COMPETENCY BASED CURRICULUM

DIPLOMA
IN
INSTRUMENTATION & CONTROL ENGINEERING

(Duration 3 Years)
NSQF Level – 5

Under
Haryana State Board of Technical Education

Developed By

Curriculum Development Center

National Institute of Technical Teachers Training & Research

(Ministry of Education, Government of India)

Sector - 26, Chandigarh, UT, India.

(September, 2024)

PREFACE

Learning and learning experience are the foundation of any education system. Appropriateness of education and its useful implications stand on the platform of knowledge and skill. But the knowledge and skill cannot be quantified qualitatively without ensuring learning experience. Curriculum is the pathway to select and organise learning experience. It helps the teachers to provide tangible resources, goals and objectives to learners. Curriculum acts as a catalyst to stimulate creativity, innovation, ethics, values, responsibility and many human factors. Curriculum embodies rigour and high standards and creates coherence to empower learner to meet the industrial and societal needs. Curriculum is a central guide for a teacher to plan a standard based sequence for the instructional delivery.

The industrial revolution 4.0 has forced the technical education system to reinvent the curriculum to meet the human resource requirement of the industry. The data driven systems relying on the subjects like machine-learning, Artificial Intelligence, Data Science etc are literally forcing the technical education system to offer different subjects differently to address the emerging challenges. The non-linear way of learning now facilitates students to choose path of knowledge to skill or vice-versa. The bi-directional process requires innovative curriculum design and revision. Diploma programme is now more challenging than ever. The level of skill and knowledge demanded by industry from diploma holders are highly interdisciplinary at the same time address special need. Hence, there is a need to align the curriculum to National Skill Qualification Framework (NSQF).

National Education Policy, NEP-2020 has now opened up diversities for the education system to explore and exploit to make the education relevant. The policy emphasises to inculcate value, ethics, respect to culture and society etc along with industry ready knowledge and skill among the students. The interdisciplinary nature of curriculum, academic bank of credits and integration of technology in teaching-learning envisaged in NEP-2020 make it more challenging for curriculum development. NITTTR, Chandigarh has developed the art of curriculum development over 54 years of its existence. The expertise and experience available in the institute follow time-tested and acclaimed scientific methods to design/revise curriculum. The experienced faculty members entrusted with the curriculum development or revision activities are well-versed with NSQF, NEP and Outcome based education. I am happy to note that **Haryana State Board of Technical Education, Panchkula, Haryana** reposed their confidence on this expertise to develop **AICTE/NSQF/NEP 2020** aligned curriculum for the state. This documented curriculum is an outcome of meticulous planning and discussions among renowned experts of the subject through series of workshops. The effective implementation of this curriculum supported with quality instructional resources will go a long way in infusing the learning experience among learners to make them industry ready.

Director

National Institute of Technical Teachers Training & Research, Chandigarh

ACKNOWLEDGEMENT

We gratefully acknowledge the assistance and guidance received from the following persons:

i) Principal Secretary Technical Education-cum-Chairman, Haryana State Board of Technical Education, Panchkula, Haryana for initiating this project on designing of AICTE/NSQF/NEP 2020 aligned curriculum.

ii) Director General, Technical Education, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

iii) Secretary, Haryana State Board of Technical Education, Panchkula, Haryana for his untiring assistance and support in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

iv) Management Officials of Haryana State Board of Technical Education, Panchkula, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

v) Director, National Institute of Technical Teachers' Training and Research, Chandigarh for his support and academic freedom provided to Curriculum Development Centre.

vi) All the participants from Industry / field Organizations, Academic Institutions, State Technical Universities / Polytechnics for their professional & academic inputs during curriculum workshops.

vii) Faculty and staff of Curriculum Development Centre, NITTTR, Chandigarh for their dedicated contribution and support in design of NSQF aligned curriculum.

viii) Faculty from different departments of NITTTR, Chandigarh for their valuable inputs in design of NSQF aligned curriculum.

Professor and Head
Curriculum Development Center
National Institute of Technical Teachers Training & Research, Chandigarh

TABLE OF CONTENTS

1. SALIENT FEATURES

1.	Name	:	**Diploma in Instrumentation & Control Engineering**
2.	Duration	:	**03 Years**
3.	Hours per week	:	**35**
4.	Entry Qualification	:	**10th Pass**
5.	Student Intake	:	**As per sanctioned strength**
6.	Pattern	:	**Semester**
7.	Scheme	**:**	**Multipoint Entry and Exit**
8.	NSQF Level	:	**5**
9.	Theory Practical Ratio	:	**36 : 64**
10.	Project Work	:	**Minor and Major Project**
11.	In-house/Industrial Internship	:	**Mandatory after First and Second Year**

2. NSQF GUIDELINES

National Skill Qualification Framework has defined total Ten Levels. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Fig1: NSQF Domains

NSQF LEVEL - 3 COMPLIANCE

The NSQF level - 3 descriptor is as follows:

Process	• Person may carry out a job which may require limited range of activities routine and predictable.
Professional Knowledge	• Basic facts, process and principle applied in trade of employment.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application.
Core Skill	• Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Under close supervision. Some responsibility for own work within defined limit.

Fig 2: NSQF Level – 3 Descriptor

Work requiring knowledge, skills and aptitudes at level 3 will be routine and predictable. Job holders will be responsible for carrying out a limited range of jobs under close supervision. Their work may require the completion of a number of related tasks. People carrying out these job roles may be described as "Semi skilled workers". Individuals in jobs which require level 3 qualifications will normally be expected to be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation and should know the basic facts, processes and principles applied in the trade for which they are qualified and be able to apply the basic skills of the trade to a limited range of straightforward jobs in the occupation.

They will be expected to understand what constitutes quality in their job role and more widely in the sector or sub-sector and to distinguish between good and bad quality in the context of the jobs they are given. Job holders at this level will be expected to carry out the jobs they are given safely and securely. They will work hygienically and in ways which show an understanding of environmental issues. This means that they will be expected to take responsibility for their own health and safety and that of fellow workers and, where appropriate, customers and/or clients. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social environment. They should be able to make a good contribution to team work.

NSQF LEVEL - 4 COMPLIANCE

The NSQF level-4 descriptor is given below:

Process	• Work in familiar, predictable, routine, situation of clear choice
Professional Knowledge	• Factual knowledge of field of knowledge or study.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts.
Core Skill	• Communication written and oral, with required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Responsibility for own work and learning.

Fig 3: NSQF Level – 4 Descriptor

Work requiring knowledge, skills and aptitudes at level 4 will be carried out in familiar, predictable and routine situations. Job holders will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. People carrying out these jobs may be described as "skilled workers". Individuals in jobs which require level 4 qualifications should be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation in which they are employed, to appreciate the nature of the occupation and to understand and apply the rules which govern good practice. They will be able to make choices about the best way to carry out routine jobs where the choices are clear.

They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their job roles. Job holders at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They will work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They should be able to guide or lead teams on work within their capability.

NSQF LEVEL - 5 COMPLIANCE

The NSQF level-5 description is given below:

Process	• Job that requires well developed skill, with clear choice of procedures in familiar context.
Professional Knowledge	• Knowledge of facts, principles, processes and general concepts, in a field of work or study.
Professional Skill	• A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.
Core Skill	• Desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.
Responsibility	• Responsibility for own work and learning and some responsibility for others' works and learning

Fig 4: NSQF Level – 5 Descriptor

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. People carrying out these jobs may be described as "fully skilled workers" or "supervisors".

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organise information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise. In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

3. NATIONAL EDUCATION POLICY (NEP) - 2020

NEP 2020 aims at a comprehensive holistic education to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral - in an integrated manner. A holistic arts education will help develop well-rounded individuals that possess: critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

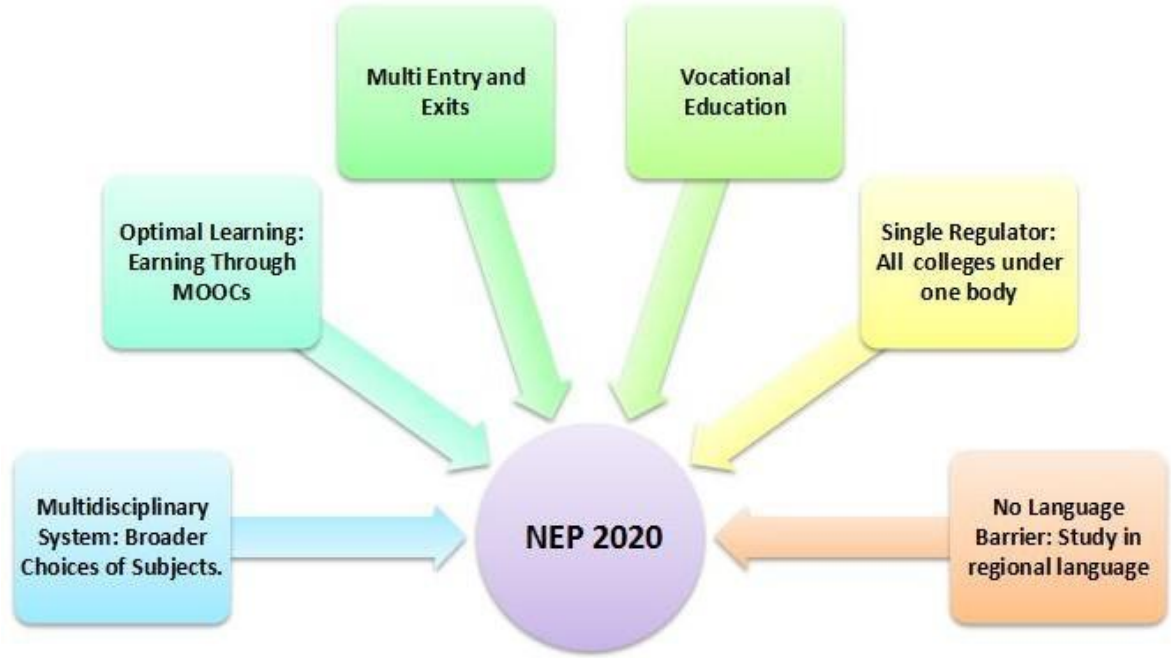

Fig 5: NEP 2020

Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialisation in a subject or subjects. Pedagogy for courses will strive for significantly less rote learning and an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking. The flexible and innovative curriculum shall emphasize on offering credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. As part of a holistic education, students will be provided with opportunities

for internships with local industry, businesses, artists, crafts persons, villages and local communities, etc., as well as research internships with faculty and researchers at their own or other HEIs or research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Effective learning requires relevant curriculum, engaging pedagogy, continuous formative assessment and adequate student support. The curriculum must be updated regularly aligning with the latest knowledge requirements and shall meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students - thus directly influencing learning outcomes. The assessment methods have to be scientific and test the application of knowledge. Higher Education Institutes should move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs should also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

4. PROGRAM OUTCOMES

The program outcomes are derived from five domains of NSQF Level namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Acquire knowledge of basic mathematics, sciences and basic engineering to understand Instrumentation and Control Engineering.

PO2: Inculcate comprehensive education in Instrumentation engineering to ensure core competency in Instrumentation, Control and Automation.

PO3: Apply the developed skills using modern engineering tools and appropriate technique to conduct standard tests and measurements

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO 5: Take the responsibility for ongoing professional development to enhance work performance as an Instrumentation and Control Engineering technician.

PO6: Engage in Multi-disciplinary skills, team spirit and leadership qualities with professional ethics, to excel in professional career and/or higher studies in Instrumentation and Control Engineering.

5. DERIVING CURRICULUM AREAS FROM PROGRAMME OUTCOMES

The following curriculum areas have been derived from Programme outcomes:

Sr. No.	Programme Outcomes	Curriculum Subjects / Areas
1.	**PO1:**Acquire knowledge of basic mathematics, sciences and basic engineering to understand Instrumentation and Control Engineering.	● Applied Physics – I ● Applied Mathematics - I ● Applied Mathematics-II ● Applied Physics - II ● Fundamentals of Instrumentation Engg ● Fundamentals of Electrical Engineering ● Control System Engineering ● Industrial Electronics and Control of Drives ● PLC, DCS and SCADA
2.	**PO2:** Inculcate comprehensive education in Instrumentation engineering to ensure core competency in Instrumentation, Control and Automation.	● Applied Physics - I ● Fundamentals of Electrical Engineering. ● Fundamentals of Instrumentation Engg ● Applied Physics - II ● Analog & Digital Electronics ● Measurement and Instrumentation ● Sensors and Transducers ● Process Control ● Microcontroller and Embedded systems ● Power Plant Instrumentation ● Electric Vehicles ● Process Instrumentation ● Minor Project

3.	**PO3:**Apply the developed skills using modern engineering tools and appropriate technique to conduct standard tests and measurements	• Applied Physics – II • Applied Maths-II • Analog & Digital Electronics • Engineering Graphics • Fundamentals of Instrumentation Engg • Fundamentals of Electrical Engineering • Instrumentation Workshop • Electrical Machines • Process Control • Analytical Instrumentation • Robotics & Automation • PLC, DCS and SCADA • Process Instrumentation • Biomedical Instrumentation • Minor Project
4.	**PO4:** Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• English and Communication Skills I-II • Applied Mathematics - I • Fundamentals of IT • Applied Mathematics – II • Environmental Studies & Disaster Management • Electrical Machines • Entrepreneurship Development & Management • Industrial Communication Technologies • IOT and IIOT
5.	**PO5**: Take the responsibility for ongoing professional development to enhance work performance as a Instrumentation and Control Engineering technician.	• Fundamentals of Electrical Engineering • Analogue & Digital Electronics • Instrumentation workshop • Fundamentals of Instrumentation Engg

		● Instrumentation Drawing ● Installation and Maintenance of Industrial Equipment ● Power Plant Instrumentation ● Biomedical Instrumentation ● Major Project
6.	**PO6:** Engage in Multi-disciplinary skills, team spirit and leadership qualities with professional ethics, to excel in professional career and/or higher studies in Instrumentation and Control Engineering	● Multidisciplinary Elective ● Open Elective ● Programme Elective- ● IOT and IIOT

FIRST YEAR
NSQF LEVEL - 3

FIRST YEAR
6. STUDY AND EVALUATION SCHEME

FIRST SEMESTER :

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
1.1	*English & Communication Skill	2	2	2+1=3	40	40	80	60	60	120	200
1.2	*Applied Mathematics -1	4	0	4+0=4	40	-	40	60	-	60	100
1.3	*Applied Physics-I	2	2	2+1=3	40	40	80	60	60	120	200
1.4	Fundamentals of Instrumentation Engg	3	4	3+2=5	40	40	80	60	60	120	200
1.5	*Fundamentals of IT	2	4	2+2=4	40	40	80	60	60	120	200
1.6	*Engineering Graphics	-	6	0+3=3	-	40	40	60	-	60	100
#Student Centred Activities (SCA)		-	4	-	-	-	-	-	-	-	-
Total		**13**	**22**	**22**	**200**	**200**	**400**	**360**	**240**	**600**	**1000**

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

SECOND SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
2.1	*Applied Mathematics –II	4	0	4+0=4	40	-	40	60	-	60	100
2.2	*Applied Physics - II	2	2	2+1=3	40	40	80	60	60	120	200
2.3	**Fundamentals of Electrical Engineering	3	4	3+2=5	40	40	80	60	60	120	200
2.4	**Analogue & Digital Electronics	3	4	3+2=5	40	40	80	60	60	120	200
2.5	* Environmental Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
2.6	* Instrumentation workshop	-	6	0+3=3	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	5	-	-	-	-	-	-	-	-
Total		**14**	**21**	**22**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programmes

** Common with Diploma programme of Medical Electronics

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

Summer Industrial/In-house Training: After 2nd semester, students shall undergo Summer Training of 4 Weeks.

7. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects	Hours Per Week	
		First Semester	Second Semester
1.	English and Communication Skills - I	4	-
2.	Applied Mathematics - I	4	-
3.	Applied Physics - I	4	-
4.	Fundamentals of IT	6	-
5.	Fundamentals of Instrumentation Engg	7	-
6.	Engineering Graphics	6	
7.	Applied Mathematics-II	-	4
8.	Applied Physics - II	-	4
9.	Fundamentals of Electrical Engineering		7
10.	Analogue & Digital Electronics		7
11.	Instrumentation Workshop	-	6
12.	Environmental Studies & Disaster Management	-	2
13.	Student Centered Activities	4	5
	Total	**35**	**35**

8. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

In current scenario one can find innumerous instruments at home and at workplace possible only because of the science termed Instrumentation. Since instrumentation being the order of the day, it is very much necessary for the young minds to get accustomed with the latest developments in instrumentation field. Moreover Instrumentation being one of the most important sought branches in Industrial point of view, a combination of Instrumentation and Control would fetch high dividends for the students who take up it as their career course. Instrumentation and Control Engineers are responsible for designing, developing, installing, managing and maintaining equipment which is used to monitor and control engineering systems, machinery and processes.

Instrumentation engineering is a specialized branch and it deals with measurement, control and automation of processes. Its main objective is to ensure that systems and processes operate safely and efficiently. An Instrumentation Engineer is fit for both Hardware and Software Sectors. Moreover, an instrumentation engineer is responsible for designing, developing, installing, managing and maintaining equipment which are used to monitor and control engineering systems, machinery and processes.

Job Prospects of I&C Engineer

They have a bright future ahead of them as they are needed by almost all Industries in various cadres like Design, Development, Automation, Control, Fabrication, Inspection, Quality control, Maintenance and Service and so on. Graduates from instrumentation and control programs can expect to fill positions such as:

- Instrument Engineer
- Automation Engineer
- Control Engineer
- Instrumentation Technologists or Technician
- Instrument Mechanic
- Control Systems Technologist
- Process Analyzer

The NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of Medical Electronics. In government and private sectors related to Medical Electronics, “Semi Skilled workers” are required to carry out a limited range

of predictable tasks under close supervision. They are normally expected to communicate clearly in speech and along with knowledge of arithmetic and algebraic processes. They should know the basic facts, processes and principles applied in limited area of Medical Electronics. Skills acquired through course will help the student to troubleshoot medical equipments. The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency

They have wide scope in the following designations as

- Process Industries - Supervisor/technician (Maintenance and repair) - Supervisor/technician (Erection, commissioning and testing) - Laboratory technician/workshop in charge in process industries , Supervisor (automation)
- Manufacturing Industries: - Design and development assistant - Production supervisor/senior assistant - Foreman - Erection, calibration, testing and commissioning supervisor in measuring instruments and control system of manufacturing and assembly industries
- Marketing and Service Organization: - Marketing Assistant - Sales and Service Engineer - Customer Support Service Engineer
- Service Organization: - Repair and Maintenance Technician - Customer Support Service Engineer
- Instrumentation User Organization - Instrument technician/supervisor, in institutions / research laboratories - Junior Engineer - Maintenance Mechanic/Supervisor
- Laboratory Supervisor in Educational Institutions, Medical and Healthcare Institutions for - Repair and Maintenance & - sales and service
- Service Engineer – in Electronics / ECE / Instrumentation), Field Service Engineer, Engineer - Field Service, Sales/Service Engineer.

This is a multi-disciplinary stream and covers subjects from various branches such as chemical, mechanical, electrical, electronics, biomedical and computers. This helps in making a switch to other disciplines, if anyone wishes to after completion of the Course.

9. PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level – 3 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Perform out a task which may require limited range of predictable activities related to the Instrumentation & Control Engineering.

PO2: Acquire knowledge of facts, process and principles related to Instrumentation & Control Engineering for sustainability and employment.

PO3: Demonstrate the ability to perform the skills essential in narrow range of Instrumentation & Control Engineering applications.

PO4: Communicate accurately and appropriately and demonstrate professional behavior along with skill of basic arithmetic and algebraic principles, and basic understanding of social and natural environment.

PO5: Be responsible to perform task under close supervision with some responsibility withindefined limit.

10. ASSESSMENT OF PROGRAM AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform out a task which may require limited range of predictable activities related to the Instrumentation & Control Engineering.	• Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry. • Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Acquire moderate level understanding of the physics behind the electrical engineering materials. • Acquire basic knowledge of instrumentation systems and measurement. • Illustrate basics of Sensors and Transducers. • Acquire knowledge and understand the elements of electricity and DC circuits. • Describe the fundamental behaviour of AC circuits and solve AC circuit problems. • Comprehend the concept of Electrostatics and Magentostatics and apply the knowledge.

PO2: Acquire knowledge of facts, process and principles related to Instrumentation & Control Engineering for sustainability and employment.	• Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software. • Elaborate scientific work, energy and power, forms of friction and solve problems related to them. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Formulate the engineering problems into mathematical format with the use of differential equations and differential • Use the differentiation and Integration in solving various Mathematical and Engineering problems. • Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data. • Describe different Semiconductor devices and explain their characteristics • Acquire the knowledge of transistor in CB and CE mode and demonstrate the working of transistor as an amplifier. • Explain the fundamentals of FETs & MOSFETs and their applications.

