISA |
| 03 | Michal P. Lukas | Distributed Control System. | -- |
| 04 | S. K. Singh | Industrial Instrumentation and Control | PHI |

**Websites:**

- www.idc-online.com
- http://www.abautomation.in/

**List of Laboratory equipment**

- IEC 1131- 3 Compatible Software
- Two PLC's, sensors and Transmitters, PC server, Two work Stations
- Temperature Control Loop, VFD, Single phase Motor

**Course Name : Diploma in Instrumentation / Diploma in Instrumentation Control**

**Course Code : IS/IC**

**Semester : Sixth**

**Subject Title : Biomedical Instrumentation (Elective)**

**Subject Code : 17666**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| 03 | -- | 02 | 03 | 100 | -- | -- | 25@ | 125 |

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

**Rationale**:

The human body generates various types of signals within it, which are indicators of various activities taking place inside the body.

Biomedical Instrumentation will help to understand, interpret the various signals originating in the human body.

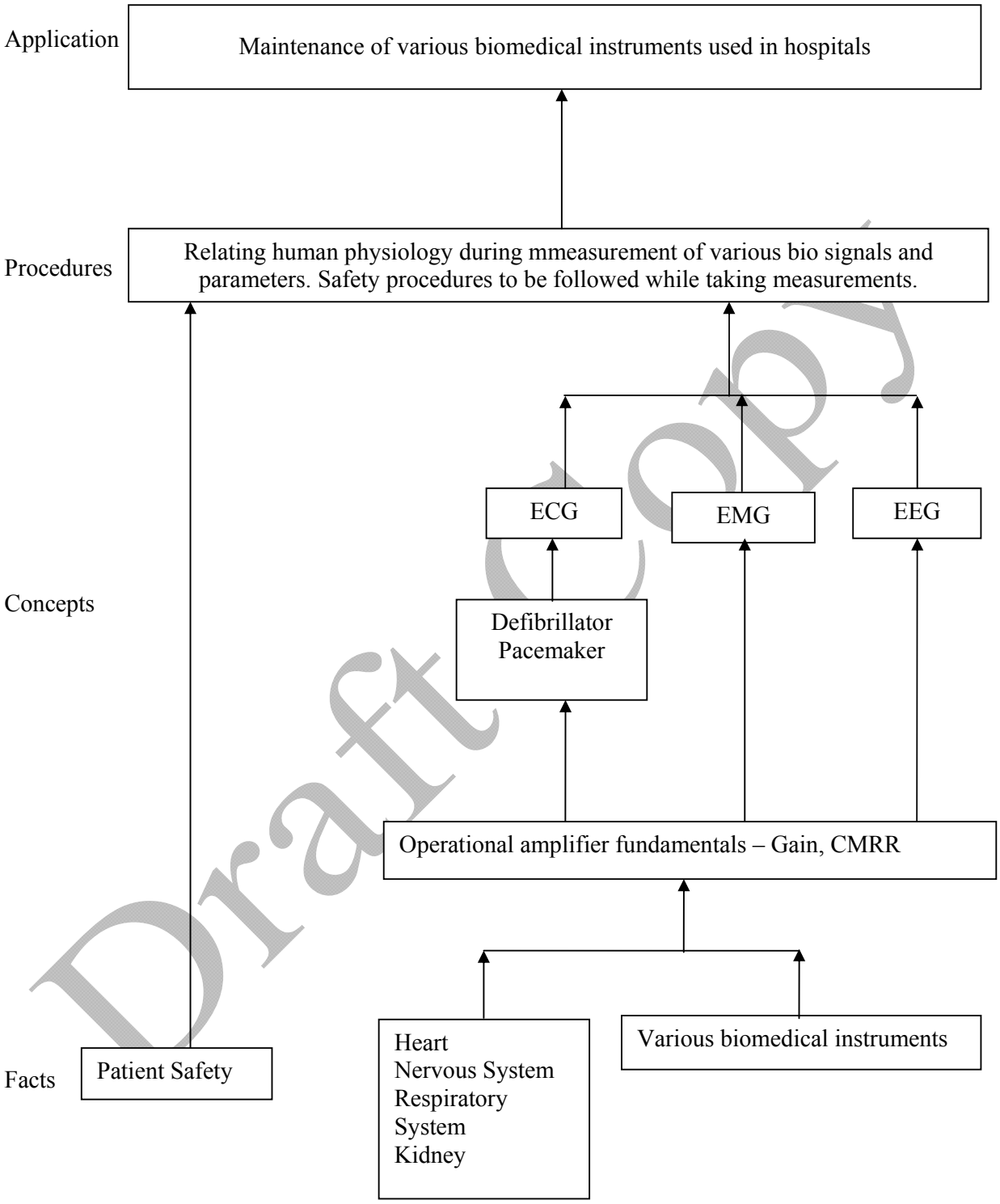
The subject provides basic knowledge of human physiology, how signals from the body are picked up, basic building blocks of the instruments that processes these signals which provide vital diagnostic information such as: ECG machine, EEG machine, CAT, X-ray machine, etc.

