6.1 INDUSTRIAL AUTOMATION

L	P
3	3

RATIONALE

A diploma holder employed in automated manufacturing units/assembly lines, process industry, Power generation stations needs to know about systems/components required for automation of a modern industrial unit. Design concepts have changed to electrical/electronics controls from the conventional mechanical cams/timers, thus making the automation process more flexible and comprehensive.

Programmable logic controllers (PLCs) are flexible automation controllers in which the Inputs/Outputs and Control sequences including timers are changed by changing the programme. Diploma holder in industry are required to trouble shoot/change automation sequences for optimizing the production through automatic machines/assembly lines.

A plant/process Industry/automated manufacturing lines have multiple sensors/actuators /process parameter transmitters which are connected to the central control room through standard instrumentation buses hence knowledge about these buses for data communication will be required. Control methodology are implemented through Supervisory Control and Data Acquisition (SCADA) or Distributor Control (DCs) hence understanding of these is necessary.

DETAILED CONTENTS

1. Automation Components – Relays, Switches, Contactors (Construction, Working & Applications) (8hrs)

2. Programmable logic controllers (PLCs) (24hrs)

3. SCADA & DCS (8 hrs)
   Introduction to SCADA, Different elements of SCADA Studying a typical SCADA Configuration Meaning of DCS, Difference between DCS and SCADA, Comparison DCs and SCADA

4. Instrumentation Buses (8 hrs)
   - Concept of BUS, Sensor Bus, device bus and field bus.
   - Overview and salient features of Ethernet, HART, Foundation field Bus, ASI Bus , Mod bus, Devicenet and Profibus
   - Wireless Gateways, Wireless Thum

LIST OF PRACTICALS

1. Identification of control components and using them in simple electrical control circuits.
2. Practicals of PLCs
3. Demonstration of DCs system in typical pharmaceutical plant/thermal power plant

LIST OF BOOKS

1. Mechatronics by Bolton

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted for Lectures and Tutorials (Periods)	Marks Allotted (%)
1	08	16
2	24	50
3	08	18
4	08	16
Total	48	100

6.2 ROBOTICS

L	T	P
3	-	3

RATIONALE

Robotics and automation are becoming common for various applications in manufacturing plants. Basic knowledge of different configurations, end effectors, sensors and actuators are essential for the diploma students. Diversified applications of robots in industries are enormous and hence students have to be imparted the knowledge of robot applications. Hence this subject

DETAILED CONTENTS

1. Introduction (4 hrs)

   Robot definition, need, robot terminology, robot motion, robot classification based on physical configuration, advantages and limitations of robot.

2. Basic Elements of Robots (20 hrs)

   Basic structure, classification of robotic systems- accordingly to types of system, according to control loop, according to structure of manipulator (Cartesian, cylindrical, spherical and articulated). Degree of freedom.
   End effectors- types, working principle and applications
   Drives- types and application with working principle.
   Sensing Devices- optical senor, proximity sensor- LVDT, Force sensor (strain gauges and piezoelectric), RTD and thermocouple.
   Motion encoders, Selection Criteria for Robot.

3. Robot controls (8 hrs)
   Purpose, level of controls
   Device controller
   Work cell controller
   Servo and Non-servo control systems – types, basic principle and block diagrams.
   Working, advantages, limit at ions of some control system
   - Adaptive control
   - Computed Torque Technique
   - New minimum time control
   - Resolved motion control

4. Robot Programming (10 hrs)

   Need and function of robot programming, Methods
   - Manual Teaching
   - Lead through
   - Programming languages (VAN,RAIL)
   - Types, features and applications of various programming languages

5. Robotic Applications. (6 hrs)

Material transfer, Machine loading and unloading, painting, packaging, inspection and welding.