	• Acquire basic knowledge of instrumentation systems and measurement. • Calibrate various Industrial and Laboratory instruments. • Illustrate basics of Sensors and Transducers. • Acquire knowledge and understand the elements of electricity and DC circuits. • Describe the fundamental behaviour of AC circuits and solve AC circuit problems. • Comprehend the concept of Electrostatics and magentostatics and apply the knowledge. • Use various batteries as storage devices and be aware of safe disposal of batteries.
PO3: Demonstrate the ability to perform the skills essential in narrow range of Instrumentation & Control Engineering applications. .	• Draw Orthographic views of different objects viewed from different angles. • Draw and interpret sectional views of an object which are otherwise not visible in normal view. • Draw Isometric views of different solids and develop their surfaces. • Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances /fittings. • Draw orthographic views of different objects by using basic commands of AutoCAD. • Demonstrate a strong foundation on Modern Physics to use at various technical and engineering applications. • Describe different Semiconductor devices and explain their characteristics • Acquire the knowledge of transistor in CB and CE mode and demonstrate the working of transistor as an amplifier.

	• Explain the fundamentals of FETs & MOSFETs and their applications. • Evaluate and realize the various digital circuits. • Analyze sequential and combinational digital circuits • Identify electronics components like resistors, capacitors, diodes, transistors etc. • Operate Recorders and Display units. • Apply the knowledge of instrumentation to remove various errors in measurement. • Apply the knowledge of basic circuital law and simplify the network • Use various batteries as storage devices and be aware of safe disposal of batteries. • Take measurements with the help of basic measuring tools/equipment. • Perform soldering and desoldering on PCB. • Troubleshoot parameters of various instruments. • Plan and Wire a small domestic building for a given load requirement following safety procedures and precautionary measures.
PO4: Communicate accurately and appropriately and demonstrate professional behavior along with skill of basic arithmetic and algebraic principles, and basic understanding of social and natural environment.	• Identify the nuances of Communication, both Oral and Written. • Acquire knowledge of the meaning of communication, communication process and speaking skills. • Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication. • Communicate effectively with an increased confidence to read, write and speak in English language fluently.

	• Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry. • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers • Handle the computer /laptop/mobiles /Internet Utilities and Install/Configure OS • Assemble a PC and connect it to external devices. • Manage and Use Office practiced Automation Tools. • Develop worksheets and Prepare presentations. • Comprehend the importance of sustainable ecosystem. • Clarify interdisciplinary nature of environmental issues. • Describe corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Recognize various types of disasters.

PO5: Be responsible to perform task under close supervision with some responsibility withindefined limit.	• Calculate the approximate area under a curve by applying integration and numerical methods. • Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software. • Evaluate and realize the various digital circuits. • Analyze sequential and combinational digital circuits. • Calibrate various Industrial and Laboratory instruments. • Apply the knowledge of instrumentation to remove various errors in measurement. • Apply the knowledge of basic circuital law and simplify the network. • Identify tools and equipment used and their respective functions. • Take measurements with the help of basic measuring tools/equipment. • Perform soldering and desoldering on PCB. Troubleshoot parameters of various instruments. • Plan and Wire a small domestic building for a given load requirement following safety procedures and precautionary measures.

11. SUBJECTS & CONTENTS (FIRST YEAR)

FIRST SEMESTER

1.1 ENGLISH & COMMUNICATION SKILLS – I

L	P
2	2

RATIONALE

Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life –personal, social and professional. This course is intended to break fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework. This course is designed to help students to acquire the concept of communication and develop an ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Identify the nuances of Communication, both Oral and Written.

CO2: Acquire knowledge of the meaning of communication, communication process and speaking skills.

CO3: Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication.

CO4: Communicate effectively with an increased confidence to read, write and speak in English language fluently.

DETAILED CONTENTS

UNIT I

Reading

1.1 Techniques of reading: Skimming and Scanning

1.2 Extensive and Intensive Reading: Textual Study

1.3 Homecoming – R.N. Tagore

1.4 Life Sketch of Sir Mokshagundam Visvesvarayya

1.5 Life Sketch of Dr. Abdul Kalam

1.6 Narayan Murthy’s speech at LBSNA, Dehradun

UNIT II

Fundamentals of Communication

2.1 Concept and Process of Communication

2.2 Types of Communication (Verbal Communication)

2.3 Barriers to Communication
2.4 Speaking Skill: Significance and essentials of Spoken Communication
2.5 Listening Skill: Significance and essentials of Listening

UNIT III

Grammar and Usage

3.1 Nouns
3.2 Pronouns
3.3 Articles
3.4 Verbs(Main and Auxiliary)
3.5 Tenses

UNIT IV

Writing Skills

4.1 Significance, essentials and effectiveness of Written Communication
4.2 Notice Writing
4.3 Official Letters and E-mails.
4.4 Frequently-used Abbreviations used in Letter-Writing
4.5 Paragraph Writing
4.6 Netiquettes

PRACTICAL EXERCISES

1. Reading

Reading Practice of lessons in the Lab Activity classes.

i. Comprehension exercises of unseen passages along with the lessons prescribed.
ii. Vocabulary enrichment and grammar exercises based on the selected readings.
iii. Reading aloud Newspaper headlines and important articles.

2. Fundamentals of Communication

i. Introducing oneself, others and leave- taking(talking about yourself)
ii. Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
iii. Situational Conversation: Offering-Responding to offers; Congratulating; Apologizing and Forgiving; Complaining; Talking about likes and dislikes, Self-introduction Mock Interviews

3. Grammar and Usage

i. Written and Oral Drills will be undertaken in the class to facilitate holistic linguistic competency among learners.
ii. Exercises on the prescribed grammar topics.

4. Writing Skills

i. Students should be given Written Practice in groups so as to inculcate team-spirit and collaborative learning .
ii. Group exercises on writing paragraphs on given topics.
iii. Opening an e-mail account, receiving and sending emails.

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 2", M/S Abhishek Publications, Chandigarh.
2. V Sasikumar & PV Dhamija, "Spoken English", Tata MC Graw Hills, New Delhi, Second Edition.
3. JK Gangal, "A Practical Course in Spoken English", PHI Learning Pvt. Ltd., New Delhi.
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma and Krishna Mohan, "Business Correspondence & Report writing", Tata MC Graw Hills, New Delhi, Fourth Edition.
6. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
7. Nira Konar, "Communication Skills for professionals", PHI Learning Pvt. Ltd., New Delhi.
8. Krishna Mohan & Meera Banerji, "Developing Communication Skills", Macmillan Publishers India Ltd., New Delhi, Second Edition
9. M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
10. Andrea J Rutherfoord, "Basic Communication Skills for Technology", Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced as exercises in the Lab regularly for development of communication skills in the students. The students should be involved in activities to enhance their personality skills. This subject contains four units of equal weightage.

1.2 APPLIED MATHEMATICS - I

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RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like logarithm, binomial theorem, matrices, t-ratios and co-ordinates for solving complex engineering problems with exact solutions in a way which involve less computational task. By understanding the logarithm, they will be able to make long calculations in short time and it is also a pre-requisite for understanding Calculus.

COURSE OUTCOMES

At the end of this subject, the students will be able to:

CO1: Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry.

CO2: Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry

CO3: Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.

CO4: Explore the idea of location, graph, and linear relationships between two variables.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

Algebra

1.1 Complex Numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a complex number, modulus and amplitude, addition subtraction, multiplication and division of complex numb

1.2 Logarithms and its basic properties

UNIT II

Binomial Theorem, Determinants and Matrices

2.1 Meaning of ${}^{n}P_{r}$ & ${}^{n}C_{r}$ (mathematical expression). Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion up to 3 terms - without proof), first binomial approximation with application to engineering problems.

2.2 Determinants and Matrices – Evaluation of determinants (upto 2^{nd}order), solution of equations (upto 2 unknowns) by Crammer's rule, definition of Matrices and its types, addition, subtraction and multiplication of matrices (upto 2^{nd} order).

UNIT III

Trigonometry

3.1 Concept of angle, measurement of angle in degrees, grades, radians and their conversions.

3.2 T-Ratios of Allied angles (without proof), Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa

3.3 Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

UNIT-IV

Co-ordinate Geometry

4.1 Cartesian and Polar co-ordinates (two dimensional), Distance between two points, mid-point, centroid of vertices of a triangle.

4.2 Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, symmetric form, normal form, general form), intersection of two straight lines, concurrency of lines, angle between straight lines, parallel and perpendicular lines, perpendicular distance formula, conversion of general form of equation to the various forms.

UNIT V

Geometry of Circle and Software

Circle

5.1 General equation of a circle and its characteristics. To find the equation of a circle, given:

i. Centre and radius
ii. Three points lying on it
iii. Coordinates of end points of a diameter

Software

5.2 **MATLAB Or SciLab software –** Theoretical Introduction, MATLAB or Scilab as Simple Calculator (Addition and subtraction of values –Trigonometric and Inverse Trigonometric functions) – General Practice

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.
3. "Mathematics for Class XII", NCERT Publication, New Delhi.
4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics – I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-fifth Edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.scilab.org

INSTRUCTIONAL STATREGY

This is theoretical subject and contains five units of equal weight age.

Basic elements of algebra, trigonometry and co-ordinate geometry can be taught in the light of their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics related to Algebra, Trigonometry and Coordinate Geometry that the industry requires. Examples to be used should be related to engineering. Useful software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Students should be able to relate to the actual use of these examples and the way mathematical calculations will help them in doing their job.

1.3 APPLIED PHYSICS-I

L	P
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RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various technical fields of are given prominence in the course content.

COURSE OUTCOMES

At the end of this subject, student should be able to:

CO1: Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy.

CO2: Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications.

CO3: Elaborate scientific work, energy and power, forms of friction and solve problems related to them.

CO4: Comprehend properties of matter and effect of temperature on various matter and phenomenon.

CO5: Demonstrate the use of physical principles and analysis in various technical fields.

DETAILED CONTENTS

UNIT I

Unit and Dimensions

1.1 Definition of Physics, physical quantities- fundamental and derived

1.2 Units: fundamental and derived

1.3 System of units: CGS, FPS, MKS, SI

1.4 Dimension, dimensional formulae and SI units of physical quantities-distance, displacement, area, volume, density, velocity, acceleration, linear momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)

1.5 Dimensional equations, principle of homogeneity of dimensional equation

1.6 Application of dimensional analysis: checking the correctness of physical equation, conversion of system of unit (force, work, acceleration)

UNIT II

Force and Motion

2.1 Scalar and vector quantities– definition and examples, representation of vector, types of vector (unit vector, position vector, co-initial vector, collinear vector, co-planar vector)

2.2 Vector algebra- addition of vectors, Triangle & Parallelogram law (statement and formula only),

2.3 Scalar and vector product (statement and formula only)

2.4 Force and its units, resolution of force (statement and formula only)

2.5 Newton's laws of motion (statement and examples)

2.6 Linear momentum, Law of conservation of linear momentum (statement and examples), Impulse

2.7 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity, centripetal and centrifugal forces (definition and formula only), application of centripetal force in banking of road

2.8 Rotational motion: definition with examples

2.9 Definition of torque, angular momentum, moment of inertia and its physical significance

UNIT III

Work, Power and Energy

3.1 Work- definition, symbol, formula and SI unit, types of work (zero work, positive work and negative work) with example

3.2 Friction– definition and its simple daily life applications

3.3 Power- definition, formula and units

3.4 Energy- definition and its SI unit, examples of transformation of energy.

3.5 Kinetic energy- definition, examples, formula and its derivation

3.6 Potential energy- definition, examples, formula and its derivation

3.7 Law of conservation of mechanical energy for freely falling bodies (with derivation)

3.8 Simple numerical problems based on formula of Power and Energy

UNIT IV

Properties of Matter

4.1 Elasticity and plasticity- definition, deforming force, restoring force, example of elastic and plastic body

4.2 Definition of stress and strain, Hooke's law, modulus of elasticity

4.3 Pressure- definition, atmospheric pressure, gauge pressure, absolute pressure, Pascal's law

4.4 Surface tension- definition, SI unit, applications of surface tension, effect of temperature on surface tension

4.5 Viscosity: definition, unit, examples, effect of temperature on viscosity

UNIT V

Heat and Temperature

5.1 Definition of heat and temperature (on the basis of kinetic theory)

5.2 Difference between heat and temperature

5.3 Principle and working of mercury thermometer

5.4 Modes of transfer of heat- conduction, convection and radiation with examples.

5.5 Properties of heat radiation

5.6 Different scales of temperature and their relationship

PRACTICAL EXERCISES

1. Familiarization of measurement instruments and their parts (for example - vernier calliper, screw gauge, spherometer, travelling microscope etc.), and taking a reading. (compulsory to all students)
2. To find diameter of solid cylinder using a vernier calliper
3. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.
4. To find the diameter of wire using screw gauge
5. To find thickness of paper using screw gauge.
6. To determine the thickness of glass strip using a spherometer
7. To determine radius of curvature of a given spherical surface by a spherometer.
8. To verify parallelogram law of force
9. To determine the atmospheric pressure at a place using Fortin's Barometer
10. To determine force constant of spring using Hooke's law
11. Measuring room temperature with the help of thermometer and its conversion in different scale.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XI (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I and Vol. II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics – I", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – I", Eagle Prakashan, Jalandhar.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
6. C. L. Arora, "Practical Physics", S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. The Physics Classroom
3. https://www.khanacademy.org/science/physics

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students. Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

1.4 FUNDAMENTALS OF INSTRUMENTATION ENGGINEERING

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RATIONALE

This syllabus has been designed to impart the knowledge of basic principles involved in instrumentation systems. The student will learn the measurement concept, building blocks of instrumentation system, various types and characteristics of instruments, displaying variables besides instrument selection criteria. The student will also learn about errors in measurements. These concepts will help the student in forming a solid foundation for higher learning in the area of Instrumentation engineering.

COURSE OUTCOMES

After undergoing the subject, student will be able to:

CO1: Acquire basic knowledge of instrumentation systems and measurement.
CO2: Operate Recorders and Display units.
CO3: Calibrate various Industrial and Laboratory instruments.
CO4: Illustrate basics of Sensors and Transducers.
CO5: Apply the knowledge of instrumentation to remove various errors in measurement.

DETAILED CONTENTS

UNIT 1

Basics of Instrumentation

1.1 Definition of measurements and its significance
1.2 Methods of measurements: Direct methods, Indirect methods
1.3 Scope and necessity of instruments
1.4 Elements of a Generalized Measurement system
  i. Primary sensing element
  ii. Variable conversion element
  iii. Data presentation element
1.5 Introduction of Transducers
  i. Definition of sensors & transducers,
  ii. Difference between sensor & transducer.

UNIT II

Instrumentation Systems

2.1 Types of instrumentation systems
- i. Intelligent instrumentation system
- ii. Dump instrumentation system

2.2 Classification of Instruments
- i. Absolute instruments
- ii. Secondary instruments.

2.3 Functions of instruments
- i. Indicating function
- ii. Recording function
- iii. Controlling function

2.4 Modes of operation of secondary Instruments.
- i. Analog mode
- ii. Digital mode

UNIT III

Performance Characteristics and Selection Criteria of Instruments

3.1 Performance characteristics
- i. Static characteristics of instruments-accuracy, precision, linearity, resolution, sensitivity, hysteresis, drift, dead time, loading effects.
- ii. Dynamic characteristics-time constant, response time, natural frequency, damping coefficient.

3.2 Selection criteria of instruments.

3.3 Calibration.
- i. Definition and importance of calibration.
- ii. Process of calibration.

UNIT IV

Display and Recording Devices

4.1 Need of Recorders in Instrumentation system

4.2 Classification of Recorders

4.3 XY, Strip chart recorder, magnetic tape recorder

4.4 Digital display units
- i. Light Emitting Diode (LED)
- ii. Liquid Crystal Display (LCD)
- iii. Segmental displays
- iv. Dot matrices
- v. Fluorescent Displays

UNIT V

Errors in Measurement

5.1 Limiting errors
5.2 Relative limiting error
5.3 known error
5.4 Sources of errors
  i. Gross error
  ii. Systematic error
  iii. Instrumental error
  iv. Environmental error
  v. Observational error
  vi. Random error
5.5 Normal distribution of errors

PRACTICAL EXERCISES

1. Familiarization with the process of calibration.
2. Calibrate the given Ammeter with the standard Ammeter of same range.
3. Calibrate the given Voltmeter with the standard Voltmeter of same range.
4. Familiarization and demonstration of Liquid Crystal Display.
5. Identification of various types of Instruments.
6. To study and operate different types of printers.
7. Demonstration and operation of strip chart recorder
8. Demonstration of Circular chart recorder.
9. To assemble seven segment display using LEDs.
10. Calculate parallax error in analog meter.
11. Detection and removal of Systematic error in an Instrument.
12. Identification of various types of Sensors and transducers.
13. Familiarization and use of Fluorescent display.
14. To prepare laboratory equipment maintenance check list.
15. To study safety precautions in handling laboratory equipments.

RECOMMENDED BOOKS

1. RK Jain, “Mechanical and Industrial Measurement”, Khanna Publishers, New Delhi Eleventh edition.
2. AK Sawhney, “Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai and Co., New Delhi, Nineteenth Edition.
3. Joseph J. Carr, “Elements of Electronic Instrumentation and Measurement”, Pearson Education, Third Edition.

4. K. Lal Kishore, "Electronic Instrumentation and Measurement", Pearson Education, Second Edition.
5. JB Gupta, "Electrical and Electronic Measurement and Instrumentation'', S.K Kataria and Sons Publishers, New Delhi, 2013.
6. E.O. Doeblin, "Measurement Systems", Mc. Graw Hill Education Publisher, Sixth Edition.
7. Donald P. Eckrman, "Industrial Instrumentation" CBS Publication, First Edition.
8. E-books/e-tools/relevant software to be used as recommended by AICTETE/HSBTE/NITTTTR.

SUGGESTED WEBSITE

1. https://www.vlab.co.in
2. https://swayam.gov.in
3. https://nptel.ac.in/course.html

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Being a first branch specific subject, the teacher should lay emphasis on giving an overview of the field of instrumentation and control. In addition, for exposure the students should be taken to various process industries or where control system and electronic instrumentation is being used. The teacher shall demonstrate the instruments and their functioning.

1.5 FUNDAMENTALS OF IT

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RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concepts of information technology and its scope, operating a computer: use of various office management tools, using internet and mobile applications etc. This course is intended to make new students comfortable with computing environment - Learning basic computer skills, learning basic application software tools, Understanding Computer Hardware, Cyber security awareness.

COURSE OUTCOMES

At the end of the subject student will be able to

CO1: Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers

CO2: Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS

CO3: Assemble a PC and connect it to external devices

CO4: Manage and Use Office practiced Automation Tools

CO5: Develop worksheets and Prepare presentations

DETAILED CONTENTS

UNIT I

Basics of Computer

Brief history of development of computers, Definition of Computer, Block diagram of a Computer, Hardware, Software, Booting: Cold and Hot Booting, Interaction between the CPU and Memory with Input/Output devices, Function of CPU and major functional parts of CPU.

Memory, Bit, Nibble, Byte, KB, MB, GB, TB, PB, Functions of memory, Use of storage devices in a Computer, List types of memory used in a Computer, Importance of cache memory, CPU speed and CPU word length

UNIT II

Basic Internet Skills

Understanding browser, Introduction to WWW, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. Advantages of Email, Various email service providers, Creation of email id, sending and receiving emails, attaching documents with email and drive.

Effective use of Gmail, G-Drive, Google Calendar, Google Sites, Google Sheets, Online mode of communication using Google Meet & WebEx.

Unit III

Basic Logic building

Introduction to Programming, Steps involved in problem solving, Definition of Algorithm, Definition of Flowchart, Steps involved in algorithm development, differentiate algorithm and flowchart, symbols used in flowcharts, algorithms for simple problems, flowcharts for simple problems, Practice logic building using flowchart/algorithms

Unit IV

Office Tools

Office Tools like LibreOffice/OpenOffice/MSOffice.

OpenOffice Writer – Typesetting Text and Basic Formatting, Inserting Images, Hyperlinks, Bookmarks, Tables and Table Properties in Writer

Introducing LibreOffice/OpenOffice *Calc*, Working with Cells, Sheets, data, tables, using formulae and functions, using charts and graphics.

OpenOffice Impress – Creating and Viewing Presentations, Inserting Pictures and Tables, Slide Master and Slide Design, Custom Animation.

Unit V

Use of Social Media

Introduction to Digital Marketing – Why Digital Marketing, Characteristics of Digital Marketing, Tools for Digital Marketing, , Effective use of Social Media like LinkedIn, Google+, Facebook, Twitter, etc.: Features of Social media, Advantages and Disadvantages of Social Media.

PRACTICAL EXERCISES

1. Browser features, browsing, using various search engines, writing search queries
2. Visit various e-governance/Digital India portals, understand their features, services offered
3. Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognize various ports/interfaces and related cables, etc.
4. Using Administrative Tools/Control Panel Settings of Operating Systems

5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6. Explore features of Open Office tools and MS-Office, create documents, create presentation, create spread sheet, using these features, do it multiple times
7. Working with Conversion Software like pdfToWord, WordToPPT, etc.
8. Working with Mobile Applications – Searching for Authentic Mobile app, Installation and Settings, Govt. of India Mobile Applications
9. Creating email id, sending and receiving mails with attachments.
10. Using Google drive, Google calendar
11. Create Flow chart and Algorithm for the following

i. Addition of n numbers and display result
ii. To convert temperature from Celsius to Fahrenheit
iii. To find Area and Perimeter of Square
iv. Swap Two Numbers
v. find the smallest of two numbers
vi. Find whether given number is Even or Odd
vii. To print first n even Numbers
viii. find sum of series 1+2+3+…..+N
ix. print multiplication Table of a number
x. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)
xi. sum and average of given series of numbers
xii. Factorial of number n (n!=1x2x3x…n)
xiii. Armstrong Number
xiv. Find whether given number is Prime or not

RECOMMENDED BOOKS

1. R.S. Salaria, “Computer Fundamentals”, Khanna Publishing House.
2. Ramesh Bangia, “PC Software Made Easy – The PC Course Kit”, Khanna Publishing House.
3. Online Resources, Linux man pages, Wikipedia
4. Mokhtar Ebrahim and Andrew Mallett, “Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming”.
5. Vikas Gupta, “Comdex Hardware and Networking Course Kit” Dream Tech press, New Delhi, 2008.
6. Sumitabha Das, “UNIX concepts and applications” Tata McGraw Hill, New Delhi, 2008, Fourth Edition.