**General Objectives.**

The student will be able to:

1. Study different organs of human body with neat & labeled diagram.
2. Understand the bioelectric signals & measurement of heart, brain & muscle signals for diagnosis.
3. Understand the need & working of life support equipments.
4. Know about Electrical safety to avoid accidents.

**Learning Structure**



**Theory:**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1] Fundamentals of Physiology**<br>**Specific Objectives:**<br>➢ Draw, label and explain the working of man instrument system<br>➢ List and explain the problems encountered during measurement of important parameters of living system<br>➢ Draw, label, describe functioning of cardiovascular system, nervous system, respiratory system and kidneys.<br><br>**Contents:**<br>• Man - instrument system: - components, block diagram & working.<br>• Cardiovascular system: - structure of heart, cardiovascular circulation, electrical conduction system of heart, generation of heart sound, importance of cardiac output.<br>• Respiratory system: - physiology of respiratory system, mechanism of breathing, lung volumes & capacities.<br>• Nervous system: - structure and functioning of neurone. Structure of brain, functions of cerebrum, cerebellum, pons, mid brain, medulla oblongata, thalamus, hypothalamus, Spinal cord. Neuronal communication diagram and description.<br>• Kidney: - structure, functions & operation. | 14 | 24 |
| **Topic 2] Bioelectric Signals & Electrodes**<br>**Specific Objectives:**<br>➢ State origin of bio electric signal.<br>➢ Define action and resting potentials.<br>➢ Draw, label and describe working of various electrodes used in biomedical applications.<br><br>**Contents:**<br>• Resting & action potentials with schematic diagrams<br>• Electrode electrolyte interface with schematic diagram<br>• Construction and diagram of various electrodes used for measuring ECG, EEG & EMG - Microelectrodes, surface electrodes (suction cup electrode, Disposable electrode, Floating type electrode, Metal Disk electrode) & needle electrodes.<br>• ECG system: - block diagram, working, leads – unipolar, bipolar, typical electrocardiogram and its details, technical specification.<br>• EMG system: - define electromyography, block diagram, working, and technical specification.<br>• EEG: Define electroencephalogram, block diagram working, specification. Waveforms and description of various stages of sleep | 12 | 18 |
| **Topic 3] Measurement of Heart Sound, Blood Pressure, Respiration Rate, Blood Flow.**<br>**Specific Objectives:**<br>➢ Define pressure, flow and state its units.<br>➢ Describe the working of sphygmomanometer with the help of schematic diagram.<br>➢ Draw the diagram and explain the working of spirometer.<br>➢ List the methods used for measurement of blood flow. | 05 | 16 |

| | | |
|---|---|---|
| **Contents:**<br>• Measurement of heart sound using phonocardiograph.<br>• Principle of blood pressure measurement, list only the names of direct & indirect method of blood pressure measurement. Schematic diagram and working of sphygmomanometer.<br>• Measurement of respiration rate - Spirometer (diagram, construction and working).<br>• Measurement of blood flow - plethysmograph, electromagnetic, ultrasonic method (diagram, construction and working). | | |
| **Topic 4] Life support equipments**<br>**Specific Objectives:**<br>➢ Define fibrillation of heart.<br>➢ State the need of defibrillator.<br>➢ Give classification of peacemakers.<br>➢ Write technical specifications of pacemaker, dialysis machine and defibrillators.<br><br>**Contents:**<br>• Defibrillator - concept of fibrillation, defibrillation. Types of defibrillators, dc defibrillation (diagram, working, output waveforms), electrodes used - paddle electrodes, specification of defibrillator.<br>• Pacemaker: - Concept of Pacemaker. Types of Pacemaker - internal & external, working of various pacing modes. Block diagram of Pacemaker and its working, specification.<br>• Dialysis machine - need, function; block diagram, working, specification. | 06 | 16 |
| **Topic 5] Imaging systems**<br>**Specific Objectives:**<br>➢ List the applications of X ray, CT scan and ultrasonography machine in biomedical field.<br>➢ Describe the working of CT scan machine<br>➢ State the principle of Ultrasonography machine.<br><br>**Contents:**<br>• X-ray: - principle of X rays, block diagram of X ray machine , working, image intensifier schematic diagram and working, application of X ray machine, specification of X ray machine.<br>• CAT- principle of CT scan, block diagram, working, applications and specification.<br>• Ultrasonography - principle of ultrasonography, its block diagram, workings, specification and applications. Various mode (A, B & M mode) | 06 | 18 |
| **Topic 6] Laboratory equipments & patient safety**<br>**Specific Objectives:**<br>➢ Enlist the equipments used in the laboratory of a hospital.<br>➢ Define micro shock & macro shock.<br>➢ State the patient safety precautions.<br><br>**Contents:**<br>Laboratory equipment<br>• Centrifuge, autoclave, incubator, deionizer - principle of operation, | 05 | 08 |