LIST OF PRACTICLES

1. Study demonstration and analysis of robot features, specifications, elements, configurations
2. Study on different types of end affecters
3. Study and prepare report for any one type of special purpose robot.
4. Seminar/Group discussion/case study/industrial visit for subject content and recent developments in the field of robotics.
5. Simulation of various robot actions (motions, operations etc.) for different tasks on any robotic software
6. Practice/Programming on robotic software

LIST OF REFERENCE BOOKS

1. Robotics for Engineers Yoram Koren; McGraw Hill Publisher
2. CAD/CAM/CIM by P. Radhakrishnan and S.Subramaniyam; Wiley Eastern Publishers, New Delhi
3. Robotics by K S Fu, R. C. Gonzalez and C S G Lee
4. Robotic Engineering by Richard K Lafter
5. Robot Reliability and Safety by B.S.Dhillon
6. Industrial Robotics by M.P.Groovers et al.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted for Lectures and Tutorials (Periods)	Marks Allotted (%)
1	04	10
2	20	30
3	08	15
4	10	25
5	06	20
Total	48	100

6.3 INSPECTION AND QUALITY CONTROL

L	T	P
4	-	2

RATIONALE

Diploma holders in this course required to measure and inspect for ensuring quality of product. For this purpose, knowledge and skills about standards of measurement, limits, fits and tolerances, types of inspection and various measuring instruments, SQC & quality standards are necessary. Hence this subject.

DETAILED CONTENT

1. Inspection (09 hrs)

- Introduction, units of measurement, standards for measurement and interchangeability.
- International, national and company standard, line and wavelength standards.
- Planning of inspection: what to inspect? When to inspect? Who should inspect? Where to inspect?
- Types of inspection: remedial, preventive and operative inspection, incoming, in-process and final inspection.
- Study of factors influencing the quality of manufacture.

2. Measurement and Gauging (22 hrs)

- Basic principles used in measurement and gauging, mechanical, optical, electrical and electronic.
- Study of various measuring instruments like: calipers, micrometers, dial indicators, surface plate, straight edge, try square, protectors, sine bar, clinometer, comparators – mechanical, electrical and pneumatic. Slip gauges, tool room microscope, profile projector.
  Limit gauges: plug, ring, snap, taper, thread, height, depth, form, feeler, wire and their applications for linear, angular, surface, thread and gear measurements, gauge tolerances.
- Geometrical parameters and errors:
  Errors & their effect on quality, concept of errors, measurement of geometrical parameter such as straightness, flatness and parallelism.
- Study of procedure for alignment tests on lathes, drilling and milling machines.
- Testing and maintenance of measuring instruments.

3. Statistical Quality Control (16 hrs)

- Basic statistical concepts, empirical distribution and histograms, frequency, mean, mode, standard deviation, normal distribution, binomial and Poisson, Simple- examples.
- Introduction to control charts, namely X, R, P and C charts and their applications.
- Sampling plans, selection of sample size, method of taking samples, frequency of samples.
- Inspection plan format and test reports

4. Modern Quality Concepts (09 hrs)

- Concept of total quality management (TQM)
- National and International Codes.
- ISO-9000, concept and its evolution
- QC tools
- Introduction to Kaizen, 5S

5. Instrumentation (08 hrs)

Measurement of mechanical quantities such as displacement, vibration, frequency, pressure temperature by electro mechanical transducers of resistance, capacitance & inductance type.

LIST OF PRACTICALS

1 Use of dial indicator for measuring taper.

2 Use of combination set, bevel protector and sine bar for measuring taper.

3 Measurement of thread characteristic using vernier and gauges.

4 Use of slip gauge in measurement of center distance between two pins.

5 Use of tool maker's microscope and comparator.

6 Plot frequency distribution for 50 turned components.

7 With the help of given data, plot X, R, P and C charts

RECOMMENDED BOOKS

1. Statistical Quality Control by M.Mahajan: Dhanpat Rai and Sons, Delhi

2. Engineering Metrology by RK Jain

3. Engineering Metrology by RK Rajput; SK Kataria and Sons

4. Production Planning Control and Management by KC Jain & Aggarwal; Khanna Publishers, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	09	14
2	22	34
3	16	24
4	09	14
5	08	14
Total	**64**	**100**

6.4 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

L	T	P
3	-	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

DETAILED CONTENTS

SECTION – A ENTREPRENEURSHIP

1. Introduction (14 hrs)

- Concept /Meaning and its need
- Qualities and functions of entrepreneur and barriers in entrepreneurship
- Sole proprietorship and partnership forms of business organisations
- Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