SUGGESTED WEBSITES

1. https://nptel.ac.in/courses/106/106/106106222/ - NPTEL Course on Modern Application Development
2. https://onlinecourses.swayam2.ac.in/aic19_de01/preview -
3. https://spoken-tutorial.org/ - Tutorials on Introduction to Computers, HTML, LibreOffice Tools, etc.
4. NOTEPAD++
5. https://tms-outsource.com/blog/posts/web-development-ide/

INSTRUCTIONAL STRATEGY

This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age.

1.6 ENGINEERING GRAPHICS

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RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawings is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

COURSE OUTCOMES

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

CO1: Draw Orthographic views of different objects viewed from different angles.

CO2: Draw and interpret sectional views of an object which are otherwise not visible in normal view.

CO3: Draw Isometric views of different solids and develop their surfaces.

CO4: Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances /fittings.

CO5: Draw orthographic views of different objects by using basic commands of AutoCAD.

DETAILED CONTENTS

UNIT I

1. Introduction to Engineering Drawing and Graphics

1.1 Introduction to use and care of drawing instruments, drawing materials, layout and sizes of drawing sheets and drawing boards.

1.2 Symbols and conventions-

a) Conventions of Engineering Materials, Sectional Breaks and Conventional lines.
b) Civil Engineering Sanitary fitting symbols
c) Electrical fitting symbols for domestic interior installations.

1.3 Geometrical construction-geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagons, pentagons bisecting a line and arc , division of line and circle with the help of drawing instruments.

2. Technical Lettering of Alphabet and Numerals

Definition and classification of lettering, Free hand (of height of 5,8,12 mm) and instrumental lettering (of height 20 to 35 mm): upper case and lower case, single and double stroke, vertical and inclined (Gothic lettering) at 75 degree to horizontal and with suitable height to width ratio 7:4.

3. Dimensioning

3.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions).

3.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., countersunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches.

4. Scales

4.1 Scales –Needs and importance (theoretical instructions), Type of scales, Definition of Representative Fraction (R.F.) and Length of Scale.

4.2 To draw/construct plain and diagonal scales.

UNIT II

1 Orthographic Projections

1.1 Theory of orthographic projections (Elaborate theoretical instructions).

1.2 Three views of orthographic projections of different objects of given pictorial view of a block in 1st and 3rd angle.

1.3 Projection of Points in different quadrant

1.4 Projection of Straight Line (1^{st} angle)

i. Line parallel to both the planes.
ii. Line perpendicular to any one of the reference plane and parallel to others
iii. Line inclined to any one of the references and parallel to another plane.

1.5 Projection of Plane – Different lamina like square rectangular, triangular, circle and Hexagonal pentagon. Trace of planes (HT and VT).

1.6 Identification of surfaces.

2. Sectioning

2.1 Importance and salient features

2.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections (theoretical only).

2.3 Orthographic sectional views of different objects.

UNIT III

1. Introduction of projection of right solids such as prism & pyramid (square, Pentagon, Hexagonal) cube, cone & cylinder (Axes perpendicular to H.P and parallel to V.P.)
2. Introduction of sections of right solids - Section planes, Sections of Hexagonal prism, pentagon pyramid, cylinder and cone (Section plane parallel to anyone reference planes and perpendicular to V.P. and inclined to H.P.)
3. Development of Surfaces – Development of lateral surfaces of right solids like cone, cylinder, pentagonal prism, pyramid and hexagonal pyramid (Simple problems)

UNIT IV

Isometric Views

1. Fundamentals of isometric projections and isometric scale.
2. Isometric views of different laminas like circle, pentagon and hexagon.
3. Isometric views of different regular solids like cylinder, cone, cube, cuboid, pyramid and prism.
4. Isometric views from given different orthographic projections(front, side and top view)

UNIT V

Introduction to AutoCAD

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets of different objects on AutoCAD (given pictorial/isometric view of a block). AutoCAD skill of student is evaluated in internal assessment only not in external exam.

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co.,Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, NewDelhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt;Charotar Publishing House Pvt. Ltd.,Anands
4. Engineering Drawing and Graphics using AutoCAD by T. Jeyapoovan,Vikas Publishing House Pvt, Ltd Noida.
5. A Text Book of Engineering Drawing by S.R.Singhal and O.P.Saxena, Asian Publisher, Delhi
6. Engineering Drawing by RB Gupta, Satya Prakashan, New Delhi

INSTRUCTIONAL STRATEGY

Teacher should show model of realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. First angle projection is to be followed. Minimum of 20 sheets to be prepared and at least 2 sheets on AutoCAD**.** Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students. This subject contains five units of equal weight age.

SECOND SEMESTER

2.1 APPLIED MATHEMATICS – II

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RATIONALE

Applied mathematics forms the backbone of engineering students. Basic elements of Differential calculus, Integral calculus and Differential Equations have been included in this course. This will develop analytical abilities to apply in engineering field and will provide continuing educational base to the students.

COURSE OUTCOMES

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

CO1: Formulate the engineering problems into mathematical format with the use of differential equations and differential

C02: Use the differentiation and Integration in solving various Mathematical and Engineering problems.

CO3: Calculate the approximate area under a curve by applying integration and numerical methods.

CO4: Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

Differential Calculus

1.1 Definition of function; Concept of limits (Introduction only) and problems related to four standard limits only.

1.2 Differentiation of x^n, sin x, cos x, e^x by first principle.

1.3 Differentiation of sum, product and quotient of functions.

UNIT II

Differential Calculus and Its Applications

2.1 Differentiation of trigonometric functions, inverse trigonometric functions. Logarithmic differentiation, successive differentiation (upto 2nd order)

2.2 Application of differential calculus in:

(a) Rate measures (b) Maxima and minima

UNIT III

Integral Calculus

3.1 Integration as inverse operation of differentiation with simple examples.

3.2 Simple standard integrals and related problems, Integration by Substitution method and Integration by parts.

3.3 Evaluation of definite integrals with given limits.

$$\text{Evaluation of } \int_0^{\pi/2} \sin^n x.\, dx, \quad \int_0^{\pi/2} \cos^n x\, dx, \quad \int_0^{\pi/2} \sin^m x\, \cos^n x\, dx$$

using formulae without proof (m and n being positive integers only) using pre-existing mathematical models.

UNIT IV

Application of Integration, Numerical Integration and Differential Equations

4.1 Applications of integration: for evaluation of area under a curve and axes (Simple problems).

4.2 Numerical integration by Trapezoidal Rule and Simpson's $1/3^{rd}$ Rule using pre-existing mathematical models.

Differential Equations

4.3 Definition, order, degree, Type of differential Equations, linearity, Formulation of ordinary differential equation (up to 1^{st} order), solution of ODE (1^{st} order) by variable separation method.

UNIT V

Statistics and Software

Statistics

5.1 Measures of Central Tendency: Mean, Median, Mode

5.2 Measures of Dispersion: Mean deviation, Standard deviation

Software

5.3 SciLab software – Theoretical Introduction.

5.4 Basic difference between MATLAB and SciLab software,

5.5 Calculations with MATLAB or ScilLab - (a) Representation of matrix (2×2 order), (b) Addition, Subtraction of matrices (2×2 order) in MATLAB or SciLab

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.
3. "Mathematics for Class XII", NCERT Publication, New Delhi.

4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-fifth Edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics" Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi.
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. https://www.scilab.org
2. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

Basic elements of Differential Calculus, Integral Calculus, and Differential Equations can be taught in the light of their applications in the field of engineering and technology. By laying more stress on applied part, teachers can also help in providing continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics that the industry requires. For example they need to know how to use mathematical models that use integration as opposed to learning how integration can be used. Useful authenticated software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Diploma students need to know which tools to use and how to do the job. This is theoretical subject and contains five units of equal weight age.

2.2 APPLIED PHYSICS-II

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2	2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content to prepare students for various technical applications.

COURSE OUTCOMES

At the end of this course, the students will be able to:

CO1: Differentiate between types of waves and their motion.
CO2: Illustrate laws of reflection and refraction of light.
CO3: Demonstrate competency in phenomena of electrostatics and electricity.
CO4: Characterize properties of material to prepare new materials for various technical applications.
CO5: Demonstrate a strong foundation on Modern Physics to use at various technical applications

DETAILED CONTENTS

UNIT I

Wave Motion and its Applications

1.1 Waves: definition, types (mechanical and electromagnetic wave)
1.2 Wave motion- transverse and longitudinal with examples, terms used in wave motion like displacement, amplitude, time period, frequency, wavelength, wave velocity; relationship among wave velocity, frequency and wave length
1.3 Simple harmonic motion (SHM): definition, examples
1.4 Cantilever: definition, formula of time period (without derivation)
1.5 Free, forced and resonant vibrations with examples
1.6 Sound waves: types (infrasonic, audible, ultrasonic) on the basis of frequency, noise, coefficient of absorption of sound, echo

UNIT II

Optics

2.1 Reflection and refraction of light with laws, refractive index

2.2 Lens: introduction, lens formulae (no derivation), power of lens and simple numerical problems

2.3 Total internal reflection and its applications, critical angle and conditions for total internal reflection

2.4 Superposition of waves (concept only), definition of Interference, Diffraction and Polarization of waves

2.5 Introduction to Microscope, Telescope and their applications

UNIT III

Electrostatics and Electricity

3.1 Electric charge, unit of charge, conservation of charge

3.2 Coulomb's law of electrostatics

3.3 Electric field, electric lines of force (definition and properties), electric field intensity due to a point charge

3.4 Definition of electric flux, Gauss law (statement and formula)

3.5 Capacitor and capacitance (with formula and unit)

3.6 Electric current and its SI Unit, direct and alternating current

3.7 Resistance, conductance (definition and unit)

3.8 Series and parallel combination of resistances

3.9 Ohm's law (statement and formula)

UNIT IV

Classification of Materials and their Properties

4.1 Definition of energy level, energy bands

4.2 Types of materials (conductor, semiconductor, insulator and dielectric) with examples, intrinsic and extrinsic semiconductors (introduction only)

4.3 Introduction to magnetism, type of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials with examples

4.4 Magnetic field, magnetic lines of force, magnetic flux

4.5 Electromagnetic induction (definition)

UNIT V

Modern Physics

5.1 Laser: introduction, principle, absorption, spontaneous emission, stimulated emission, population inversion

5.2 Engineering and medical applications of laser

5.3 Fibre optics**:** introduction to optical fibers (definition, principle and parts), light propagation, fiber types (mono-mode, multi-mode), applications in medical, telecommunication and sensors

5.4 Nanotechnology: introduction, definition of nanomaterials with examples, properties at nanoscale, applications of nanotechnology (brief)

PRACTICAL EXERCISES

1. Familiarization with apparatus (resistor, rheostat, key, ammeter, voltmeter, telescope, microscope etc.)
2. To find the time period of a simple pendulum.
3. To study variation of time period of a simple pendulum with change in length of pendulum.
4. To determine and verify the time period of Cantilever.
5. To verify Ohm's laws by plotting a graph between voltage and current.
6. To study colour coding scheme of resistance.
7. To verify laws of resistances in series combination.
8. To verify laws of resistance in parallel combination.
9. To find resistance of galvanometer by half deflection method.
10. To verify laws of reflection of light using mirror.
11. To verify laws of refraction using glass slab.
12. To find the focal length of a concave lens, using a convex lens.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XII (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I & II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics –II", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – II", Eagle Prakashan, Jalandhar.
5. N Subrahmanyam, Brij Lal and Avadhanulu, "A text book of OPTICS", S Chand Publishing, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
7. M H Fulekar, "Nanotechnology: Importance and Applications", IK International Publishing House (P) Ltd., New Delhi.
8. C. L. Arora, "Practical Physics", S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

2.3 FUNDAMENTALS OF ELECTRICAL ENGINEERING

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RATIONALE

A diploma holder may be involved in various jobs ranging from preventive maintenance of electrical installation to fault location. In addition, he/she may be working in testing laboratories where he/she uses measuring instruments. To carry out these jobs effectively, knowledge of basic concepts, principles and their applications is very essential. This course will enable the students to understand the basic concepts and principles of DC and AC fundamental, ac circuits, batteries, electromagnetic induction, voltage and current sources etc.

COURSE OUTCOMES

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

CO1: Acquire knowledge and understand the elements of electricity and DC circuits.
CO2: Apply the knowledge of basic circuital law and simplify the network
CO3: Describe the fundamental behaviour of AC circuits and solve AC circuit problems.
CO4: Comprehend the concept of Electrostatics and magentostatics and apply the knowledge.
CO5: Use various batteries as storage devices and be aware of safe disposal of batteries.

DETAILED CONTENTS

UNIT I

Electrical Fundamentals

1.1 Nature of Electricity, Charge, free electrons, Electric current, Electric potential and potential difference, Electric current, Electrical Energy, Electrical power and their unit.
1.2 Resistance: Definition, Unit, Laws of resistance, conductivity and resistivity, Effect of temperature on resistance, Temperature coefficient of resistance, Types of resistance & their applications, Color coding of resistance.
1.3 Inductors and capacitors with their wattage consideration.
1.4 Factors affecting capacitance of a capacitor. Capacitors in series and parallel.

UNIT II

DC Circuits & Theorems

2.1 Ohm's law and its verification.
2.2 Kirchhoff’s current law and Kirchhoff’s voltage law.
2.3 Star – Delta connections.

2.4 Voltage and current source, symbol and graphical representation, characteristics of ideal and practical sources.

2.5 Mesh and Loop analysis

2.6 Thevenin's theorem, Norton's theorem, Superposition Theorem, Maximum Power Transfer Theorem.

UNIT III

AC Circuits

3.1 AC Fundamentals: Cycle, frequency, time period, amplitude, difference between AC and DC, instantaneous value, average value, r.m.s. value, maximum value, form factor and peak factor.

3.2 Concept of conductance, susceptance, admittance, impedance and concept of inductive and capacitive reactance

3.3 RL-RC Circuits

3.4 Introduction to series and parallel resonance and its conditions

3.5 Power in pure resistance, inductance and capacitance, power in combined RLC circuits.

3.6 Power factor, active and reactive power: Definition and their significance.

UNIT IV

Electro Magnetic Circuit

4.1 Concept of electro-magnetic field produced by flow of electric current, magnetic circuit, concept of magneto-motive force (MMF), flux, reluctance, permeability, analogy between electric and magnetic circuit.

4.2 Faraday's laws of electro-magnetic induction, principles of self and mutual induction, self and mutually induced emf.

4.3 Energy stored in an inductor, series and parallel combination of inductors.

UNIT V

Batteries

5.1 Basic idea of primary and secondary cells.

5.2 Construction, working principle and applications of Lead-Acid, Nickel-Cadmium, Li- Ion batteries.

5.3 Series and parallel connections of batteries.

5.4 Introduction to maintenance of free batteries.

5.5 Disposal of batteries

5.6 General idea of solar cells, solar panels and their applications.

PRACTICAL EXERCISES

1. Familiarization of measuring instruments viz voltmeter, ammeter, CRO, Wattmeter and multi-meter and other accessories.
2. To measure (very low) resistance of an ammeter and (very high) resistance of a voltmeter
3. To verify Ohm's law by drawing a graph between voltage and current.
4. To observe change in resistance of a bulb in hot and cold conditions, using voltmeter and ammeter.
5. To determine the value of resistance using colour coding method.
6. Verification of Kirchhoff's Current and Voltage Laws in a DC circuit on bread board.
7. Verification of Thevenin's theorem.
8. Verification of Norton's theorem.
9. Verification of Superposition theorem.
10. Verification of Maximum Power theorem.
11. Alternating voltage applied to resistance and inductance, resistance and capacitance in series.
12. To find the voltage current relationship in a single phase R-L circuits, draw their impedance triangles.
13. To find the voltage current relationship in R-C Series circuits, draw their impedance triangles.
14. Measurement of power and power factor in a single phase R,L,C. circuit
15. Calculation of active and reactive powers in the circuit.
16. To test a lead - acid storage battery and measure its specific gravity.
17. Care and maintenance of lead-acid battery.
18. Visit to a nearby Power Station.

RECOMMENDED BOOKS

1. SK Bhattacharya, KM Rastogi, "Experiments in Basic Electrical Engineering", New Age International (P) Ltd., Publishers, New Delhi, January 2007.
2. BR Gupta, "Principles of Electrical Engineering", S Chand and Co, New Delhi, 2001.
3. JB Gupta, "Basic Electrical Engineering", SK Kataria and Sons, New Delhi, Eighth Edition, January 2020.
4. T.S. Anand, "Basic Electrical Engineering", North Publications, Jalandhar, March 2019.
5. Edward Hughes, "Electrical Technology", Fifth Edition, Longman Publishers, 2008.
6. GP Chhalhotra, "Experiments in Basic Electrical Engineering", Khanna Publishers, New Delhi, 2016-17.
7. SK Sahdev, "Basic Electrical and Electronics Engineering", Dhanpat Rai and Sons, New Delhi, November 2017.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

The teacher should make the students aware about the basic knowledge of electrical circuits including A.C and D.C circuit. The teacher should explain the importance of the electrical engineering, and reinforce theory with practical exercises. Teacher may encourage student to perform practical simultaneously for better understanding of the subject and verification of theoretical subject.

2.4 ANALOGUE & DIGITAL ELECTRONICS

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RATIONALE

This subject gives the knowledge of fundamental concepts and principles of basic electronics and aims at providing the students with basic understanding of various types of materials based on their conductivity. Students will study p-n junction, rectifiers and their significance, filters, basic structure and working principle of transistors in various configurations. This course also gives the knowledge to make the students know about the fundamental principles of digital electronics and gain familiarity with the available IC chips.

COURSE OUTCOMES

After completing this subject, student will be able to:

CO1: Describe different Semiconductor devices and explain their characteristics

CO2: Acquire the knowledge of transistor in CB and CE mode and demonstrate the working of transistor as an amplifier.

CO3: Explain the fundamentals of FETs & MOSFETs and their applications.

CO4: Evaluate and realize the various digital circuits.

CO5: Analyze sequential and combinational digital circuits.

DETAILED CONTENTS

UNIT I

Semiconductor devices

1.1 Concept of insulators, conductors and semiconductors, doping, minority and majority charge carriers.

1.2 P and N type semiconductors , PN junction diode, mechanism of current flow in PN junction, forward and reverse biased PN junction, potential barrier, drift and diffusion currents, depletion layer. V-I characteristics of diodes.

1.3 Concept of junction capacitance in forward and reverse biased condition. Characteristics and applications of Zener diodes. Zener and avalanche breakdown.

1.4 Diode as rectifier:-Diode as half-wave, full wave and bridge rectifiers. Peak Inverse Voltage, rectification efficiencies and ripple factor calculations, Concept of filters

UNIT II

Introduction to Bipolar Transistors

2.1 Concept of a bipolar transistor, its structure, PNP and NPN transistors, their symbols, Concept of leakage current.

2.2 CB, CE, CC configurations of a transistor; Input and output characteristics in CB and CE configurations.

2.3 Transistor as an amplifier in CE Configuration, Current amplification factors, relation b/w α, β and γ, Comparison of CB, CE and CC Configurations.

UNIT III

Field Effect Transistors

3.1 Construction, operation and characteristics of FETs, FET as an amplifier

3.2 Construction, operation and characteristics of a MOSFET and its applications.

3.3 Comparison of JFET, MOSFET and BJT.

UNIT IV

Digital Electronics

4.1 Distinction between analogue and digital signal.

4.2 Number system Decimal, Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa. Binary addition and subtraction.

4.3 Logic gates-Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates.

4.4 Gate realization with CMOS

UNIT V

Sequential and Combinational Circuit

5.1 Sequential Circuits: Half adder, Full adder, Mux, De-Mux, Encoder and Decoder.

5.2 Combinational Circuits: Concept of latch, Flip Flops (S-R, D, J-K, T types) Basic concept of shift registers and counters.

5.3 A/D and D/A Converters: Basic concept of A/D and D/A converters, Applications

PRACTICAL EXERCISES

1. To Plot V-I characteristics of a PN junction diode on bread board.
2. To Plot V-I characteristics of a Zener diode on bread board.
3. Observe the output of waveform using bread board:

a. Half-wave rectifier circuit using one diode

b. Full-wave rectifier circuit using two diodes

4. Bridge-rectifier circuit using four diodes

5. Plotting of input and output characteristics and calculation of parameters of transistors in CE configuration.
6. Plotting of input and output characteristics and calculation of parameters of transistors in CB configuration.
7. Plotting of V-I characteristics of a FET.
8. Basic logic operations AND, OR, NOT gates on bread board.
9. Verification of truth tables for NAND, NOR and Exclusive OR (EX-OR) and Exclusive NOR (EX-NOR) gates on bread board.
10. Realization of logic functions with the help of NAND or NOR gates.
11. To design a half adder using XOR and NAND gates and verification of its operations.
12. Construction of a full adder circuit using XOR and NAND gates and verify its operation
13. Verification of truth table for IC flip-flops (At least one IC each of D latch, D flip-flop, JK flip-flops).
14. Verification of truth table for encoder and decoder ICs,
15. Verification of truth table for Mux and De-Mux.