| | | |
|---|---|---|
| applications.<br>Patient safety<br>• Safety:- micro shock & macro shock, effects of leakage current on human body, types of leakage current, precaution to minimize electric shock hazards & leakage current. | | |
| **TOTAL** | **48** | **100** |

**Practical:**
**Skills to be developed**

**Intellectual Skills:**

1. Select electrodes, understand placement of electrodes / leads on human body
2. Appropriate use of various medical instruments
3. Understand & follow patient safety measures

**Motor Skills:**

1. Connect the equipment properly.
2. Make accurate measurements.
3. Take the output of equipment on recorder.

**List of Practicals**:

1. Study construction details, applications of various electrodes used in measurement of various physiological parameters.
2. Plot the electrocardiogram by using ECG machine.
3. Plot electromyogram using EMG system.
4. Plot phonocardiogram using phonocardiograph.
5. Plot spirogram using spirometer.
6. Measurement of blood pressure by using sphygmomanometer.
7. Study defibrillator. Compare various fibrillation waveforms with normal ECG equipments.waveform.
8. Prepare a report on visit to Hospital for various biomedical equipment such as CT scan, Ultrasonography, X-ray machine and laboratory

**List of assignments (Compulsory):**

**Write any four assignments from the list given below:**

1. With the help of neat and labeled diagram explain: cardiovascular circulation, structure of neuron, structure of nephrone, mechanism of breathing, structure of Kidney.
2. State two functions of each: Cerebrum, cerebellum, Medulla oblongata, Spinal cord.

3. With the help neat and labeled diagram explain action potential and resting potential.
4. With the help of neat and labeled diagram explain the working of phonocardiograph, along with output waveform.
5. State various pacing modes used in pacemaker.
6. List any eight precautions to minimize electrical shock hazard.
7. State two applications of each: Centrifuge, Autoclave, Deionizer, Incubator.

**Learning Resources:**
**Books:**

| Sr. No. | Author | Title | Publisher |
|---|---|---|---|
| 1 | Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer | Biomedical Instrumentation & Measurements | PHI |
| 2 | R. S. Khandpur | Handbook of Biomedical Instrumentation | Tata McGraw Hill |
| 3 | John G. Webster, Editor | Medical Instrumentation-Application & Design | Wiley India Pvt. Ltd. |
| 4 | Carr Joseph J., Brown J.M | Introduction to Biomedical Equipments Technology | Pearson Education, Delhi |
| 5 | Scott Mathur | Textbook of Biomedical Instrumentation | CBS |
| 6 | Mandeep Singh | Introduction to Biomedical Instrumentation | PHI |
| 7 | R. Anananatarajan | Biomedical Instrumentation & Measurements | PHI |

**Websites:**
en.wikipedia.org/wiki/topic name

**List of equipments:**
1. Electrodes used for measurement of ECG, EEG, EMG.
2. ECG machine.
3. EMG machine.
4. Phonocardiograph machine.
5. Respiration rate meter.
6. Digital Storage Oscilloscope.

**Course Name : Electronics Engineering Group**

**Course Code : ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU/IU/ED/EI**

**Semester : Sixth for ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU and Seventh for IU/ED/EI**

**Subject Title : Simulation Software**

**Subject Code : 17807**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| -- | -- | 02 | -- | -- | -- | -- | 25@ | 25 |