2. Market Survey and Opportunity Identification (10 hrs)

- Scanning of business environment
- Salient features of National and State industrial policies and resultant business opportunities
- Types and conduct of market survey
- Assessment of demand and supply in potential areas of growth
- Identifying business opportunity
- Considerations in product selection

3. Project report Preparation (08 hrs)

- Preliminary project report
- Detailed project report including technical, economic and market feasibility
- Common errors in project report preparations
- Exercises on preparation of project report

SECTION –B MANAGEMENT

4. Introduction to Management (04 hrs)

- Definitions and importance of management
- Functions of management: Importance and Process of planning, organising, staffing,
  directing and controlling
- Principles of management (Henri Fayol, F.W. Taylor)
- Concept and structure of an organisation
- Types of industrial organisations

  a) Line organisation
  b) Line and staff organisation
  c) Functional Organisation

5. Leadership and Motivation (03 hrs)

a) Leadership

- Definition and Need
- Qualities and functions of a leader
- Manager Vs leader
- Types of leadership

b) Motivation

- Definitions and characteristics
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, McGregor)

6. Management Scope in Different Areas (06 hrs)

a) Human Resource Management
- Introduction and objective
- Introduction to Man power planning, recruitment and selection
- Introduction to performance appraisal methods

b) Material and Store Management
- Introduction functions, and objectives
- ABC Analysis and EOQ

c) Marketing and sales

- Introduction, importance, and its functions
- Physical distribution

- Introduction to promotion mix
- Sales promotion

d) Financial Management

- Introductions, importance and its functions
- Elementary knowledge of income tax, sales tax, excise duty, custom duty and VAT

7. Miscellaneous Topics (03 hrs)

a) Customer Relation Management (CRM)

- Definition and need
- Types of CRM

b) Total Quality Management (TQM)

- Statistical process control
- Total employees Involvement
- Just in time (JIT)

c) Intellectual Property Right (IPR)

- Introductions, definition and its importance
- Infringement related to patents, copy right, trade mark

Note: In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised.

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development published by Tata McGraw Hill Publishing Company Ltd., New Delhi
3. Entrepreneurship Development in India by CB Gupta and P Srinivasan; Sultan Chand and Sons, New Delhi
4. Entrepreneurship Development - Small Business Enterprises by Poornima M Charantimath; Pearson Education, New Delhi
5. Entrepreneurship : New Venture Creation by David H Holt; Prentice Hall of India Pvt. Ltd., New Delhi
6. Handbook of Small Scale Industry by PM Bhandari
7. Principles and Practice of Management by L M Prasad; Sultan Chand & Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	28
2	10	20
3	08	16
4	04	10
5	03	06
6	06	14
7	03	06
Total	**48**	**100**

6.5 EMPLOYABILITY SKILLS – II

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS

1. Oral Practice

i)	Mock interview	(05 hrs)
ii)	Preparing for meeting	(05 hrs)
iii)	Group discussion	(05 hrs)
iv)	Seminar presentation	(05 hrs)
v)	Making a presentation	(12 hrs)

a) Elements of good presentation
b) Structure and tools of presentation
c) Paper reading
d) Power point presentation

6.6 MECHANISMS AND MACHINES

L	T	P
3	-	-

RATIONALE

A diploma holder in this course is required to assist in the design and development of prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

DETAILED CONTENTS

1. Basic Concepts (12 hrs)

   1.1 Introduction to link, kinematic pair, lower and higher pair, Kinematic chain, mechanism, Inversion.
   1.2 Four bar chains and its inversions, Single slider crank chain and its inversions, Double slider crank chain and its inversions

2. Power Transmission (12 hrs)

   2.1 Introduction to belt and rope drives
   2.2 Types of belt drives and types of pulleys
   2.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
   2.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
   2.5 Different types of chains and their terminology
   2.6 Gear terminology, types of gears and their applications; simple and compound gear trains; power transmitted by simple spur gear

3. Flywheel (08 hrs)

   3.1 Principle and applications of flywheel, Types of fly wheel
   3.2 Turning - moment diagram of flywheel for different engines
   3.3 Fluctuation of speed and fluctuation of energy - Concept only
   3.4 Coefficient of fluctuation of speed and coefficient of fluctuation of energy
   3.5 Simple numerical problems on fluctuation of speed and fluctuation of energy

4. Cam (06 hrs)

   4.1 Function of Cam
   4.2 Types of cams and followers, Displacement diagram
   4.3 Simple cam profile for uniform velocity, SHM and uniform acceleration and retardation with flat, knife edge and roller type follower.