RECOMMENDED BOOKS

1. Kulshreshta and SC Gupta, “Basic Electronics and Linear Circuit” byTata McGraw Hill Education Pvt Ltd., New Delhi.
2. VK Mehta, “Principles of Electrical and Electronics Engineering” by S Chand and Co., New Delhi
3. Millman and Halkias, “Electronics Devices and Circuits” by McGraw Hill.
4. Albert Paul Malvino, “Principles of Electronics” by Tata McGraw Hill Education Pvt Ltd.
5. SK Sahdev, “Electronic Principles” by Dhanpat Rai& Co., New Delhi
6. JB Gupta, “Basic Electronics” BY SK Kataria and Sons, New Delhi
7. Schultz, “Grob’s Basic Electronics- A text Lab Manual” (Special Indian Edition) by Tata McGraw Hill Education Pvt Ltd, New Delhi.
8. Anand Kumar “Fundamentals of Digital Circuits” PHI
9. Anil K. Maini “Digital Electronics: Principles And Integrated Circuit”, Wiley Publications
10. R P Jain- “Modern Digital Electronics”-Tata McGraw Hill.
11. E-books/e-tools/relevant software to be used as recommended by ICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. www.efymag.com
3. www.electronicsforu.com

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage. The teacher should also organize for the students various Webinars/Online lectures from experts, Open Online MOOC Courses for special topics.

2.5 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

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RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industrial and construction activities so that he/she may help in balancing the ecosystem and controlling pollution by various control measures. The course is intended to provide a general concept in the dimensions of environmental pollution and disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

COURSE OUTCOMES

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

CO1: Comprehend the importance of sustainable ecosystem.
CO2: Clarify interdisciplinary nature of environmental issues.
CO3: Describe corrective measures for the abatement of pollution.
CO4: Identify the role of non-conventional energy resources in environmental protection.
CO5: Recognize various types of disasters.

DETAILED CONTENTS

UNIT I

Introduction

1.1 Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.
1.2 Rain water harvesting
1.3 Deforestation – its effects & control measures

UNIT II

Air and Noise Pollution

2.1 Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.
2.2 Noise Pollution: Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimizing noise pollution.

UNIT III

Water and Soil Pollution

3.1 Water Pollution: Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of DO, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

3.2 Soil Pollution :Sources of soil pollution, Effects and Control of soil pollution, Types of Solid waste- House hold, Industrial, Agricultural, Biomedical, Disposal of solid waste, Solid waste management E-waste, E – waste management

UNIT IV

Impact of Energy Usage on Environment

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings, Concept of Carbon Credit & Carbon footprint.

UNIT V

Disaster Management

A. Different Types of Disaster:

Natural Disaster: such as Flood, Cyclone, Earthquakes and Landslides etc.

Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.

B.Disaster Preparedness:

Disaster Preparedness Plan

Prediction, Early Warnings and Safety Measures of Disaster

Psychological response and Management (Trauma, Stress, Rumour and Panic)

RECOMMENDED BOOKS

1. S.C. Sharma & M.P. Poonia, “Environmental Studies”, Khanna Publishing House, New Delhi.
2. BR Sharma, “Environmental and Pollution Awareness”, Satya Prakashan, New Delhi.
3. Dr. RK Khitoliya, “Environmental Pollution”, S Chand Publishing, New Delhi.
4. Erach Bharucha, “Environmental Studies”, University Press (India) Private Ltd., Hyderabad.
5. Suresh K Dhamija, “Environmental Engineering and Management”, S K Kataria and Sons, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
7. Dr. Mrinalini Pandey, “Disaster Management”, Wiley India Pvt. Ltd.

8. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill Education (India) Pvt. Ltd.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies and Disaster Management like expert lectures, seminars, visits etc. may also be organized This subject contains five units of equal weightage.

2.6 INSTRUMENTATION WORKSHOP

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RATIONALE

Instrumentation workshop practices are included in the curriculum in order to provide hands-on experience about use of different basic instruments used in domestic as well as industrial purpose. This subject aims at developing general manual and machining skills in the students. In addition, the development of a sense of safety at work place, team working and development of right attitude are the other objectives.

COURSE OUTCOMES

After completing the subject, the students will be able to:

CO1: Identify tools and equipment used and their respective functions.
CO2: Take measurements with the help of basic measuring tools/equipment.
CO3: Perform soldering and desoldering on PCB.
CO4: Troubleshoot parameters of various instruments.
CO5: Plan and Wire a small domestic building for a given load requirement following safety procedures and precautionary measures.

PRACTICAL EXERCISES

1. Study of electrical safety measures and protective devices
2. Study, demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, MCB & ELCB, fuses, cleats, clamps and allied items, tools and accessories.
3. Identification and familiarization with the following tools used in instrumentation workshop such as Tweezers, Screw drivers (different sizes), Insulated Pliers, Cutter, Sniper, Screw Driver (Star Screw Driver), L- Keys, Soldering Iron, soldering wire, flux .
4. Identification and familiarization with various types of plugs, sockets, connectors suitable for general purpose audio video use. Connectors, Banana plugs, sockets and similar male and female connectors and terminal strips.
5. Familiarization and demonstration of various types of switches such as: normal/miniature toggle, slide, push button piano key, rotary, SPST, SPDT, DPST, DPDT.
6. Identification, familiarization and uses of various type of cell and batteries.

7. Identification, familiarization and uses of commonly used components; active and passive components; colour code and types of resistor and potentiometers, Diode, Transistor, LED, LDR etc.
8. Measure value of given resistor & compare it with theoretical value obtained using colour code.
9. Planning and performing of connection to single phase domestic electrical appliances using Phase, Neutral and Earth wires.
10. To perform the installation of electrical earthing for domestic purpose.
11. Prepare an extension board using fuse, switches, sockets, fan regulator, indicator etc. for single phase connections.
12. To perform connection of two LED bulbs as per staircase wiring.
13. Measurement of current by using of ammeter (both analogue and digital type)
14. Measurement of voltage by voltmeter (both analogue and digital type)
15. Connecting various components to perform single phase parallel and series circuit connections.
16. To perform single phase Invertor Connections for domestic purpose
17. Connection of 2HP, three phase motor with DOL starter.
18. Solder components e.g. resistor, capacitor, diodes, transistors on a general purpose PCB.
19. De-soldering practice with de-soldering pump and with de-soldering wick.
20. To measure inner & outer diameter using Verniercallipers.
21. To measure thickness of the metallic sheet with micrometer.
22. Repair a LED Bulb.
23. Convert a simple LED bulb into automatic LED Bulb.
24. To troubleshoot the circuit board of phone charger.
25. To perform installation and connection of Solar P.V. Cells.
26. Controlling the timing of turning ON/OFF a solar light with the help of LDR /Photocell and a timer.
27. To perform dismantling and reassembling of auto electric iron.
28. To perform dismantling and reassembling of desert cooler.
29. Troubleshooting of electric device like heater or kettle.
30. To perform the installation of a water overflow alarm and to troubleshoot it, in case of any problem.

RECOMMENDED BOOKS

1. R.K Jain, “Mechanical and Industrial Measurement”, Khanna Publishers, New Delhi Eleventh Edition.
3 Preeti Maheshwari, “Electronic components and Processes”, New Age International (P) Ltd. Publishers, New Delhi, 2006.

4 K.B. Bhatia, "Study of Electrical Appliances and Devices", Khanna Publishers, Seventh Edition.
5 S.K Bhattacharya and K.M Rastogi, "Experiments in Basic Electrical Engineering", New Age International (P) Ltd. Publishers, New Delhi, Second Edition.
6 Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall India Learning Private Ltd., 1992.
7 S.L. Uppal, "Electrical Wiring Estimating and Costing", Khanna Publishers, New Delhi.
8 E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/ NITTTR.

SUGGESTED WEBSITES

1. https://www.vlab.co.in
2. http://swayam.gov.in
3. https://nptel.ac.in/course.html

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students. All the experiments are to be performed by the students.

SECOND YEAR

NSQF LEVEL - 4

12. STUDY AND EVALUATION SCHEME

THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits L+P= C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
3.1	Industrial/In-HouseTraining - I	-	2	**0+1 =1**	-	40	40	-	60	60	100
3.2	Control System Engineering	3	4	**3+2=5**	40	40	80	60	60	120	200
3.3	Sensors and Transducers	3	4	**3+2=5**	40	40	80	60	60	120	200
3.4	Measurement and Instrumentation	3	2	**3+1=4**	40	40	80	60	60	120	200
3.5	Electrical Machines	3	2	**3+1=4**	40	40	80	60	60	120	200
3.6	Open Elective (MOOCs^{+}/Offline)	2	-	**2+0=2**	40	-	40	60	-	60	100
3.7	Instrumentation Drawing	-	4	**0+2=2**	-	40	40	-	60	60	100
# Student Centered Activities (SCA)		-	3	-	-	-	-	-	-	-	-
Total		**14**	**21**	**23**	**200**	**240**	**440**	**300**	**360**	**660**	**1100**

\+ Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks.

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits C L + P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
4.1	*English and Communication Skills - II	2	2	**2+1=3**	40	40	80	60	60	120	200
4.2	Process Control	3	4	**3+2=5**	40	40	80	60	60	120	200
4.3	Microcontroller and Embedded systems	3	2	**3+1=4**	40	40	80	60	60	120	200
4.4	Analytical Instrumentation	2	2	**2+1=3**	40	40	80	60	60	120	200
4.5	Installation and Maintenance of Industrial Equipment	-	4	**0+2=2**	-	40	40	-	60	60	100
4.6	Programme Elective-I	3	-	**3+0=3**	40	-	40	60	-	60	100
4.7	Minor Project	-	6	**0+3=3**	-	40	40	-	60	60	100
# Student Centered Activities (SCA)		-	2	-	-	-	-	-	-	-	-
Total		**13**	**22**	**23**	**200**	**240**	**440**	**300**	**360**	**660**	**1100**

* Common with other diploma programmes

Programme Elective-I 4.6.1 Power Plant Instrumentation 4.6.2 Electric Vehicles 4.6.3 Robotics & Automation

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

Industrial/ Training: After 4th Semester, students shall undergo Industrial Training of 4 Weeks.

13. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Third Semester	Fourth Semester
1.	Industrial/In-House Training - I	2	-
2.	Control System Engineering	7	-
3.	Sensors and Transducers	7	-
4.	Measurement and Instrumentation	5	-
5.	Electrical Machines	5	-
6.	Open Elective	2	-
7.	Instrumentation Drawing	4	-
8.	English and Communication Skills- II	-	4
9.	Process Control	-	7
10.	Microcontroller and Embedded systems	-	5
11.	Analytical Instrumentation	-	4
12.	Installation and Maintenance of Industrial Equipment	-	4
13.	Programme Elective-I	-	3
14.	Minor Project	-	6
15.	Student Centered Activities	3	2
Total		**35**	**35**

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Industry and government sector pertaining to **Instrumentation & Control Engineering** require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They should be able to communicate in writing and speaking with required clarity and fluency. Students after passing level 4 shall have understanding of basic arithmetic, algebraic principles along with basic understanding of social and natural environment. They are expected to recall and demonstrate quality skill in narrow range of applications using appropriate rules and tools. Students having the diploma in **Instrumentation & Control Engineering** experience and expansive skill set needed to design and operate electrical systems.

Skilled workers will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. They should know what constitutes quality in the occupation and should distinguish between good and bad quality in the context of their job roles. Skilled worker at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They should work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment.

NSQF Level – 4 pass out students are expected to deal with measurement, control and automation of processes. Its main objective is to ensure that systems and processes operate safely and efficiently. This role often requires hands-on work, and need to have a strong understanding of instrumentation principles and safety standards. This role also requires a high level of attention to detail and a strong understanding of measurement principles.

Wide range of employment opportunities are as Instrumentation Technician, Control Engineer, Automation Engineer and Calibration Technician. Overall, the job opportunities for diploma holders in instrumentation and control engineering are quite diverse, and you can find employment in a wide range of industries, including manufacturing, oil and gas, utilities, and more.

15. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 4 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform out task in familiar, predictable, routine situation of clear choice.

PO2: Acquire factual knowledge in the field of Instrumentation & Control Engineering for employment.

PO3: Demonstrate quality skills in routine and repetitive in narrow range of Instrumentation & Control Engineering applications.

PO4: Communicate in writing and speaking with required clarity and demonstrate **p**rofessional behavior.

PO5: Adopt self-study learning and acquire knowledge aiming towards holistic development of learners through MOOCs.

16. ASSESSMENT OF PROGRAM AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform out task in familiar, predictable, routine situation of clear choice.	• Understand the working environment of industries. • Comprehend fundamentals of control system and concept of linear and non-linear control system. • Identify different types of sensors and transducers and their applications in the field of Instrumentation and Control. • Select appropriate transducers relating to a process. • Acquire technical know how about the conditioning of a signal from a transducer for the purpose of control. • Acquire and convert a signal available from a transducer to make it worth displaying or computer compatible. • Demonstrate working and applications of different transducers. • Describe various Electrical and Electronic Instruments. • Handle properly, operate and maintain instruments used in industries. • Measure various electrical quantities with the help of different instruments. • Operate various instruments and measure the physical quantities. • Demonstrate usage of C.R.O. and D.S.O in the lab. • Select and learn the subject related to own interest. • Identify the different types of symbols as per ANSI standards.

	• Identify instruments and read different types of instrument diagrams. • Draw the schematic drawings and go through installation procedure. • Comprehend the evaluation criteria and selection techniques of controllers. • Comprehend the working of microcontrollers and their application of in industries. • Handle properly industrial panel and gas chromatography. • Handle pollution monitoring instruments using new techniques like Arduino and IoT • Assemble various rectifier circuits. • Troubleshoot instrumentation panel wiring. • Install any instrument using screw and hange type instruments. • Provide an overview of different methods of power generation with a particular stress on thermal power generation • Discuss measurement of electrical and non-electrical parameters involved in power generation plants. • Provide an overview of basics of electric vehicle history and components

PO2: Acquire factual knowledge in the field of Instrumentation & Control Engineering for employment.	• Understand the working environment of industries. • Take necessary safety precautions and measures. • Learn about present and future requirement of industries. • Develop required competencies and skills for relevant industries. • Develop required competencies for effective communication and presentation. • Comprehend fundamentals of control system and concept of linear and non-linear control system. • Select appropriate transducers relating to a process. • Demonstrate working and applications of different transducers • Describe various Electrical and Electronic Instruments. • Handle properly, operate and maintain instruments used in industries. • Measure various electrical quantities with the help of different instruments. • Operate various instruments and measure the physical quantities. • Demonstrate usage of C.R.O. and D.S.O in the lab. • Explain phase, line voltages and current relationships in 3-phase power supply. • Demonstrate the concept of single phase transformers and determine the efficiency. • Demonstrate the working of DC, AC and single phase fractional kilowatt motors. • Explore latest developments in the field of interest. • Identify the different types of symbols as per ANSI standards.

	• Identify instruments and read different types of instrument diagrams. • Draw the schematic drawings and go through installation procedure. • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend the working of microcontrollers and their application of in industries. • Comprehend concept of liquid analysis and paramagnetic oxygen analysis. • Illustrate usage of recording instruments and mass spectroscopy. • Install any instrument using screw and hinge type instruments. • Apply concepts, principles and practices taught in the classroom in solving field / industrial problems. • Select the minor project according to the need of relevant industries. • Provide an overview of different methods of power generation with a particular stress on thermal power generation. • Discuss measurement of electrical and non-electrical parameters involved in power generation plants. • Illustrate the different types of devices used for data acquisition and analyze in power plants • Provide an overview of basics of electric vehicle history and components • Comprehend various properties of batteries, their charging and discharging. • Illustrate the electrical machine properties and measurement of electrical and non-electrical parameters involved electric vehicle drive systems

PO3: Demonstrate quality skills in routine and repetitive in narrow range of Instrumentation & Control Engineering applications.	• Develop required competencies and skills for relevant industries. • Develop required competencies for effective communication and presentation. • Comprehend fundamentals of control system and concept of linear and non-linear control system. • Analyze the response of first order system w.r.t. different Input signals • Analyze the stability and behavior of closed loop systems using various tools • Apply the transfer function and analyze different methods to find the transfer function. • Identify different types of sensors and transducers and their applications in the field of Instrumentation and Control. • Select appropriate transducers relating to a process. • Acquire technical know how about the conditioning of a signal from a transducer for the purpose of control. • Acquire and convert a signal available from a transducer to make it worth displaying or computer compatible. • Describe various Electrical and Electronic Instruments. • Handle properly, operate and maintain instruments used in industries. • Measure various electrical quantities with the help of different instruments. • Operate various instruments and measure the physical quantities. • Explain phase, line voltages and current relationships in 3-phase power supply. • Demonstrate the concept of single phase transformers and determine the efficiency. • Demonstrate the working of DC, AC and single

	phase fractional kilowatt motors. • Apply the working principle of rotating electrical machines. • Connect and run a DC shunt motor with supply through a 3 point starter. • Analyze basic principles and importance of process control in industry. • Analyze the working of electrical, pneumatic and hydraulic control element. • Analyze the working of different valves so that well desired control is achieved. • Troubleshoot and identify various switches in the industry. • Illustrate knowledge of embedded systems for their applications • Troubleshoot instrumentation panel wiring. • Install any instrument using screw and hinge type instruments. • Select the minor project according to the need of relevant industries. • Provide an overview of different methods of power generation with a particular stress on thermal power generation • Discuss measurement of electrical and non-electrical parameters involved in power generation plants. • Illustrate the different types of devices used for data acquisition and analyze in power plants • Describe control system and control loops applied in power plants. • Integrate monitoring of different parameters like speed, vibration of turbines and their control • Describe control system and control loops applied in power plants. • Integrate electrical vehicles technology to understand the concepts of hybrid electric vehicles

PO4: Communicate in writing and speaking with required clarity and demonstrate Professional behavior. .	• Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses. • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes. • Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews • Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships. • Work as a team member for successful completion of minor project. • Acquire Life Long Learning skills. • Write the minor project report effectively and present through ppt.
PO5: Adopt self-study learning and acquire knowledge aiming towards holistic development of learners through MOOCs.	• Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses. • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes. • Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews

	• Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships. • Work as a team member for successful completion of minor project. • Acquire Life Long Learning skills. • Write the minor project report effectively and present through ppt. • Work in team for solving industrial problems. • Perform in a better way in the professional world. • Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses. • Handle properly industrial panel and gas chromatography. • Handle pollution monitoring instruments using new techniques like Arduino and IoT

17. SUBJECTS & CONTENTS

(SECOND YEAR)

THIRD SEMESTER

3.1 INDUSTRIAL/IN-HOUSE TRAINING- I

L	P
-	2

RATIONALE

Industrial training / In – house training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It will also give exposure about the present and future requirements of the relevant industries. This training is very important for development of required competencies and skills for employment and start – ups.

COURSE OUTCOMES

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

CO1: Understand the working environment of industries.
CO2: Take necessary safety precautions and measures.
CO3: Learn about present and future requirement of industries.
CO4: Work in team for solving industrial problems.
CO5: Develop required competencies and skills for relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training / In – house training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial / In-house assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

3.2 CONTROL SYSTEM ENGINEERING

L	P
3	4

RATIONALE

It is pre-requisite for the students to know the various total plant controls in the process industry. An automatic control system saves manpower, reduces cost of production, increases the accuracy of the finished product and helps in mass production. The knowledge of this subject is required to have deeper grasp of the control environment/techniques as need to be studied in the forthcoming subjects e.g. process control, process instrumentation.

COURSE OUTCOMES

After undergoing the subject, student will be able to:

CO1: Comprehend fundamentals of control system and concept of linear and non-linear control system.
CO2: Analyze the response of first order system w.r.t. different Input signals
CO3: Analyze the stability and behavior of closed loop systems using various tools
CO4: Apply the transfer function and analyze different methods to find the transfer function.

DETAILED CONTENTS

UNIT I

Introduction

1.1 Basic elements of control system.
1.2 Open loop control system.
1.3 Closed loop control system.
1.4 Manually controlled closed loop systems.
1.5 Automatic controlled closed loop systems.
1.6 Basic elements of a servo mechanism.
1.7 Linear systems, non-linear systems.
1.8 Mathematical modelling of physical systems
  1.8.1 Mechanical system: Rotational and Translational systems.
  1.8.2 Electrical system
1.9 Introduction to Laplace transform.

UNIT II

Control System Representation

2.1 Transfer function.

2.2 Block diagram of closed loop system.

2.3 Block diagram reduction techniques, Problems on block diagram.

2.4 Signal flow graph, Mason's formula.

UNIT III

Time Response Analysis

3.1 Standard test signals

3.2 Time response of first order system subjected to step and impulse input.

3.3 Introduction to second order system (Over damped, critically damped and under damped systems).

3.4 Time domain specifications (Delay time, rise time, peak time, peak overshoot, settling time, steady state error).

UNIT IV

Stability

4.1 Routh Array Criterion, Problems of Routh Array.

4.2 Introduction to Root Locus Technique.

4.3 Introduction to Bode Plot.

UNIT V

Non-Linear Control System

5.1 Introduction to behaviour of non-linear control system.

5.2 Principle of superposition and homogeneity.

5.3 Different types of non-linearites

- 5.3.1 Saturation.
- 5.3.2 Backlash
- 5.3.3 Hysteresis.
- 5.3.4 Dead zone.
- 5.3.5 Relay.
- 5.3.6 Friction.
- 5.3.7 Limit cycles.
- 5.3.8 Jump resonance.
- 5.3.9 Jump phenomenon.