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

**Rationale:**

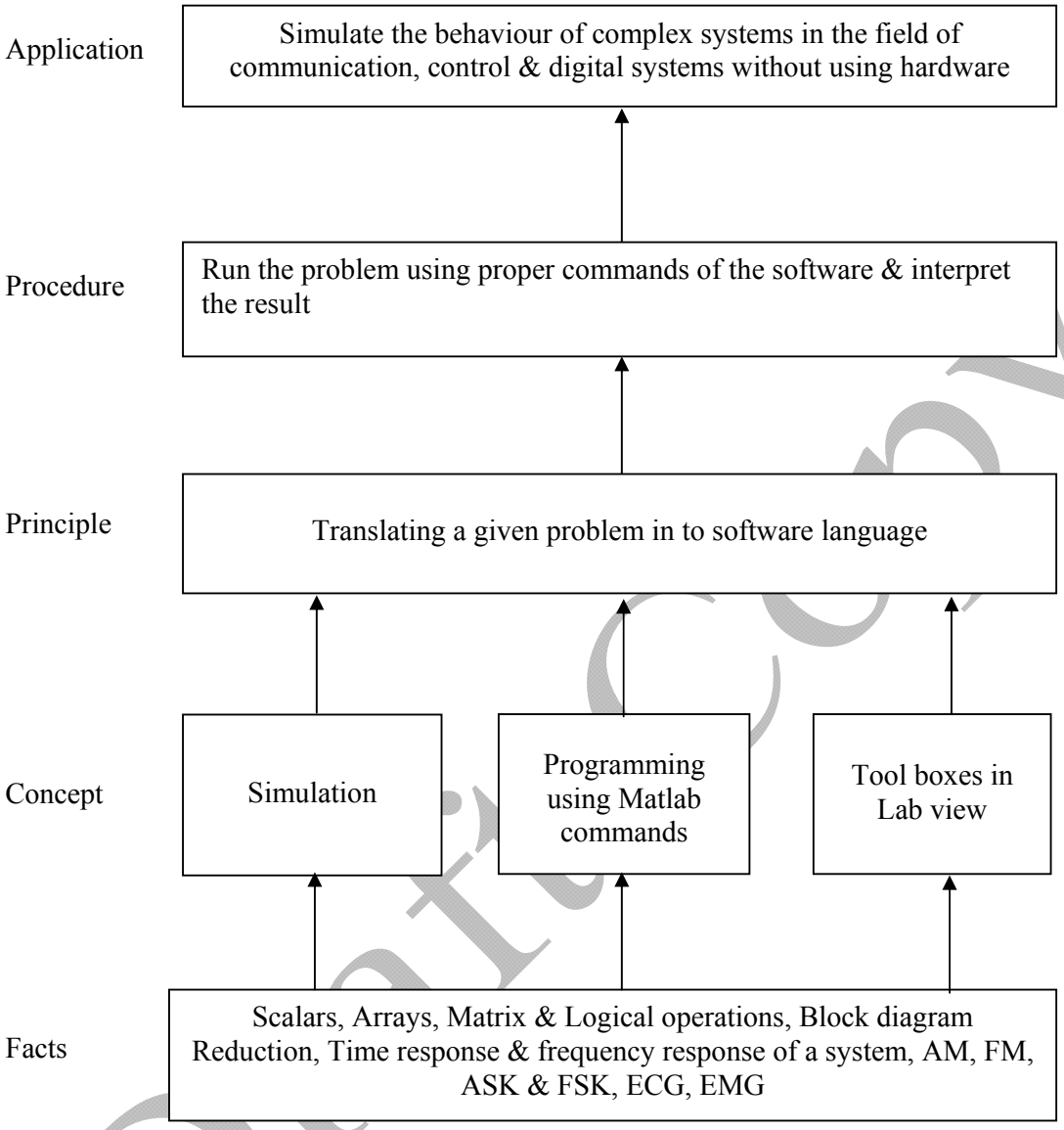
Recent development in technology has put a lot of emphasis on awareness of analytical tools available in the market. The ready to use library functions available in different simulation software enable the user to design circuits without knowing the complex mathematical details. Under this subject students will be taught softwares like Labview & MATLAB which are commonly used by electronics engineers, worldwide.

**General Objectives:**

Students will be able to:

1. Learn the use of various library functions available in the software.
2. Construct given circuit diagram using these library functions.
3. Study the working of the circuit for various inputs.

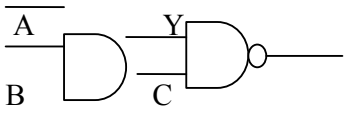
**Learning Structure:**



**List of Experiments**

1. Verify simple mathematical operations of all elements in row/column vector. Using MATLAB
    a. Sum
    b. Mean
    c. Length
    d. Max
    e. Min
    f. Prod
    g. Sign
    h. Round
    i. Sort
    j. Fix
2. Use commands to
    a. convert centigrade to Fahrenheit
    b. Given the radius of circle. Find the circumference & its area