5. Balancing (08 hrs)

5.1 Concept of balancing
5.2 Introduction to balancing of rotating masses (simple numericals)
5.3 Concept of reference plane
5.4 Simple problems related to several masses rotating in different planes

6. Vibrations (02 hrs)

6.1 Concept of vibrations and its types - longitudinal, transverse and torsional vibrations
6.2 Damping of vibrations
6.3 Causes of vibrations in machines, their harmful effects and remedies

INSTRUCTIONAL STRATEGY

1. Use teaching aids for classroom teaching
2. Give assignments for solving numerical problems
3. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives
4. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

RECOMMENDED BOOKS

1. Theory of Machines by D.R. Malhotra; Satya Prakashan, New Delhi.
2. Theory of Machines by S.S Rattan TataMcGraw hill New Delhi.
3. Theory of Machines by Jagdish Lal; Metropolitan Publishers, New Delhi.
4. Theory of Machines by R.C. Jindal; North Publications.
5. Theory of machines by R.S Khurmi; S Chand and Company Ltd. New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	22
2	12	22
3	08	18
4	06	14
5	8	14
6	02	10
Total	**48**	**100**

6.7 PROJECT WORK

L	P
-	9

Project work aims at developing skills in the students whereby they apply in totality the knowledge and skills gained through the course in the solution of a practical problem undertaken as a project work. The 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. It is also essential that the faculty of the respective departments may have a brainstorming session to identify suitable project assignments. 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 students should identify themselves or be given project assignment at least two to three months in advance. The project work identified in collaboration with industry/field organization should be preferred.

Each teacher is expected to guide the project work of 5-6 students at a time. Report for all the four project should be prepared and will give a seminar. The same will be assessed for internal and external assessment. Some of the projects are listed as follows :

1. Fabrication of:

   1.1 Voltage Stabilizer for refrigerator, air-conditioner

   1.2 Emergency light using SCR

   1.3 Power amplifier

   1.4 Low cost intercom for home

   1.5 Analog computer

   1.6 Regulated power supply (+ 12V and + 6V) using 7812, 7912 and 7806, 7906

   1.7 Automatic battery charger using SCR

   1.8 Digital Clock

   1.9 FM Radio Receiver

   1.10 Burglar Alarm

   1.11 Fabrication of UPS

   1.12 Automatic street light/dressing table light

   1.13 Mosquito Repeller

   1.14 Inverter circuit 500 watt/1 KVA.

   1.15 Solid State Control of Traffic Lights

2 **Fabrication and Testing of:**

2.1 Inverter/Emergency light circuit using power transistors

2.2 SCR based automatic battery charger

2.3 SCR operated illumination controller

2.4 SCR operated automatic water level controller

2.5 SCR based speed controller for DC shunt motor

2.6 Three phase full wave rectifier using power diodes

2.7 Timer circuit using 555-IC

2.8 SCR controlled rectifier circuit

2.9 Speed control circuit of DC shunt motor using SCR

2.10 Inverting and non-inverting amplifiers using OP AMP(741)

2.11 Comparator circuits using OP AMP (741)

3. Project using PLC

4. Project relating to Microprocessor

5. Project relating to Microcontroller

Note: The quality of end-product and process adopted by the students in its execution should be taken into consideration along with other parameters while evaluating the students

A suggestive criteria for assessing student performance by the external (personnel 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-evaluated 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. **The internal and external examiner must follow these criteria 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 100 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 student's 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. The students must submit project report

It is proposed that the institute may organize an annual exhibition of the project items prepared by the students and invite leading Industrial organisations in such an exhibition. 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 industries are approached for instituting such awards.