5.4 Difference between linear and non-linear control system.

PRACTICAL EXERCISES

1. To draw a bode plot problems using Scilab/Matlab.
2. To find gain margin and phase margin with crossover frequency of a system using Scilab/Matlab.
3. To plot the root locus of a given system using Scilab/Matlab.
4. To find the stability of polynomial using Routh array criterion using Scilab/Matlab.
5. To illustrate the effect the damping factor on the frequency response of second order system using Scilab/Matlab.
6. To demonstrate the synchro characteristic and use a synchro pair as error detector.
7. To study Non linearity behaviour of relay.
8. To study/design an open loop control system.
9. To study/design closed loop control system.
10. To study and demonstrate principle of servo mechanism.
11. To study and demonstrate Backlash non linearity.
12. To study and demonstrate dead zone non linearity.
13. To study and demonstrate Hysteresis non linearity.
14. To study and verify different standard test signals.

RECOMMENDED BOOKS

1. Nagrath and Gopal, “Control Systems”.
2. B. S. Manke, “Linear Control Systems”, Khanna Publication.
3. Ghosh, “Control Systems: Theory and Applications”, Pearson Education, Sector 62, Noida.
4. R. C. Sukla, “Control Systems”, Dhanpat Rai and Sons.
5. Ogata, “Control Systems”.
6. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

Since the knowledge of this subject is required to have deeper grasp of the control environment/techniques as need to be studied in the forthcoming subjects e.g. process control, process instrumentation, the subject teacher is required to make the subject interesting and provide information about practical applications. The students may be given exposure in process industry and shown various controls. This subject contains five units of equal weightage.

3.3 SENSORS AND TRANSDUCERS

L	P
3	4

RATIONALE

This subject gives an introduction to various methods of processing a signal available from a transducer to make it worth displaying or computer compatible. Telemetry is an advanced application of communication for instrumentation which lays the foundation for modern means of information transmission and reception like digital data, satellite based communication.
Subject teachers are advised to show the students different types of sensors and transducers while teaching the various topics of this course. Further, teachers may give some assignment problems related to industrial signal processing and applications which calls for use of specific transducer and signal conditioning equipment in specifications.

COURSE OUTCOMES

After undergoing the subject, student will be able to:

CO1: Identify different types of sensors and transducers and their applications in the field of Instrumentation and Control.
CO2: Select appropriate transducers relating to a process.
CO3: Acquire technical know how about the conditioning of a signal from a transducer for the purpose of control.
CO4: Acquire and convert a signal available from a transducer to make it worth displaying or computer compatible.
CO5: Demonstrate working and applications of different transducers

DETAILED CONTENTS

UNIT I
Introduction to Sensors and Transducer

1.1 Definition of Sensor
1.2 Definition of Transducer
1.2 Classification of Sensors and Transducer
1.3 Selection Criteria of Sensors and Transducer

1.4 Characteristics of Transducer

UNIT II

Resistive Transducer

Construction, working Principle, Advantage and Disadvantage, Application of following Transducer

2.1 Potentiometer
2.2 Strain Gauage
2.3 Hot Wire anemometer
2.4 Resistive Temperature Transducer (RTD, Thermistor)
2.5 Pick-up

UNIT III

Inductive Transducer

Construction, working Principle, Advantage and Disadvantage, Application of following Transducer.

3.1 LVDT
3.2 RVDT
3.3 Electromagnetic Pick-up
3.4 Inductive Microphone

UNIT IV

Capacitive Transducer

Construction, working Principle, Advantage and Disadvantage, Application of following Transducer.

4.1 Capacitive Pick –Up
4.2 Condenser/Capacitor microphone
4.3 Differential Capacitor Pick-up

UNIT V

Other Types of Transducers

Working Principle, Application of following Transducer

5.1 Piezoelectric Transducer
5.2 Seismic Pick-up
5.3 Digital Transducer –Shaft Encoders
5.4 LDR
5.5 Humidity Sensor (DHT11)

5.6 Air Quality Sensor (MQ135)

PRACTICAL EXERCISES

1. Measurement of strain using strain gauge transducer.
2. Measurement of temperature using RTD (Resistance Temperature Detector)
3. Measurement of temperature using Thermistor.
4. Measurement of displacement using LVDT.
5. Measurement of angular displacement using capacitive transducer.
6. Measurement of temperature using thermocouple.
7. Measurement of Resistance using LDR.
8. To draw the characteristics of Photo Diode.
9. To draw the characteristics of Photo Transistor.
10. To measure weight using load cell.
11. To measure the linear velocity.
12. To measure the density using Hydrometer.

RECOMMENDED BOOKS

1. RK Jain, “Mechanical and industrial Measurements”, Khanna Publishers, New Delhi.
2. OGATA, “Modern Control Engineering”.
3. AE Fribance, “Fundamentals of Instrumentation”.
4. Peter Norton, “Transducers”.
5. Bolton, “Mechatronics”, Prentice Hall of India, New Delhi.
6. AK Sawhney, “Electronics Measurement and Instrumentation”, Dhanpat Rai and Co, New Delhi.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

Since the knowledge of this subject is required to have deeper grasp of the control environment/techniques as need to be studied in the forthcoming subjects e.g. process control, process instrumentation, the subject teacher is required to make the subject interesting and provide information about practical applications. The students may be given exposure in process industry and shown various controls. This subject contains five units of equal weightage.

3.4 MEASUREMENT AND INSTRUMENTATION

L	P
3	2

RATIONALE

Instrumentation and control engineering diploma holders are normally placed in process and manufacturing industries and service sector. This course provides a starting background to the students of diploma program in Instrumentation and Control acquainting him/her with various electrical and electronic instruments for their principle, operation, testing, calibration and applications. Proper understanding of the measuring techniques, construction and working principles of various instruments will help the students in proper handling, operation and maintenance of industrial plants, control circuits and panels etc.

COURSE OUTCOME

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

CO1: Describe various Electrical and Electronic Instruments.
CO2: Handle properly, operate and maintain instruments used in industries.
CO3: Measure various electrical quantities with the help of different instruments.
CO4: Operate various instruments and measure the physical quantities.
CO5: Demonstrate usage of C.R.O. and D.S.O in the lab.

DETAILED CONTENTS

UNIT I

Measurement of Resistance, Inductance and Capacitance

1.1 Measurement of Resistance:
1.1.1 Wheatstone Bridge
1.1.2 Potentiometer method
1.2 Measurement of Inductance
1.2.1 Hay’s bridge
1.2.2 Maxwell Bridge
1.3 Measurement of capacitance
1.3.1 De Sauty’s bridge

UNIT II

Ammeter, Voltmeter and Multimeter

2.1 Construction and working principle, applications of Ammeter and voltmeter

2.1.1 Moving Iron

2.1.2 Permanent Magnet Moving Coil Meters

2.1.3 Thermocouple type

2.1.4 Electrostatic type

2.1.5 Rectifier type

UNIT III

Power and Energy Measurement

3.1 Introduction to single-phase and three-phase system.

3.2 Comparison between three-phase and single-phase system.

3.3 Working principle of dynamometer type watt meter

3.4 Power measurement using 2 watt meter or 3 watt meter methods

3.5 Working principle, construction and applications of energy meter

UNIT IV

Frequency Measurement

Working Principle and applications of

4.1 Stroboscopes

4.2 Digital frequency meters

UNIT V

Cathode Ray Oscilloscope

5.1 Construction and working of Cathode Ray Tube (CRT)

5.2 Block diagram and working principle of a basic CRO

5.3 Digital storage oscilloscope (DSO): block diagram and working principle.

PRACTICAL EXERCISES

1 To measure the capacitance by De Sauty's Bridge

2 To identify and study of indicating, integrating and recording instruments.

3 Extension of range of a given voltmeter and an ammeter.

4 Use of analog and digital multimeter for measurement of voltage, current (AC/DC) and resistance

5 Study the constructional details, working and calibration of an ammeter (moving Coil and moving iron type)
6 To measure power, power factor in a 1-phase circuit, using wattmeter and power factor meter and verify results with calculations.
7 Study the constructional details, working of a Meggar and measurement of Insulation resistance of a given motor.
8 To measure the value of earth resistance using earth tester.
9 To measure unknown resistance with wheat-stone bridge.
10 To measure frequency, power, power factor in a single-phase circuit, using digital frequency meter, wattmeter and power factor meter and to verify results with calculations.
11 Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
12 Use of LCR meter for measuring inductance, capacitance, Q-factor and resistance.
13 Measurement of voltage, frequency, time period, phase using CRO.
14 Measurement of voltage, frequency, time period, phase using DSO.

RECOMMENDED BOOKS

1. AK Sawhney, "A Course in Electrical Measurement and Measuring Instruments", Dhanpat Rai and Sons, New Delhi.
2. SK Sahdev, "Electrical Measurements and Measuring Instruments", Unique International Publications, Jalandhar.
3. SK Bhattacharya and KM Rastogi, "Experiments in Basic Electrical Engineering", New Age International (P) Ltd., Publishers, New Delhi.
4. Malvino, "Electronic, Instrumentation Fundamentals".
5. DR Nagpal, "Electrical Measurement".
6. D. Cooper, "Electric Instruments", Prentice Hall of India, New Delhi.
7. JB Gupta, "Electronics Instrumentation", Satya Prakashan, New Delhi.
8. Cooper, "Modern Electronic Instrumentation and Measurement Techniques".
9. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

While teaching this course the teacher should give demonstration in working and calibration of the instruments pertaining to relevant topics in the class. A visit to power plant or industry can also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. The students may be given exposure in process industry and shown various controls. This subject contains five units of equal weightage.

3.5 ELECTRICAL MACHINES

L	P
3	2

RATIONALE

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Explain phase, line voltages and current relationships in 3-phase power supply.
CO2: Demonstrate the concept of single phase transformers and determine the efficiency.
CO3: Demonstrate the working of DC, AC and single phase fractional kilowatt motors.
CO4: Measure the power and power factor in 3 phase load.
CO5: Apply the working principle of rotating electrical machines.
CO6: Connect and run a DC shunt motor with supply through a 3 point starter.

DETAILED CONTENTS

UNIT I

Transformers

Principle of operation and constructional details of single phase transformer

1.1 Voltage Regulation of a transformer (No Derivation)
1.2 Losses in a transformer
1.3 Efficiency, condition for maximum efficiency and all day efficiency
1.4 CTs and PTs (Current transformer and potential transformer)
1.5 CVT (Constant Voltage Transformer)

UNIT II

Introduction to Rotating Electrical Machines

2.1 E.M.F induced in a coil rotating in a magnetic field.
2.2 Definition of motor and generator
2.3 Basic principle of a generator and a motor
2.4 Torque due to alignment of two magnetic fields and the concept of Torque angle
2.5 Basic Electromagnetic laws (Faraday's laws of Electromagnetic Induction)

UNIT III

DC Machines

3.1 Principle of working of d.c motors and d.c generator, their constructional details
3.2 Function of the Commutator for motoring and generating action
3.3 Factors determining the speed of a DC motor
3.4 Different types of excitation
3.5 Starting of DC motors and starters

UNIT IV

AC Motors

4.1. Revolving magnetic field produced by poly phase supply
4.1. Construction and working principle of single phase induction motor
4.1. Brief introduction about three phase induction motors, its principle of operation
4.1. Construction, Working Principle and applications of Single phase Synchronous Motor
4.1. Brief introduction about three phase Synchronous motors, its principle of operation

UNIT V

Single Phase Fractional Kilowatt Motors

5.1. Concept of micro-motors
5.2. Servo- motors: AC and DC Servo Motors
5.3. Stepper Motor: Working Principle and application

PRACTICAL EXERCISES

Demonstrate various instruments use viz Ammeter, Voltmeter, Wattmeter, P.F meter etc for their identification and connecting procedure in a circuit.

1. To measure power and power factors in 3 Phase load by two wattmeter method
2. To determine the efficiency of a single phase transformer from the data obtained through open circuit and short circuit test

3. To measure power and power factor of a single phase induction motor.
4. To study speed control of DC shunt motor with i) Armature control method ii) Field control method.
5. To study DC Series motor with starter.
6. To determine efficiency of a DC motor.
7. To plot relationship between no load terminal voltage and excitation current in synchronous generator at constant speed.
8. To run a synchronous motor with a.c supply and to measure speed to verify the relation N=120 f/ P
9. To make connections of starting and running winding of a single phase capacitor motor and to run it with the help a DOL starter and to measure its speed
10. To perform speed control of stepper Motor.
11. Measurement of speed control of motor with tachometric feedback.
12. Use of SciLab to perform electrical machine practicals.

RECOMMENDED BOOKS

1. SK Bhattacharya, “Electrical Machine”, Tata McGraw Hill Education Pvt Ltd, New Delhi.
2. Nagrath and Kothari, “Electrical Machines”, Tata McGraw Hill Education Pvt Ltd, New Delhi.
3. S.K. Bhattacharya, and KM Rastogi, “Experiments in Basic Electrical Engineering”, New Age International (P) Ltd. Publishers, New Delhi.
4. SK Sahdev, “Electrical Machines”, Uneek Publications, Jalandhar.
5. JB Gupta, “Electrical Engineering”, SK Kataria & Sons, New Delhi.
6. DR Arora, “Electrical Machines”, Ishan Publications, Ambala city.
7. B.L. Thareja, “Electrical Technology Vol. - I and II”, S Chand and Co. New Delhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

A visit to a small factory (Preferably Transformer Factory) must be organised to give live exposure to students. For this the teacher should visit first to understand the assembly line-up which could be followed by a visit of the students in groups of 10-20 (depending upon the size of the factory), where the instructor can give an idea of the working of the factory without much seeking assistance of the factory staff. Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making. This subject contains five units of equal weightage.

3.6 OPEN ELECTIVE

L	P
2	-

RATIONALE

Open electives are very important and play major role in implementation of National Education Policy. These subjects provide greater autonomy to the students in the curriculum, giving them the opportunity to customize it to reflect their passions and interests. The system of open electives also encourages cross learning, as students pick and choose subjects from the differents streams.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: State the basic concepts and principles about the subject of interest.
CO2: Perform in a better way in the professional world.
CO3: Select and learn the subject related to own interest.
CO4: Explore latest developments in the field of interest.
CO5: Develop the habit of self-learning through online courses.

LIST OF OPEN ELECTIVES

(The list is indicative and not exhaustive)

1. Computer Application in Business
2. Introduction to NGO Management
3. Basics of Event Management
4. Event Planning
5. Administrative Law
6. Introduction to Advertising
7. Moodle Learning Management System
8. Linux Operating System
9. E-Commerce Technologies
10. NCC
11. Marketing and Sales
12. Graphics and Animations
13. Digital Marketing

14. Human Resource Management
15. Supply Chain Management
16. TQM

GUIDELINES

Open Elective shall be offered preferably in online mode. Online mode open elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of open electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online open electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline open electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs open elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable open elective is available online, only then the course may be conducted in offline mode. The assessment of offline open elective shall be internal and external. The offline open elective internal assessment of 40 marks shall be based on internal sessional tests; assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

NOTE:

The students enrolled under NCC will compulsorily undertake NCC as an open elective subject.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

3.7 INSTRUMENTATION DRAWING

L	P
-	4

RATIONALE

Since drawing is the language of engineers through which they can express technical ideas in this subject, students will be able to draw component layouts and interpret the actual drawings used in the field of Instrumentation. Also student will be able to study various graphical symbols as per ANSI standards.

COURSE OUTCOMES

After undergoing this course, the student will be able to:

CO1: Identify the different types of symbols as per ANSI standards.
CO2: Identify instruments and read different types of instrument diagrams.
CO3: Draw the schematic drawings and go through installation procedure.
CO4: Illustrate the drawing of power plant, steel plant & cement plant.

DETAILED CONTENTS CUM PRACTICAL SESSIONS

UNIT I

Study of Symbols

1.1 Electronic symbols.
1.2 Process instrumentation symbols.
1.3 Graphical symbols for pipe fittings (Valves and Piping), Graphical symbols and codes for pressure, temperature, flow, level measuring instruments as per ANSI standards.
1.4 Colour coding of lines (Electric lines and fluid lines).

UNIT II

Instrumentation Diagrams

2.1 Study of block diagram.
2.2 Study of schematic diagram.
2.3 Study of wiring diagram.
2.4 Study of graphical panel diagram.
2.5 Study of P& I diagram.

UNIT III

Instrument Installation System

3.1 Instrument Identification.

3.2 Study of instrument installation procedure.

3.3 Check list of good installation system

UNIT IV

Plant Instrumentation (Power and Refinery Plant)

4.1 Instrumentation drawing of power and refinery plant.

4.2 Block diagram of power and refinery plant.

4.3 Flow diagram of power and refinery plant.

UNIT V

Plant Instrumentation (Steel and Cement Plant)

5.1 Instrumentation drawing of steel and cement plant.

5.2 Block diagram of steel and cement plant.

5.3 Flow diagram of steel and cement plant.

UNIT VI

Schematic Diagrams

6.1 Schematic diagram of single acting cylinder.

6.2 Schematic diagram of double acting cylinder.

6.3 Schematic diagram of spring return cylinder.

6.4 Schematic diagram of tandem valve and shuttle valve.

6.5 Schematic diagram of SOL-Valve.

** A visit to any of the plant mentioned in Unit 4 and 5 is compulsory, a brief report regarding the same should be submitted by every student to the subject teacher.

Industrial safety:

Fire prevention and control, handling of fire accidents, electrical safety, environmental safety, various safety equipment and their constructional features, maintenance and repair of safety equipment, safety in high pressure operations, safety management, safety provisions in the factory act, laws related to the industrial safety, measurement of safety performance, safety audit.

RECOMMENDED BOOKS

1. WG Andrews, “Applied Instrumentation”.
2. BG Liptic, “Instrumentation Engineers Hand Book Vol.2”.
3. DM Considine, “Handbook of Applied Instrumentation”.
4. RK Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi.
5. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.ac.in

INSTRUCTIONAL STRATEGY

The teacher should lay emphasis on identification of symbols, draw sketches, wiring diagrams. Demonstrate different views, working drawings for interpretation. Make students aware of handbooks, data books and manuals for reference.

This subject contains five units of equal weightage.

FOURTH SEMESTER

4.1 ENGLISH AND COMMUNICATION SKILLS - II

L	P
2	2

RATIONALE

Communication II moves a step further from Communication Skills I and is aimed at enhancing the linguistic competency of the students. Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life – personal, social and professional. This course is intended to make fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework.

COURSE OUTCOMES

After undergoing this course, the learners will be able to:

CO1: Communicate effectively with an increased confidence; read, write and speak in English language fluently.

CO2: Comprehend special features of format and style of formal communication through various modes.

CO3: Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews

CO4: Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.

DETAILED CONTENTS

UNIT I

Reading

1.1 Portrait of a Lady - Khushwant Singh

1.2 The Doctor's Word by R K Narayan

1.3 Speech by Dr Kiran Bedi at IIM Indore2007 Leadership Concepts

1.4 The Bet - by Anton Chekov

UNIT II

Effective Communication Skills

2.1 Modern means of Communication (Video Conferencing, e- mail, Teleconferencing)

2.2 Effective Communication Skills: 7 C's of Communication
2.3 Non-verbal Communication – Significance, Types and Techniques for Effective Communication
2.4 Barriers and Effectiveness in Listening Skills
2.5 Barriers and Effectiveness in Speaking Skills

Unit III

Professional Writing

3.1 Correspondence: Enquiry letters, placing orders, complaint letters
3.2 Report Writing
3.3 Memos
3.4 Circulars
3.5 Press Release
3.6 Inspection Notes and tips for Note-taking
3.7 Corrigendum writing
3.8 Cover Letter

UNIT IV

Grammar and Vocabulary

4.1 Prepositions
4.2 Conjunctions
4.3 Punctuation
4.4 Idioms and Phrases: A bird of ill omen, A bird's eye view, A burning question, A child's play, A cat and dog life, A feather in one's cap, A fish out of water, A shark, A snail's pace, A snake in the grass, A wild goose chase, As busy as a bee, As faithful as dog, Apple of One's eye, Behind one's back, Breath one's last, Below the belt, Beat about the bush, Birds of a feather flock together, Black Sheep, Blue blood, By hook or crook, Chicken hearted, Cut a sorry figure ,Hand in glove, In black and white, In the twinkling, In full swing ,Is blind as a bat, No rose without a thorn, Once in a blue moon, Out of the frying pan in to the fire, know no bounds ,To back out, To bell the cat, To blow one's trumpet, To call a spade a spade, To cut one's coat according to one's cloth, To eat humble pie, To give ear to, To have a thing on one's finger tips, To have one's foot in the grave, To hold one's tongue, To kill two birds with one stone, To make an ass of oneself, To put two and two together, To the back bone, Turn coat, ups and downs.
4.5 Pairs of words commonly misused and confused: Accept-except, Access-excess, Affect-effect, Artificial- artful, Aspire-expire, Bail-bale, Bare-bear, Berth-birth, Beside-besides,

Break-brake, Canvas-canvass, Course- coarse, Casual-causal, Council-counsel, Continual-continuous, Coma-comma, Cue- queue, Corpse- corps-core, Dairy-diary, Desert-dessert, Dual-duel, Dew- due, Die-dye, Draft- draught-drought, Device-devise, Doze-dose, Eligible-illegible, Emigrant- immigrant, Envelop-envelope, Farther-further, Gate-gait, Goal-goal, Human-humane, Honorable-honorary, Hail-hale, Hair-heir-hare, Industrial-industrious, Impossible- impassable, Idle-idol-ideal, Lose-loose, Later-latter, Lesson-lessen, Main-Mane, Mental-mantle, Metal-mettle, Meter-metre, Oar-ore, Pray-prey, Plain-plan, Principal - principle, Personal- personnel, Roll- role, Route-rout- roote, Stationary-stationery, Union- unity, Urban- urbane, Vocation- vacation, Vain- vein-vane, Vary- very.