3. Calculate the output for all the eight conditions of A,B,C




4. Use of commands to
    a. Find the determinant, inverse & transpose of the given 2X2 matrix
    b. Evaluate the following expression

$$Y = 1 + \frac{x^2}{2} + \frac{x^3}{3} + \frac{x^4}{4} + \frac{x^5}{5}$$

5. Calculate the natural frequency of oscillators for the given RLC circuit. Assume L=0.01mH, R=100Ω & C varying from 0.1 to 0.5 in steps of 0.1 μF using following equation

$$F = \sqrt{\frac{1}{LC} - \frac{R^2}{4C^2}}$$

6. A series R-L-C circuit connected across 100V peak, 50 Hz supply, consists of R=10Ω, L=0.2H, C=100μF. Write a MATLAB script to determine the resonant frequency & current at resonance
   [hint: $f = \frac{1}{2\pi\sqrt{LC}}$ ; $I = \frac{V}{R}$ ; Vrms= $\frac{V_{pp}}{\sqrt{2}}$]

7. Connect three sine wave sources of given amplitude and frequency but with a phase shift of 0, 2π/3,and - 2π/3 to a 3X1 multiplexer and observe the waveforms on scope. Also, de multiplex these waveforms and observe on the scope.

8. Create a VI that produces a sine wave with a specified frequency and displays the data on a Waveform chart until stopped by the user.

9. Simulation of amplitude and frequency modulation

10. Design a low pass filter with R= 1 K Ω and C = 0.1 μF and calculate the cut off frequency.

**Course Specific Simulation Programs (using either Matlab / Labview / Open source free downloadable software)**

For Instrumentation Course

1. Observe step & impulse response of first & second order system & calculate time response parameters- $t_d$, $t_r$, $t_p$, $M_p$, $t_s$, $e_{ss}$
2. Characteristics equation of a system is given by $S^5+2S^4+4S^3+8S^2+3^S+1$ Check their stability with routh Hurwitz criterion
3. Observe the characteristics of linear, equal percentage and quick opening control valves

**For Electronics and Industrial Electronics Course**

1. Simulation of R-L-C series circuit
2. Single phase half wave phase controlled converter
3. Observe step & impulse response of first & second order system

**For Medical Electronics Course**

1. Calculate Body Mass Index, given the height and weight
2. Given the Heart Rate and display whether the person is having trachicardia and bradicardia
3. Design a scope for patient monitoring with at least four different parameters and observe the waveform by changing these parameters.

**For EJ/ET/EX/EV Courses**

1. Simulation of Sampling theorem
2. Simulation of Amplitude shift keying
3. Simulation of TDM

**Course Name : Electronics Engineering Group**

**Course Code : ET/EN/EJ/IE/IS/IC/DE/EV/MU/IU/ED/EI**

**Semester : Sixth for ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU and Seventh for IU/ED/EI**

**Subject Title : Industrial Project**

**Subject Code : 17808**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| -- | -- | 04 | -- | -- | -- | 50# | 50@ | 100 |

**Rationale:**

Diploma holder need to be capable of doing self-Study throughout their life as the technology is developing with fast rate. Student will be able to find out various sources of technical information and develop self-study techniques to prepare a project and write a project report.

This subject is intended to teach students to understand facts, concepts and techniques of electrical equipments, its repairs, fault finding and testing, estimation of cost and procurement of material, fabrication and manufacturing of various items used in electrical field. This will help the students to acquire skills and attitudes so as to discharge the function of supervisor in industry and can start his own small-scale enterprise.

**Objectives:**

The students will be able to,

1. Work in Groups, Plan the work, and Coordinate the work.
2. Develop leadership qualities.
3. Analyse the different types of Case studies.
4. Develop Innovative ideas.
5. Develop basic technical Skills by hands on experience.
6. Write project report.
7. Develop skills to use latest technology in Electronics field.

**Contents:**

During fifth semester students will collect information, analyse the information and select the project. They will also prepare the List of the components required, PCB design, Testing

Procedure, Design of the Cabinet or Box or Board as the case may be. They will also prepare a synopsis of the project.

So at sixth semester they have to execute the project. A tentative Schedule is proposed below:

| Proposed Schedule: | Weeks |
|---|---|
| Procuring components, component testing and circuit testing | 02 |
| PCB making and onboard testing | 06 |
| Trouble shooting and cabinet making | 04 |
| Documentation | 04 |

**References: Books/Magazines:**

**Name of the Magazines**

1. Industrial Automation
2. Electronics for You
3. Electronics Projects
4. Computer World
5. Chip
6. Any Journal Related to Electronics/Computer/Information Technology

**Website:**

Using any search engine, such as http://www.google.co.in/ the relevant information can be searched on the Internet.