4.6 Translation of Administrative and Technical Terms in Hindi or Mother tongue: Academy, Abandon, Acting in official capacity, Administrator, Admission, Aforesaid, Affidavit, Agenda, Alma Master, Ambiguous, Appointing Authority, Apprentice, Additional, Advertisement, Assistant, Assumption of charge, Assurance, Attested copy, Bonafide, Bond, Cashier, Chief Minister, Chief Justice Clerical error, Commanding ,Officer, Consent, Contractor, corruption, Craftsman, Compensation, Code, Compensatory allowance, Compile, Confidential letter, Daily Wager, Data, Dearness allowance, Death - Cum Retirement, Dispatch, Dispatch Register, Disciplinary, Disciplinary Action, Disparity Department, Dictionary, Director, Director of Technical Education, Earned Leave, Efficiency Bar, Estate, Exemption, Executive Engineer, Extraordinary, Employment Exchange, Flying Squad, General Body, Head Clerk, Head Office, High Commission, Inconvenience, Income Tax, Indian Assembly Service, Justify, Legislative Assembly, Negligence, Officiating ,Office Record, Office Discipline, On Probation, Part Time, Performance, Polytechnic, Proof Reader Precautionary, Provisional, Qualified, Regret, Responsibility, Self-Sufficient, Senior, Simultaneous ,Staff, Stenography ,Superior, Slate, Takeover, Target Data Technical Approval, Tenure, Temporary, Timely Compliance, Under Investigation, Under Consideration, Verification, Viva-voce, Write off, Working Committee, Warning, Yours Faithfully , Zero Hour.

UNIT V

Employability Skills

5.1 Presentation Skills: How to prepare and deliver a good presentation

5.2 Telephone Etiquettes

5.3 Importance of developing employable and soft skills

5.4 Resume Writing: Definition, Kinds of Resume, Difference between Bio-data and Curriculum Vitae and Preparing a Resume for Job/ Internship

5.5 Group discussions: Concept and fundamentals of GD, and learning Group Dynamics.
5.6 Case Studies and Role Plays

PRACTICAL EXERCISES

1. Reading Practice of the above lessons in the Lab Activity classes.
2. Comprehension exercises of unseen passages along with the given lessons.
3. Vocabulary enrichment and grammar exercises based on the above selective readings.
4. Situational Conversation: Requesting and responding to requests; Expressing sympathy and condolence.
5. Warning; Asking and giving information.
6. Getting and giving permission.
7. Asking for and giving opinions.
8. A small formal and informal speech.
9. Seminar.
10. Debate.
11. Interview Skills: Preparing for the Interview and guidelines for success in the Interview and significance of acceptable body-language during the Interview.
12. Written Drills will be undertaken in the class to facilitate a holistic linguistic competency among learners.
13. Participation in a GD, Functional and Non-functional roles in GD, Case Studies and Role Plays
14. Presentations, using audio-visual aids (including power-point).
15. Telephonic interviews, face to face interviews.
16. Presentations as Mode of Communication: Persuasive Presentations using multi-media aids.
17. Practice of idioms and phrases on: Above board , Apple of One's eye , At sea, At random, At large, A burning question, A child's play, A wolf in sheep's clothing, A deal, Breath one's last, Bid fair to, Beat about the bush, Blue Blood, Big Gun, Bring to Book, Cut a sorry figure, Call names, Carry weight, Dark Horse, Eat Humble pie, Feel small, French leave, Grease the palm, Go against the grains, Get One's nerves, Hard and Fast, Hue and Cry, Head and ears, In full swing, Jack of all trades, know no bounds, kiss the dust, Keep an eye on, Lion's share, learn by rote, Null and void, on the cards, Pull a long face, Run amuck, Right and Left, Rain on Shine, Small talk, Take to one's heels, Tooth and nail, to take by storm, , Wet blanket, Yearn for.

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 1, 2", M/s Abhishek Publications, Chandigarh.
2. J Sethi, Kamlesh Sadanand & DV Jindal, "Course in English Pronunciation", PHI Learning Pvt. Ltd., New Delhi.
3. Wren and Martin, "High School English Grammar and Composition" .
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma, and Krishna Mohan, "Business Correspondence & Report Writing", (4^{th} Edition), by Tata MC Graw Hills, New Delhi.
6. Varinder Kumar, Bodh Raj & NP Manocha, "Business Communication Skills", Kalyani Publisher, New Delhi.
7. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
8. Nira Konar, "Communication Skills for Professionals", PHI Learning Pvt. Ltd., New Delhi.
9. Krishna Mohan & Meera Banerji, "Developing Communication Skills", (2^{nd} Edition), Macmillan Publishers India Ltd., New Delhi.
10. M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
11. Andrea J Rutherford, "Basic Communication Skills for Technology", Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required communication skills in the students. Emphasis should be given on practicing of communication skills. This subject contains five unit of equal weight age.

4.2 PROCESS CONTROL

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RATIONALE

This course will enable the students to study in detail different types of control devices used in instrumentation and will provide understanding of basic control loops and characteristics of various controllers. The course also introduces various control mechanisms, modes and valves which are necessary to understand simple control systems in a process plant. The contents of the course have been selected and arranged so as to treat it in a logical manner, to understand the important laws of operation of industrial automatic control systems, to provide practical background of theory and to evaluate the effect of changes in process parameters on the control response.

COURSE OUTCOMES

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

CO1: Comprehend the evaluation criteria and selection techniques of controllers.
CO2: Analyze basic principles and importance of process control in industry.
CO3: Analyze the working of electrical, pneumatic and hydraulic control element.
CO4: Analyze the working of different valves so that well desired control is achieved.
CO5: Troubleshoot and identify various switches in the industry.

DETAILED CONTENTS

UNIT I
Basic Control Loops and Characteristics

1.1 Basics of process control
1.2 Different process variables
1.3 Introduction to single and multi-loop control system
1.4 Feed- forward control system
1.5 Cascade control system
1.6 Ratio control system
1.7 Split range control system

UNIT II

Basic Controller Modes and Characteristics

2.1 Concept of On-Off control, advantages and disadvantages.

2.2 Proportional, Integral, Derivative action and their combinations PI, PD and PID controls, their examples, merits and demerits.

2.3 Process lag, Measurement lag and Transmission lag

UNIT III

Construction, principle of operation and applications of

3.1 Pneumatic control elements: pneumatic pressure supply, pneumatic actuator, pneumatic relay, Flapper Nozzle system as control element.

3.2 Hydraulic control elements: hydraulic actuators, hydraulic valves

3.3 Electric Actuators

3.4 I/P Converter and P/I Converter

3.5 Comparison between Pneumatic and Hydraulic control systems

UNIT IV

Control Valves

Principle of operation, constructional details and applications of

4.1 Diaphragm operated valve

4.2 Globe valve

4.3 Ball valve

4.4 Butterfly valve

4.5 Solenoid Valve

UNIT V

Switches

5.1 Temperature switches

5.2 Flow switches

5.3 Pressure switches

5.4 Limit Switches

5.5 Interlocking and Sequencing Circuit

PRACTICAL EXERCISES

1. To study and verify ratio control system.
2. To study and verify cascade control system.
3. To study and verify feed forward control system.
4. To demonstrate the working of any on-off control system
5. To rig up an electronic proportional controller and verify its working
6. To demonstrate working of P/I converter.
7. To study working of a valve using I/P converter.
8. To study constructional details and working of Butterfly, Solenoid, Ball, Globe and Diaphragm operated valve.
9. To rig up an electronic proportional integral controller unit
10. To demonstrate the working of pneumatic pressure supply.
11. To demonstrate the working of Auto transformer
12. To rig up an electronic proportional integrated derivative controller unit
13. To demonstrate the working of Hydraulic valve.
14. To demonstrate the construction and working of any one control valve.
15. To study the construction and working of a pressure switch.
16. To study the construction and working of a temperature switch.
17. To study the construction and working of a float type of level switch.

**Student may visit any one process plant along with teacher and write a brief report

RECOMMENDED BOOKS

1. Peter Harrot, “Process Control”, Tata McGraw Hill Publishers, New Delhi.
2. DP, Eckman, “Automatic Process Control”, John Wiley and Sons, New Delhi.
3. Liptak BG, “Instrument Engineers Handbook”.
4. Johnson Curtis D, “Process Control Instrumentation Technology”, John Wiley and Sons, New Delhi.
5. Liptak BG, “Process Measurement and Analysis”.
6. DM Considine, “Handbook of Applied Instrumentation”.
7. RK Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.ac.in

INSTRUCTIONAL STRATEGY

Along with theoretical inputs, visits to process plants must be organized where the students will be exposed to various types of control actions. Small projects in the form of control loops may be identified and given to students as assignments or report writing. Field visits to any relevant process industries or laboratories like paper mills, sugar mill, thermal plant and power house etc. to show them control components physically. The teacher should also explain the salient features of control scheme used there. This subject contains five units of equal weight age.

4.3 MICROCONTROLLER AND EMBEDDED SYSTEMS

L	P
3	2

RATIONALE

The study of microcontrollers in terms of architecture, software and interfacing techniques leads to the understanding of working of microcontrollers and applications of microcontroller in Instrumentation Industries. The microcontroller is an area of specialization & microcontroller is the heart of the programmable devices. Students of Instrumentation and related engineering branches often use microcontroller to introduce programmable control in their projects, automation and fault finding in industry.

COURSE OUTCOMES

After undergoing the subject, student will be able to:

CO1: Comprehend the working of microcontrollers and their application of in industries.
CO2: Familiarize with the instruction set and addressing modes of microcontroller
CO3: Illustrate knowledge of embedded systems for their applications
CO4: Explain the architecture of advanced microcontrollers.

DETAILED CONTENTS

UNIT I

Introduction

1.1 Difference between microprocessor and microcontroller.
1.2 Microcontroller and their applications.
1.3 Microcontroller for embedded system.
1.4 Overview of the 8051 family

UNIT II

8051 Architecture

2.1 Block Diagram and Pin Diagram of 8051 microcontroller.
2.2 The 8051 Oscillator & clock.
2.3 Program Counter and Data Pointer.

2.4 A & B CPU registers.
2.5 Flag and the program status word (PSW).
2.6 Internal Memory.
2.7 The stack and stack pointer.
2.8 Input/output ports.
2.9 Counters and timers.
2.10 Serial Data input/output.
2.11 Interrupts.

UNIT III

Addressing Modes & Instructions

3.1 Instructions set of 8051.
3.1.1 Arithmetic instructions.
3.1.2 Loops and jump instructions.
3.1.3 Call instructions.
3.1.4 Push and Pop Instructions.
3.2 Addressing modes of 8051**.**

UNIT IV

Introduction to Embedded System

4.1 Definition of embedded system.
4.2 Embedded operating system, RTOS.
4.3 Embedded hardware units and devices in a system.
4.4 Design parameters of an embedded system and its importance.
4.5 Applications of embedded system.

UNIT V

Advanced Microcontroller

5.1 Only brief general architecture of AVR, PIC and ARM microcontroller
5.2 Introduction to Arduino IDE
5.3 Applications of advanced microcontroller in the Instrumentation and Control field

PRACTICAL EXERCISES

1. Familiarization with Micro-controller Kit and its different sections.
2. Familiarization with Assembly Language Programming (PC Based).

3. Familiarization with C Language Programming (PC Based).
4. Program to add two hexadecimal numbers using C Language Programming.
5. Program to add two decimal numbers using C Language Programming.
6. Program to check whether number is odd or even using C Language Programming.
7. Programming to interface switches and LEDs.
8. Programming and interface of Seven Segment and LCD.
9. Programming and interfacing of Graphical LCD.
10. Programming to interface Keypad.
11. Programming for A/D converter, result on LCD.
12. Programming for D/A converter, result on LCD.
13. Programming for serial data transmission from PC to Kit or vice versa.
14. Programming and interfacing of RELAY and Buzzer.
15. Programming and interfacing of Stepper Motor**.**

RECOMMENDED BOOKS

1. B. Ram, "Fundamentals of Microprocessor and Microcontroller", Dhanpat Rai Publications.
2. J Kenneth Ayala, "Microcontroller: Architecture, Programming & Applications", Penram.
3. Muhammad Ali Mazidi, Rolin Mckinlay, and Janice Gillespie Mazidi, "Microcontroller and Embedded Systems using Assembly and C", Pearson.
4. Muhammad Ali Mazidi, Rolin Mckinlay, and Danny Causey, "PIC Microcontroller and Embedded Systems: Using Assembly and C", Pearson.
5. K.J. Ayala, "The 8051 Microcontroller", Penram International.
6. J B Peatman, "Design with PIC Microcontrollers", Prentice Hall.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

Instruction should be given to students to get familiar with the microcontrollers in the class room so that they can develop the concept of controllers. Programming should be done by taking simple examples like interfacing of switch, LCD and relay, keypad etc. This subject contains five units of equal weight age.

4.4 ANALYTICAL INSTRUMENTATION

L	P
2	2

RATIONALE

Analytical Instruments have an important role in the field of Pharmaceutical, food and medicine industry. This subject will provide the knowledge and skill to student of Instrumentation and control about machine and equipments, which are used to check various parameters in Agriculture, food, medicine, lab testing and environment.

Diploma holder will also able to understand the various instruments which are used to measure and check the different harmful constituents in air and water pollution. These analytical and environmental Instruments are also used for new research possibilities for any vaccine and medicine.

COURSE OUTCOMES

After undergoing the subject, student will be able to:

CO1: Handle properly industrial panel and gas chromatography.

CO2: Handle pollution monitoring instruments using new techniques like Arduino and IoT

CO3: Comprehend concept of liquid analysis and paramagnetic oxygen analysis.

CO4: Illustrate usage of recording instruments and mass spectroscopy.

DETAILED CONTENTS

UNIT I

Introduction

Fundamental blocks of analytical instruments (brief details)

UNIT II

Spectroscopic Analysis

(Working Principle, Block-diagram explanation and applications of)

2.1 UV Spectrophotometer

2.2 Atomic Absorption spectroscopy

2.3 Infra-Red FTIR spectroscopy

2.4 Mass spectroscopy
2.5 Beer-Lamberts Law

UNIT III

Gas Chromatography

3.1 Introduction (Different manufacturers and models)
3.2 Block Diagram and working principle of gas chromatography
3.3 Instruments: injectors, oven, column, and detectors
3.4 Applications of Gas Chromatography

UNIT IV

Liquid Chromatography

4.1 Introduction (Different manufacturers and models)
4.2 Block Diagram and working principle
4.3 Instrument: Injector, Oven, Column, and Detectors
4.4 Applications of Liquid Chromatography

UNIT V

Liquid Analysis

5.1 Principle of pH measurement
5.2 Electrodes used for pH measurement
5.3 Electro chemical analyser
5.4 Applications of pH meter

PRACTICAL EXERCISES

1. To find conductivity of a given solution.
2. To measure total dissolved solutions in water.
3. To measure oxygen content dissolved in water
4. Demonstration of mass spectrometer
5. Demonstration of gas chromatograph
6. Demonstration of Liquid chromatography (LC)
7. To study UV spectrometer/FTIR/AAS
8. To study spectrometer

9. To study instruments used for water quality testing.
10. To study instruments used for Food Beverages (Pesticide) testing.
11. To study instruments used for Pharmaceuticals testing industry

RECOMMENDED BOOKS

1. R.S. Khandpur, “Handbook of Analytical Instruments”, Tata Mc Graw Hill Publishing Co. New Delhi.
2. Dr. DA Skoog, “Principles of Instrumental Analysis”.
3. Chhatwal, “Introduction to Instrumental Analysis”.
4. DM Considine, “Hand book of Applied Instrumentation”.
5. RK Jain, “Mechanical and Industrial Measurements”, Khanna Publisher, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

Efforts should be made to keep relevant instruments in the laboratory. It will be beneficial for students to visit different laboratories setup in Food, Pharmaceutical industry, Agrifarm and Pollution control department etc. and show them equipments used in the relevant field. This subject containsfive units of equal weight age.

4.5 INSTALLATION AND MAINTENANCE OF INDUSTRIAL EQUIPMENT

L	P
-	4

RATIONALE

When the students reach the industries, they will be able to install various instruments, identify the various instrumentation devices, measure the current, voltage and power, solder and desolder the components, identify and remedy the electrical faults, test and wire the instrumentation loop and recognize the use of instrumentation tools. They will also be able to select right instruments and tools for the right work.

COURSE OUTCOME

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

CO1: Learn NABL process of accreditation and starting an instrumentation calibration lab.
CO2: Assemble various rectifier circuits.
CO3: Troubleshoot instrumentation panel wiring.
CO4: Calibrate temperature measuring devices
CO5: Design and develop PCB for a given circuit.

PRACTICAL EXERCISES

The exercises/practical/experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency. Following is the list for guidance for exercises/practical/experiments

1. To study the process of NABL accreditation of instrumentation calibration labs as per ISO/IEC 17025
2. Study the process to setup an NABL accredited instruments calibration lab.
3. Wire instrument panel with various accessories as per instrument hook-up diagram
4. Wire the MCB, ELCB to supply electrical power to instrument panel
5. Prepare specifications for instrumentation tools, wires, cables, switches, electronic components for a given application

6. Wire electrical circuit diagram using IEEE standard symbols for one instrument panel application
7. Wire instrumentation loop as per given diagram using ISA standard symbols for one instrument panel application controlling single loop
8. Troubleshoot instrument panel wiring for various parameters and faults
9. To perform the installation of electrical earthing for industrial purpose.
10. Dismantle & assemble recorder to identify it's components
11. Install any one instrument using screw type and hang type instrument
12. Test pressure/flow /level/temperature switch
13. Assemble and demonstrate the working of electromagnet.
14. Assemble and demonstrate the working of solenoid.
15. To calibrate an Ammeter and a voltmeter.
16. To calibrate temperature measuring devices like thermocouple, RTD, thermistor etc.
17. To measure the output of piezoelectric crystal and study its characteristics.
18. To install a Solar PV cell and make its connections.
19. To install 3 phase Star-Delta starter (with automatic switch) of motor.
20. Designing of single layer PCB for a given circuit.
21. Designing of two side PCB for a given circuit.

RECOMMENDED BOOKS

1. D. V. S. Murthy, "Transducers and Instrumentation", PHI Learning.
2. H.S. Kalsi, "Measurement Systems", McGraw Hill Publishers.
3. D.A. Bell, "Electronic Instrumentation and Measurements", PHI Learning 2010.
4. Joseph J. Carr, "Elements of Electronic Instrumentation and Measurements", Pearson Education, 2010

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in
3. http://www.instrumentationworld.com/instrumentation_tutoral.html

INSTRUCTIONAL STRATEGY

Students are required to prepare and submit a laboratory report on instruction/demonstration given by teacher and workshop activities done by students as a part of team work. This subject contains five units of equal weight age.

4.6PROGRAMME ELECTIVE-I

4.6.1 POWER PLANT INSTRUMENTATION

L	P
3	-

RATIONALE

Power plant is the most important part in different industries as well as power generation unit. Instrumentation & control is the first criteria for that. The course is designed to familiarize the student with the functions and instrumentation available in a modern power generation plant.

COURSE OUTCOME

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

CO1: Provide an overview of different methods of power generation with a particular stress on thermal power generation Learn NABL process of accreditation and starting an instrumentation calibration lab.

CO2: Discuss measurement of electrical and non-electrical parameters involved in power generation plants.

CO3: Illustrate the different types of devices used for data acquisition and analyze in power plants

CO4: Describe control system and control loops applied in power plants.

CO5: Integrate monitoring of different parameters like speed, vibration of turbines and their control

DETAILED CONTENTS

UNIT I

Overview of Power Generation

1.1 Brief survey of methods of power generation:hydro, thermal, nuclear, solar and wind.

1.2 Importance of instrumentation in power generation

1.3 Thermal power plants, block diagram, details of boiler processes

1.4 Piping and Instrumentation diagram of boiler

UNIT II

Measurements in Power Plants

2.1. Electrical Measurements: Current, voltage, power, frequency, power factor etc.

2.2. Non Electrical Parameters: Flow of feed water, fuel, air and steam with correction factor for temperature, Steam pressure and steam temperature, Drum level measurement, Radiation detector, Smoke density measurement, Dust monitor.

UNIT III

Analyzers in Power Plants

3.1. Flue gas oxygen analyzer

3.2. Analysis of impurities in feed water and steam, Dissolved oxygen analyzer

3.3. Chromatography

3.4. PH meter

3.5. Pollution monitoring instruments.

UNIT IV

Control Loops in Boiler

3.1 Combustion control

3.2 Air / fuel ratio control, Furnace draft control, Drum level control

3.3 Main steam and reheat steam temperature control, super heater control, air temperature, Interlocks in boiler operation

UNIT V

Turbine Monitoring and Control

5.1 Speed, vibration, shell temperature monitoring and control

5.2 Steam pressure control

5.3 Lubricant oil temperature control, cooling system.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

RECOMMENDED BOOKS

1. Sam G. Dukelow, 'The Control of Boilers', Instrument Society of America, 2nd Edition,.
2. P.K. Nag, 'Power Plant Engineering', Tata McGraw-Hill, 1st Edition.
3. S.M. Elonka and A.L. Kohal, "Standard Boiler Operations", Tata McGraw-Hill, 1st Edition.
4. R K Jain, "Mechanical and Industrial Measurements", Khanna Publishers, 1st Edition.
5. E Al Wakil, "Power Plant Engineering", Tata McGraw-Hill, 1st Edition.
6. D. Patranabis, Principles of Industrial Instrumentation", Tata McGraw-Hill.
7. David Lindsley, Power Plant Control & Instrumentation", Institute of Electrical Engineers.

INSTRUCTIONAL STRATEGY

Efforts should be made to keep relevant instruments in the laboratory. It will be beneficial for students to visit different laboratories setup to show them equipments used in the relevant field. Students are required to prepare and submit a laboratory report on instruction/demonstration given by teacher and workshop activities done by students as a part of team work. This subject contains five units of equal weight age.

4.6.2 ELECTRIC VEHICLES

L	P
3	-

RATIONALE

Pollution of the environment is currently a global concern. Toxic emission from internal combustion engines is one of the primary air pollutants. In order to mitigate the effects of fossil fuel emission and address environmental concerns (ECs), electric vehicles (EVs) are being promoted aggressively all over the world. Various governments are encouraging people to switch to EVs by incentivizing the transition. Previous studies indicate that the high cost of the electric car, non-availability of charging infrastructure, time and range anxiety act as impediments to consumer adoption. The Government of India has given a call for 'only Electric Vehicles' on Road by 2030.

COURSE OUTCOME

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

CO1: Provide an overview of basics of electric vehicle history and components

CO2: Comprehend various properties of batteries, their charging and discharging.

CO3: Illustrate the electrical machine properties and measurement of electrical and non-electrical parameters involved electric vehicle drive systems

CO4: Describe control system and control loops applied in power plants.

CO5: Integrate electrical vehicles technology to understand the concepts of hybrid electric vehicles

DETAILED CONTENTS

UNIT I

Electric Vehicle Machines

Classification of the electric vehicles, understanding electric drivetrain
PMSM, PMBLDCM, SRM, synchronous reluctance motor, induction motor for EVs Social and Environmental importance of Hybrid and Electric Vehicles; Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics.

UNIT II

Electrochemical Cells

Energy storage devices such as Li-ion battery, supercapacitor, fuel cells, and flow batteries at cell level, Battery Management strategies.

Battery State of Charge Estimation, Battery Cell equalization problem, thermal control, protection interface, Energy & Power estimation, battery testing, Battery Leakage, Causes of battery explosions, Thermal Runway: High discharge rates, Short circuits, charging and discharging, Battery Standards

UNIT III

Power Electronics Interface

Analysis, modelling, design and control of switched-mode power converters, On-board Charger (AC/DC), Traction Inverter (DC/AC), battery DC-DC converters. Charging Infrastructure

Classification of EV charging infrastructure- AC chargers, DC chargers and Inductive charging. Indian and international standards for dc and ac EV charging.

UNIT IV

Hybrid Electric Vehicles: Types: Parallel, Series, Parallel and Series configurations; Drive train; Sizing of components; Basics of Micro, Mild, Mini, Plug-in and Fully hybrid.

Overview of Policies

Government policies relevant to electric vehicles.

RECOMMENDED BOOKS

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley
2. K. T. Chau, Electric Vehicle Machines and Drives: Design, Analysis and Application, June 2015 Wiley-IEEE Press.
3. Sudha Letha Shimi, Bollen Math, Impact of Electric Vehicle Charging on The Power Grid, Technical report / Luleå University of Technology.
4. Mehrdad Ehsani Yimin Gao, Sebastien E. Gay, Ali Emadi, , Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Fundamentals, Theory, and Design, CRC PRESS, New York.

INSTRUCTIONAL STRATEGY

Efforts should be made to keep relevant instruments in the laboratory. It will be beneficial for students to visit different laboratories setup to show them equipments used in the relevant field. Students are required to prepare and submit a laboratory report on instruction/demonstration given by teacher and workshop activities done by students as a part of team work. This subject contains four units of equal weight age.

4.6.3 ROBOTICS AND AUTOMATION

L	P
3	-

RATIONALE

The subject prepares students for design, interface, installation and troubleshooting of industrial automation systems. Emphasis is on electronics, electrical controls, motors, programmable logic controllers, servo systems, robotics, hydraulic and pneumatics. Students will integrate electronics and electrical controls, mechanical systems and programmable controllers and explore alternative trade-offs in the process of problem solving and troubleshooting.

COURSE OUTCOME

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

CO1: Understand the concepts of robotics and the need of robots in industrial applications

CO2: Describe the structure and working of different types of robots and end-effectors and select the same for a given application

CO3: Define the need and working of different types of actuators used in robotic systems and select the appropriate type of actuation system for a given application

CO4: Explain the function of different types of sensors for robot operation and its interaction with the environment

CO5: Familiarize with the robotic applications in industrial and commercial sectors

DETAILED CONTENTS

UNIT I

Introduction

Robotics and automation, Robot anatomy, Classification of robots, Specification of robots: DOF, Joints and axes, Load carrying capacity, resolution, accuracy, repeatability, precision etc. Application of robots in industrial and commercial sectors.

UNIT II

Kinematics

Introduction, The direct Kinematics and Inverse kinematic for three and four degrees of freedom Robot arms

UNIT III

Driver, Actuator and Control

Introduction to driver and actuator system, Different types of driver and actuator system, Hydraulic driver and actuator system, Pneumatic driver and actuator system, Electrical driver and actuator system

UNIT IV

Robot End effectors/Grippers

Introduction, Classification of end effectors, Drive system for Grippers, Mechanical, Magnetic, Vacuum, Adhesive Grippers, Active and Passive grippers.

UNIT V

Robot Sensors

Introduction to Analog Sensors, Different types of analog sensors, Introduction to Digital Sensors, Different types of Digital sensors, Selection of sensors for specific application, Sensor signal conditioning

RECOMMENDED BOOKS

1. Thomas R. Kurfess," Robotics and automation handbook" Publication CRC Press
2. Katsuhiko Ogata, " Modem Control Engineering " Publication Pearson
3. E. A. Pan, "Hydraulics and Pneumatics: A Technician's and Engineer's Guide", Publication Butterworth-Heineman.

INSTRUCTIONAL STRATEGY

Efforts should be made to keep relevant instruments in the laboratory. It will be beneficial for students to visit different laboratories setup to show them equipments used in the relevant field. Students are required to prepare and submit a laboratory report on instruction/demonstration given by teacher and workshop activities done by students as a part of team work. This subject contains five units of equal weight age.

4.7 MINOR PROJECT

L	P
-	6

RATIONALE

Minor project work will help in developing the relevant skills among the students as per National Skill Qualification Framework. It aims at exposing the students to the present and future needs of various relevant industries. It is expected from the students to get familiar with industrial environment. For this purpose, students are required to be involved in Minor Project Work relatedto different in different establishments.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

CO1: Define the problem statement of the minor project according to the need of industry.
CO2: Work as a team member for successful completion of minor project.
CO3: Write the minor project report effectively.
CO4: Present the minor project report using PPT.

GUIDELINES

Depending upon the interests of the students and location of the organization the student may be asked to visit. Depending upon the interest of the students, they can develop minor projects as per present and future demand of the relevant industry. The supervisors may guide the students to identify their minor project work and chalk out their plan of action well in advance. As a minor project activity each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes/activities. The supervisor may create a group of 4 to 5 students as per their interest to work as a team for successful completion of the minor project.

The supervisor shall evaluate the students along with one external expert by considering thefollowing parameters:

	Parameter	Weightage
i	Defining problem statement, focus and approach	20%
ii	Innovation / creativity	20%
iii	Report Writing	20%
iv	Power Point Presentation	20%
v	Viva - voce	20%

THIRD YEAR

NSQF LEVEL - 4

18. STUDY AND EVALUATION SCHEME

FIFTH SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
5.1	Industrial Training - II	-	2	**0+1=1**	-	40	40	-	60	60	100
5.2	*Entrepreneurship Development & Management	3	-	**3+0=3**	40	-	40	60	-	60	100
5.3	PLC, DCS and SCADA	3	4	**3+2=5**	40	40	80	60	60	120	200
5.4	Process Instrumentation	3	4	**3+2=5**	40	40	80	60	60	120	200
5.5	**Industrial Electronics and Control of Drives	3	4	**3+2=5**	40	40	80	60	60	120	200
5.6	IOT and IIOT Lab	-	6	**0+3=3**	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	3								
Total		**12**	**23**	**22**	**160**	**200**	**360**	**240**	**300**	**540**	**900**

* Common with other diploma programmes

** Common with diploma in Electrical Engineering

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
6.1	Industrial Communication Technologies	3	2	**3+1=4**	40	40	80	60	60	120	200
6.2	Biomedical Instrumentation	3	2	**3+1=4**	40	40	80	60	60	120	200
6.3	Multi-disciplinary Elective (MOOCs+/Offline)	2	-	**2+0=2**	40	-	40	60	-	60	100
6.4	Program Elective II	3	-	**3+0=3**	40	-	40	60	-	60	100
6.5	SCADA & HMI Lab	-	6	**0+3=3**	-	40	40	-	60	60	100
6.6	Industrial Training / Major Project	-	14	**0+7=7**	-	40	40	-	60	60	100
Total		**11**	**24**	**23**	**160**	**160**	**320**	**240**	**240**	**480**	**800**

+Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks**.**
** Common with diploma in Electrical Engineering

Program Elective-II: 6.4.1 Advance Measurement Techniques 6.4.2 Energy Management 6.4.3 ******Solar Panel Installation and Maintenance

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

19. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Third Semester	Fourth Semester
1.	Industrial Training - I	2	-
2.	Entrepreneurship Development & Management	3	-
3.	PLC, DCS and SCADA	7	-
4.	Process Instrumentation	7	-
5.	Industrial Electronics and Control of Drives	7	-
6.	IOT and IIOT Lab	6	-
7.	Industrial Communication Technologies		5
8.	Biomedical Instrumentation	-	5
9.	Multi-disciplinary Elective	-	2
10.	Program Elective II	-	3
11.	SCADA & HMI Lab	-	6
12.	Industrial Training / Major Project	-	14
13.	Student Centered Activities	3	-
	Total	**35**	**35**

20. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Instrumentation & Control Engineering** require **supervisors** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to their field. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall haveunderstanding of desired mathematical skills and understanding of social and naturalenvironment. They should be able to apply knowledge and skills to provide solutions to **Instrumentation & Control Engineering** problems in industry and governmental organizations or to enhance student learning in educational institutions. They are expected to collect, organize and communicate information effectively. They are expected to have good exposure of humanities, life skills, entrepreneur development and management to establish small start-ups.

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They may also have some responsibility for others' work and learning. Diploma engineers should depict ability to design a System, Component, or Process to meet desired needs with in realistic constraints such as Economic, Environmental, Social, Ethical, Manufacturability, and Sustainability.

Responsibilities typically include preparing and agreeing project budgets, timescales and specifications with clients and managers, creating test procedures, testing, evaluating, modifying and calibrating products and instruments, analysing and interpreting data and providing technical support.

Overall, the job opportunities for diploma holders in **Instrumentation & Control Engineering** are quite diverse, and employment can be found in a wide range of industries, including manufacturing, construction, Power generation companies, Manufacturers and installers of instruments and control devices/systems, Process companies, Self-employment via consultancy/contract work is possible for individuals with several years' experience.

21. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 5 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Demonstrate skills to use modern devices, software and equipment to analyse& solve problems in Instrumentation & Control Engineering

PO2: Acquire knowledge of facts, principles and processes related to Instrumentation & Control Engineering

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems of Instrumentation & Control Engineering.

PO4: Develop skills to collect, organize and communicate information with required clarity

PO5: Accomplish own work and supervise others work in various electrical applications

PO6: Adopt self-study learning by choosing multidisciplinary electives of own interest.

22. ASSESSMENT OF PROGRAM AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Demonstrate skills to use modern devices, software and equipment to analyse & solve problems in Instrumentation & Control Engineering	• Develop competencies and skills required by relevant industries. • Develop writing, speaking and presentations skills. • Install PLC software and Interfacing of PLC with PC. • Prepare a PLC ladder program for the given applications • Interface PLC with HMI and other devices • Interpret the importance of process variables and data acquisition. • Install and maintain various measuring instruments. • Demonstrate the characteristics of different power electronic switches • Apply the appropriate power converters for commercial and industrial applications. • Evaluate Telemetry performance. • Detail various instrumentation buses and fiber optic communication. • Illustrate electronic components for signal conditioning of biomedical signals. • Handle various Medical signal and image acquisition systems. • Use instruments for measurement of non-electrical quantities. • Perform troubleshooting of advance measurement instrument. • Perform energy audit using different energy audit instruments. • Interface the given PLC with the SCADA system. • Create and animate graphics for various

	applications using SCADA software. • Perform interfacing of PLC with HMI. • Define the problem statement of the Industrial training / Major project according to the need of industry.
PO2: Acquire knowledge of facts, principles and processes related to Instrumentation & Control Engineering	• Install PLC software and Interfacing of PLC with PC. • Interpret Ladder diagram and programming techniques. • Prepare a PLC ladder program for the given applications • Describe the concept of DCS & SCADA • Interface PLC with HMI and other devices • Demonstrate the characteristics of different power electronic switches • Illustrate the working of various power converters. Discuss control techniques for AC and DC drives using variable frequency drives. • Detail various instrumentation buses and fiber optic communication. • Identify various machinery and equipment found in health technologies. • Comprehend the importance of advance measurement techniques. • Discuss application of different types of proximity sensors • Acquire knowledge about solar tracking system • Interface the given PLC with the SCADA system. • Describe the steps to develop a simple SCADA screen for the given application. • Define the problem statement of the Industrial training / Major project according to the need of industry.

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems of Instrumentation & Control Engineering.	• Familiarize with the working environment of industries • Develop competencies and skills required by relevant industries. • Classify the various types of business and business organizations. • Identify the various resources / sources and / or schemes for starting a new venture. • Install PLC software and Interfacing of PLC with PC. • Interpret Ladder diagram and programming techniques. • Prepare a PLC ladder program for the given applications • Interface PLC with HMI and other devices • Install and maintain various measuring instruments. • Choose the proper measuring sensor/ instrument for specific measurement • Apply data processing in Data Acquisition System • Demonstrate the characteristics of different power electronic switches • Apply the appropriate power converters for commercial and industrial applications. • Handle different medical instruments used in Hospitals. • Describe the steps to develop a simple IOT application. • Design some IOT based prototypes • Develop some IIOT based project • Measure physiological parameters by appropriate instruments. • Handle various Medical signal and image acquisition systems

	• Use instruments for measurement of non-electrical quantities. • Perform troubleshooting of advance measurement instrument. • Comprehended the importance of non-conventional energy sources • Perform energy audit using different energy audit instruments. • Interface the given PLC with the SCADA system. • Create and animate graphics for various applications using SCADA software. • Describe the steps to develop a simple SCADA screen for the given application. • Perform interfacing of PLC with HMI. • Define the problem statement of the Industrial training / Major project according to the need of industry.
PO4: Develop skills to collect, organize and communicate information with required clarity	• Comprehend about present and future requirement of industries. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Develop writing, speaking and presentations skills. • Classify the various types of business and business organizations. • Identify the various resources / sources and / or schemes for starting a new venture. • Conduct market survey and prepare project report. • Detail modern means of transmission and reception of signals. • Write the Training / Major project report effectively.

PO5: Accomplish own work and supervise others work in various electrical applications	• Familiarize with the working environment of industries • Apply necessary safety precautions and measures. • Comprehend about present and future requirement of industries. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Identify the various resources / sources and / or schemes for starting a new venture. • Explain the principles of management including its functions in an organization. • Conduct market survey and prepare project report. • Identify various machinery and equipment found in health technologies. • Handle different medical instruments used in Hospitals. • Handle and maintain different medical instruments used in Hospitals. • Perform troubleshooting of advance measurement instrument. • Perform energy audit using different energy audit instruments. • Check site conditions, collect tools and raw materials • Maintain the work area safe and secure • Work as a team member for successful completion of Industrial training / Major project.
PO6: Adopt self-study learning by choosing multidisciplinary electives of own interest	• Apply critical thinking in problem solving. • Demonstrate self and time management. • Display analytical and research abilities. • Integrate multiple knowledge domains. • Enhance the scope and depth of learning.

23.SUBJECTS & CONTENTS
(THIRD YEAR)

FIFTH SEMESTER

5.1 INDUSTRIAL TRAINING-II

L	P
-	2

RATIONALE

Industrial training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It will also give exposure about the present and future requirements of the relevant industries. This training is very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Familiarize with the working environment of industries
CO2: Apply necessary safety precautions and measures.
CO3: Comprehend about present and future requirement of industries.
CO4: Work in team for solving industrial problems
CO5: Develop competencies and skills required by relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	Weightage
i	Industrial assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

5.2 ENTREPRENEURSHIP DEVELOPMENT & MANAGEMENT

L	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.

COURSE OUTCOMES

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

CO1: Comprehend the importance of entrepreneurship and its role in nation's development.
CO2: Classify the various types of business and business organizations.
CO3: Identify the various resources / sources and / or schemes for starting a new venture.
CO4: Explain the principles of management including its functions in an organization.
CO5: Conduct market survey and prepare project report.

DETAILED CONTENTS

UNIT I

Entrepreneurship: Concept and definitions, classification and types of entrepreneurs, entrepreneurial competencies, Traits / Qualities of entrepreneurs, manager v/s entrepreneur, role of Entrepreneur, barriers in entrepreneurship, Sole proprietorship and partnership forms of business organizations, small business vs startup, critical components for establishing a start-up, Leadership: Definition and Need, Manager Vs leader, Types of leadership

UNIT II

Definition of MSME (micro, small and medium enterprises),

Significant provisions of MSME Act, importance of feasibility studies, technical, marketing and finance related problems faced by new enterprises, major labor issues in MSMEs and its related laws, Obtaining financial assistance through various government schemes like Prime Minister Employment Generation. Program (PMEGP) Pradhan Mantri Mudra Yogna (PMMY) , Make in India, Start up India, Stand up India National Urban Livelihood Mission (NULM);

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).

UNIT III

Nature and Functions of Management

Definition, Nature of Management, Management as a Process, Management as Science and Art, Management Functions, Management and Administration, Managerial Skills, Levels of Management; Leadership.

PLANNING AND DECISION MAKING: Planning and Forecasting - Meaning and definition, Features, Steps in Planning Process, Approaches, Principles, Importance, Advantages and Disadvantages of Planning, Types of Plans, Types of Planning, Management by Objective. Decision Making-Meaning, Characteristics.

UNIT IV

Organising and Organisation Structure

Organizing Process - Meaning and Definition, Characteristics Process, Need and Importance, Principles, Span of Management, Organizational Chart - Types, Contents, Uses, Limitations, Factors Affecting Organizational Chart.

STAFFING: Meaning, Nature, Importance, Staffing process. Manpower Planning, Recruitment, Selection, Orientation and Placement, Training, Remuneration.

CONTROLLING AND CO-ORDINATION Controlling - Meaning, Features, Importance, Control Process, Characteristics of an effective control system, Types of Control. Co-ordination - characteristics, essentials.

UNIT V

Market Survey and Opportunity Identification, Scanning of business environment, Assessment of demand and supply in potential areas of growth, Project report Preparation, Detailed project report including technical, economic and market feasibility, Common errors in project report preparations, Exercises on preparation of project report.

RECOMMENDED BOOKS

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

SUGGESTED WEBSITES

1. https://ipindia.gov.in/

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. 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. This subject contains five units of equal weightage.

5.3PLC, DCS and SCADA

L	P
3	4

RATIONALE

A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of Programmable Logic Controllers, their working and their programming. PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design, modify and troubleshoot such control circuits. . Looking at the present industrial applications, this subject finds its usefulness in the present curriculum.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Install PLC software and Interfacing of PLC with PC.
CO2: Interpret Ladder diagram and programming techniques.
CO3: Prepare a PLC ladder program for the given applications
CO4: Describe the concept of DCS & SCADA
CO5: Interface PLC with HMI and other devices

DETAILED CONTENTS

UNIT I
Introduction to PLC

1.1 Definition and Concept of PLC
1.2 Building blocks of PLC, Functions of various blocks
1.3 Limitations of relays, Advantages of PLCs over electromagnetic relays.
1.4 Overview of different programming languages
1.5 PLC specifications and manufacturers

UNIT II
Working of PLC

2.1 Basic operation and principle of PLC
2.2 Scan Cycle

2.3 Memory structure, I/O structure

2.4 Sinking and Sourcing

2.5 Programming Languages and PLC Programmers

2.6 Programming Devices

2.7 Factors affecting selection of PLC as per industrial demands

UNIT III

PLC Ladder Programming

3.1 Basic instructions: Bit and Logical instructions

3.2 Timer instructions: ON, OFF and Retentive timers, resetting of timers.

3.3 Counter instructions: UP counter, DOWN counter, resetting of counters.

3.4 Arithmetic Instructions: ADD, SUB, DIV, MUL.

3.5 MOV instruction, RTC(Real Time Clock Function), Watch Dog Timer

3.6 Comparison instructions: Equal, not equal, greater, greater than equal, less than, less than equal.

UNIT IV

DCS & SCADA

4.1 Introduction and block diagram of DCS.

4.2 Introduction and block diagram of SCADA.

4.3 Comparison of DCS with SCADA

4.4 Application of SCADA in the field of Instrumentation & Control

4.5 Features of SCADA software

UNIT V

HMI (Human Machine Interface)

5.1 Introduction and concepts of HMI

5.2 Properties of HMI

5.3 Interfacing of HMI with PLC

5.4 Selection criteria of HMI

5.5 Comparison of HMI with SCADA

PRACTICAL EXERCISES

1. Show PLC modules and components in lab/industry or through online videos.
2. Demonstration of ladder diagram programming using NO, NC and OTE instructions.
3. Learning functions of different modules of a PLC system
4. Installation of PLC software and Interfacing of PLC with PC.
5. Practical steps in programming a PLC (a) using a hand held programmer (b) using computer interface.
6. Introduction to ladder diagram symbols, instruction list syntax.
7. Basic logic operations, AND, OR, NOT functions.
8. Develop and Test the ladder program for timer instructions.
9. Develop and Test the ladder program for Counter instructions.
10. Understand the working of Container filling process using a programmable logic controller.
11. Develop and Test the ladder program for Counter instructions.
12. Achieve motor forward and reverse direction control using a PLC.

13. Write a ladder diagram program for switching ON-OFF light.
14. Write a ladder diagram program for liquid level control.
15. Logic control systems with time response as applied to Traffic light control.
16. Sequence control system e.g. in lifting a device for packaging and Counting.
17. Ladder diagram for Motor Speed Control
18. Demonstration of Conveyor Belt System.
19. Ladder diagram for Water level Control or Reaction Vessel.
20. Ladder diagram for Star delta starter interface.
21. Practical steps for automatic bottle filling, capping and labelling process.
22. Practical steps for working of lift control through PLC
23. Show online videos to demonstrate the creation and animation of graphics for various applications using SCADA.
24. Industrial visit to monitor the actual working of PLC and SCADA.
25. HMI development and programming.

RECOMMENDED BOOKS

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2. Introduction to PLCs by Gary Dunning. McGraw Hill
3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh
4. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar.
5. Module on "Allen Bradlag PLC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
6. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
7. Instrument engineers Handbook - Process Control, Modern Control Techniques for Process Industries by G Liptak
8. Computer based Industrial Control - Krishan Kant, PHI
9. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.ac.in/course.html
3. http://www.bytronic.net/product-category/software/
4. https://fossee.in/

INSTRUCTIONAL STRATEGY

This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. Demo version of LADSIM may be used to complete the practical tasks if no other software is available for programming. Concept of DCS, SCADA should be supplemented with visits to relevant industry. More emphasis may be given to practical work. This subject contains five units of equal weightage.

5.4 PROCESS INSTRUMENTATION

L	P
3	4

RATIONALE

This course will impart students the importance of process variables and their measuring techniques in process industries, which includes different process measuring instruments and related transducers. The diploma holders of Instrumentation and Control will understand the importance and limitations of different measuring techniques of process variable. A data acquisition system is an essential tool used to collect and process data from various sources by an instrumentation engineer.

COURSE OUTCOMES

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

CO1: Interpret the importance of process variables and data acquisition.

CO2: Install and maintain various measuring instruments.

CO3: Choose the proper measuring sensor/ instrument for specific measurement

CO4: Apply data processing in Data Acquisition System

.

DETAILED CONTENTS

UNIT I
Temperature Measuring Instruments

1.1 Define Temperature as process variable, along with its importance and measuring units.

1.2 Construction, working principle, applications, advantages & disadvantages of the following

1.2.1 Thermocouples

1.2.2 RTD: PT100, two wire, three wire and four wire

1.2.3 Thermocouple

1.2.4 Thermistor

1.2.5 Thermostat

1.3 Non contact type temperature measurement

1.3.1 Radiation pyrometer

1.3.2 IR detectors

1.3.3 Fiber Optic Thermometer

UNIT- II

Pressure Measuring Instruments

2.1 Define Pressure as process variable, along with its importance and measuring units.

2.2 Construction, working principle, applications, advantages & disadvantages of the following:

2.2.1 Pressure Measurements using Manometers: U Tube, Well and Inclined Tube

2.2.2 Pressure Measurements using elastic elements: Bourdon Tube, Bellow, Diaphragm

2.2.3 Low Pressure Measurements: Mc Leod gauge, Pirani gauge

2.2.4 High Pressure Measurements: Bridgman Gauge

UNIT III

Flow Measuring Instruments

3.1 Define Flow as process variable, along with its importance and measuring units.

3.2 Construction, working principle, applications, advantages & disadvantages of the following.

3.2.1 Variable flow meter (Venturimeter and Orifice)

3.2.2 Rotameters

3.2.3 Electromagnetic flow meter

3.2.4 Turbine Flow Meters

3.2.5 Ultrasonic Flow Meters

UNIT IV

Level Measurements

4.1 Define Level as process variable, along with its importance and measuring units.

4.2 Construction, working principle, applications, advantages & disadvantages of the following.

4.2.1 Level Measurements using Pressure Transducers (Diaphragm and Bourdon tube)

4.2.2 Level Measurements using Electrical methods: Resistive, Inductive and Capacitive

4.2.3 Level Measurements using Gamma Rays

4.2.4 Level Measurements using Ultrasonic Method

UNIT V

Signal Acquisitions and Processing

5.1 Necessity of data processing in Instrumentation

5.2 Block diagram and explanation of a generalized Data Acquisition System

5.3 Objective of DAS

5.4 Signal Conditioning in DAS

5.5 Single channel and multichannel DAS

5.6 Block diagram explanation, characteristics of Data Logger

5.7 Comparison between DAS and Data Logger

PRACTICAL EXERCISES

1. Measurement of flow using Rotameter
2. Measurement of flow using Venturimeter and U-tube manometer
3. Measurement of Level using capacitive method
4. Measurement of Level using resistive method
5. Measurement of Pressure using U-tube manometer
6. Measurement of Pressure using Bourdon tube
7. Measurement of Temperature using IR detector
8. Temperature measurement using RTD.
9. Temperature measurement using Thermocouple.
10. Measurement of Temperature using Thermistor
11. Design an orifice plate for a typical application.
12. Measurement of Level using gamma rays.
13. Measurement of Level by Inductive method.
14. Level Measurements using Ultrasonic Method
15. Design a DAS for ten variables.
16. Create a VI to acquire an analog signal (voltage output) of LM35 temperature sensor on the DAQ signal accessory. Using a scaling factor (vx100 = oC) convert the voltage to temperature and display both voltage and temperature values.
17. Create a VI to read an analog input signal with noise through the data acquisition card and reduce noise in analog measurement by averaging. Find its arithmetic mean to average the signal. Plot both the acquired signal and averaged signal.
18. Design a data logger for an application.

RECOMMENDED BOOKS

1. RK Jain, " Mechanical and Industrial Measurements" Khanna Publishers, New Delhi
2. A K Sawhney, "Mechanical Measurement and Instrumentation" Dhanpat Rai and Co, New Delhi
3. HS Kalsi, "Electronic Instrumentation" Tata McGraw Hill.
4. K.P.Raju &Y.J. Reddy, " Introduction to Measurement and Instrumentation" Tata McGraw Hill.
5. Allen Morris, "The Essence of Measurement" PHI.
6. H.K.P. Neubert, " Instrument Transducer" Oxford University Press.
7. E-books/e-tools/relevantsoftwaretobeusedasrecommendedbyAICTE/HSBTE/ NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.a .in/course.html

INSTRUCTIONAL STRAGEGY

Since the subject is of practical nature, it is suggested that teacher must take the students for visit of nearby process industry and show them different measurement devices. It is also recommended that various measurement devices may be brought in the lab for demonstration purpose. Student may be encouraged to explore the information on the virtual labs. This subject contains five units of equal weightage.

5.5 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

L	P
3	4

RATIONALE

Industrial electronics and drives play a very vital role in operation and controlling the modern industries which are more efficient, effective and precise as compare to the conventional methods.. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels, is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance of the subject this has been incorporated in the curriculum.

COURSE OUTCOMES

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

CO1: Demonstrate the characteristics of different power electronic switches

CO2: Illustrate the working of various power converters.

CO3:. Discuss control techniques for AC and DC drives using variable frequency drives.

CO4: Apply the appropriate power converters for commercial and industrial applications.

DETAILED CONTENTS

UNIT I
Introduction to Thyristors

1.1. Classification of Thyristors
1.2. Construction, working principle and V-I characteristics of SCR, DIAC, TRIAC
1.3. Two transistor analogy of SCR
1.4. Selection of heat sinks for Thyristors
1.5. Methods of triggering a Thyristor and their types, dv/dt and di/dt protection.
1.6. Commutation of Thyristors

1.7. UJT: Construction, working principles and V-I characteristics. UJT as a relaxation oscillator
1.8. Applications of SCR, DIACS and TRIACS such as light intensity control, speed control of DC and universal motor, fan regulator ,battery charger etc.

UNIT II

Controlled rectifiers

2.1 Single phase half wave controlled rectifier with resistive load and inductive load, concept of freewheeling diode.
2.2 Single phase half controlled full wave rectifier.
2.3 Single phase full controlled full wave rectifier.
2.4 Single phase full wave centre tapped rectifier.
2.5 Three phase full wave half controlled bridge rectifier.
2.6 Three phase full wave fully controlled bridge rectifier.

UNIT III

Inverters, Choppers, Dual Converters and Cyclo-Convertors

3.1 Inverters: Introduction, working principle, voltage and current driven, series and parallel inverters and applications.
3.2 Choppers: Introduction, types of choppers and their working principle and applications.
3.3 Dual converters: Introduction, working principle and applications.
3.4 Cyclo-converters: Introduction, types, working principle and applications.

UNIT IV

Thyristor Control of Electric Drives

4.1 Concept of electric drive**,** Advantages of Electric drives.
4.2 DC drives control: Half wave drives, Full wave drives, Chopper drives.
4.3 AC drives control: Phase control, Variable frequency AC drives, Constant V/f control
4.4 Cyclo convertors controlled AC drives.
4.5 Concept of Electric Braking for AC Drive.

UNIT V

Power Converter Applications

5.1 Uninterrupted Power supply (UPS): Working Principle of Online and off Line UPS.
5.2 Switch mode Power Supply (SMPS): Working Principle and use.
5.3 Power Converter for Electrical Vehicle charging.
5.4 Power Converter for Renewable Energy: solar and wind.

PRACTICAL EXERCISES

1. To draw V-I characteristics of an SCR.
2. To draw V-I characteristics of a TRIAC.
3. To draw V-I characteristics of a DIAC.
4. To draw uni-junction transistor characteristics.
5. To observe the output wave shape of an UJT relaxation oscillator.
6. To observe the output waves shape on CRO of Single phase half controlled full wave rectifier.
7. To observe the output wave shape on CRO of Single phase full controlled full wave rectifier.
8. Illumination control circuit using SCR/TRIAC and observe the wave shape across load.
9. Speed-control of a DC shunt motor or universal motor using SCR/TRIAC.
10. Fan speed regulator using TRIAC.
11. To study the Construction of battery charger using Thyristor.
12. Testing and Installation of UPS.

RECOMMENDED BOOKS

1. John Webb, Kevin Greshock, Maxwell, “Industrial Control Electronics”, Macmillan International editions.
2. S Rama Reddi, “Fundamentals of Power Electronics” Narosa Publishing House Pvt. Ltd, New Delhi.
3. Mohammad H. Rashid, “ Power Electronics, Circuits Devices and Applications”.
4. Dr. P S Bhimbra, “ Power Electronics” Khanna Publishers, New Delhi.

5. S K Bhattacharya & S Chatterji, " Industrial Electronics & Control" New Age International Publications (P) Ltd, New Delhi.
6. S K Sahdev, "Power Electronics" Uneek Publication, Jalandhar.
7. Samir K Datta, " Power Electronics and Controls" Prentice Hall of India, New Delhi.
8. E-books / e-tools /relevant software to be used as recommended by AICTE/ HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.a .in/course.html

INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

5.6 IOT and IIOT

L	P
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RATIONALE

Today we live in an era of connected devices (mobile phones, computers etc.), the future is of connected things (eg: home appliances, vehicles, lamp-posts, personal accessories, your pets, industrial equipments and everything which you use in day-to-day life). Internet of Things is a term given to the attempt of connecting objects to the internet and also to each other - allowing people and objects themselves to analyze data from various sources in real-time and take necessary actions in an intelligent fashion

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Familiarize with different families and architectures of Internet of things
CO2: Describe the steps to develop a simple IOT application.
CO3: Design some IOT based prototypes
CO4: Develop some IIOT based project

PRACTICAL EXERCISES

1. Introduction to Arduino and ESp8266
2. Introduction to Raspberry Pi.
3. Introduction to ThingSpeak IoT analytics open source platform
4. Modules and Interfacing of sensors like IR sensor, Ultrasonic sensors, Soil moisture sensor using Arduino or raspberry pi.
5. Modules and Interfacing of actuators like Relay, Motor, Buzzer using Arduino or raspberry pi.
6. IoT Based Temperature and Humidity Monitoring over ThingSpeak using Arduino and ESP8266 / Raspberry Pi. (https://iotdesignpro.com/projects/temperature-humidity-monitoring-over-thingspeak-using-arduino-esp8266)
7. Measurement of temperature and pressure of the process using Arduino or raspberry pi.

8. Demonstration of MQTT communication.
9. Demonstration of LoRa communication.
10. Visualization of diverse sensor data using dashboard of control panel.
11. Sending alert message to the user to control and interact with your environment.
12. Device control using mobile Apps or through Web pages.
13. Demonstration of Machine to Machine communication.
14. Industrial visit to monitor the actual working of Industrial IoT.

Projects (students should develop any one project)
(https://iotdesignpro.com/iot-arduino-projects?page=2)

1. IoT-Based Remote Patient Monitoring System to Measure Vital Body Signs.
2. Smart phone / web controlled Home Automation.
3. IoT Based Wireless Weather Station.
4. IoT based condition monitoring/ speed control of industrial motors.
5. IoT based Smart Agriculture Monitoring System

RECOMMENDED BOOKS

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
2. Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.a .in/course.html

INSTRUCTIONAL STRATEGY

This is hands on practice based laboratory for development of required automation skills in the students. Various KITS AND OPEN SOURCE software should be used to complete the practical tasks if no other software is available for programming. Small industrial problems may be taken as assignments.

SIXTH SEMESTER

6.1 INDUSTRIAL COMMUNICATION TECHNOLOGIES

L	P
3	2

RATIONALE

This subject gives introduction to the basic communication techniques which forms a foundation for understanding practical methods used in industries. Study of Digital Data communication is essential for modern means of information transmission and reception like mobile, Ethernet and other satellite based communication. Communication transducer measurements may also be implemented using the same principle which is the main objective of instrumentation engineer.

COURSE OUTCOMES

After undergoing this course, the student will be able to:

.

CO1: Identify different Telemetry system and transmitters.

CO2: Detail modern means of transmission and reception of signals.

CO3: Evaluate Telemetry performance.

CO4: Detail various instrumentation buses and fiber optic communication.

DETAIL CONTENTS

UNIT I
Telemetry

1.1 Introduction and applications of telemetry.
1.2 Telemedicine
1.3 Block Diagram of general telemetry system.
1.4 Land Line Telemetry: Voltage, current and position Telemetry.

UNIT II
R.F. Telemetry

2.2 Introduction
2.2 Need for modulation & demodulation in signal transmission
2.3 Basic idea on amplitude and Frequency modulation (no derivation)

2.4 Pulse modulation: (P.A.M.and P.C.M)
2.5 Comparison of FM, P.A.M and P.C.M

UNIT III
Transmitter

3.1 Pneumatic Transmitter
- 3.1.1 PDPT bellow type.
- 3.1.2 PDPT diaphragm type.
- 3.1.3 Force balance type.

3.2 Hydraulic Transmitter: Bellow type.

3.1 Electric Transmitter

3.4 Inductive Transmitter.

UNIT IV
Data Transmission and channels

4.1 4-20 mA current transmission, live and dead zero.
4.2 Wire line channel
4.3 Radio channel
4.4 Multiplexing channels
- 4.4.1 Need of Multiplexer in data transmission
- 4.4.2 TDM
- 4.4.3 FDM

4.5 Idea on analog and digital data transmission
4.6 Advantage and disadvantage of digital data transmission over analog data transmission.

UNIT V
Instrumentation Buses

5.1 General view of instrumentation buses.
5.2 GPIB.
5.3 Interbus and Profibus/Profinet.
5.4 Ethernet/LAN.
5.5 HART Communication Protocol.
5.6 Fibre Optic Communication.

PRACTICAL EXERCISES

1. Demonstration of hydraulic transmitter.
2. Demonstration of Pneumatic transmitter.
3. Generate and observe AM&FM waves on CRO.
4. Calculate modulation index for AM&FM.
5. Study of PDPT Diaphragm type Pneumatic Transmitter.
6. Study bellow type hydraulic transmitter.
7. Study Resistive transmitter.
8. Familiarization & study of voltage, current telemetry system.
9. Study wireline and radio channels.
10. Install and configure a network interface card in a workstation.
11. Identify the IP address of a work station and the class of the address and configure the IP Address on a workstation.
12. Visit to nearby industry for latest networking techniques.
13. Create a network of at least 6 computers.
14. Observe wave forms of PAM and PCM on CRO.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.a .in/course.html

RECOMMENDED BOOKS

1 Mechanical and industrial measurements by R.K. Jain.
2 Modern Control Engineering by Ogata.
3 Electrical and Electronic measurements and Instrumentation by A.K. Sawhney, Dhanpat Rai Publications.
4 Data Communications and Networking by BehrouzA. Forouzan, McGraw-Hill publications, 4th addition 1st July 2017.
5 HART Communication Protocol, Practice guide by James Powell, Independently published.
6 Optical fiber communications principles and practice by John. M. Senior by Person publications.

7 Communications system by Dr. Sanjay Sharma,S.K.Kataria and publication2013.
8 E-books/e-tools/relevantsoftwaretobeusedasrecommendedbyAICTE/HSBTE/ NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.a .in/course.html

INSTRUCTIONAL STRATEGY

The Teacher should explain the background and importance of the subject. Lay emphasis on the meaning of various terms, working of telemetry and communication and their applications may be explained to students. Reinforce theory with practical. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

6.2 BIOMEDICAL INSTRUMENTATION

L P
3 2

RATIONALE

Recent advances in medical field have been fuelled by the instruments developed by the Electronics and Instrumentation Engineers. This subject will enable the students to learn the basic principles of different instruments/equipment used in health care industry. The practical work done in this area will impart skill in the use, servicing and maintenance of these instruments/equipment. Proficiency in this area will enhance the knowledge and skill of diploma holders in the field of biomedical instrumentation.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Identify various machinery and equipment found in biomedical technologies.
CO2: Handle and maintain different medical instruments used in Hospitals.
CO3: Measure physiological parameters by appropriate instruments.
CO4: Handle various Medical signal and image acquisition systems.

DETAILED CONTENTS

UNIT I
Introduction to Biomedical Instruments

1.1 Generalized block diagram of a medical instrumentation system.
1.2 Types of instruments
1.3 Therapeutic Instruments
1.4 Clinical Laboratory Instruments
1.5 Diagnostic Instruments
1.6 Physiological systems of human body
- Cardiovascular system
- Respiratory system
- Nervous system
- Bio-chemical system

UNIT II

Signal Conditioning

2.1. Introduction to Operational Amplifier

2.1.1 Characteristics of an ideal operational amplifier and its block diagram

2.1.2 IC -741 and its pin configuration

2.1.3 Definition of differential voltage gain, CMRR, slew rate and input Off set current

2.1.4 Operational amplifier as an inverting mode & non inverting mode, Adder, Subtractor, Differentiator and Integrator.

2.1.5 OP- Amp. As an Instrumentation amplifier

UNIT III

Bio-medical Signals and Electrodes

3.1 Elementary idea of cell structure.

3.2 Bio-electric potentials

3.3 Resting and action potentials

3.4 Bio-electrodes

3.5 Electrode – tissue interface

3.6 Contact impedance

3.7 Types of electrodes

UNIT IV

Medical Instruments

Overview, working principle of the following

4.1 Electro cardiograph(ECG)

4.2 Electro encephalograph (EEG)

4.3 Electromyograph (EMG)

4.4 Pacemakers

4.5 Defibrillators

4.6 Pulse oxymeter SPO_2

4.7 Blood pressure measurement

4.8 Glucometer

4.9 Ventilators

UNIT V
Medical Imaging system

Introduction, block diagram and working principle of following:

5.1 X-Ray
5.2 CT Scan
5.3 MRI
5.4 Ultrasound

LIST OF PRACTICALS

1. To measure blood pressure of a person using analog and digital B.P. instruments.
2. To analyze ECG response generated from bipolar limb leads and chest leads.
3. To analyze EEG response generated from different lobes.
4. To understand normal ECG waveform and various abnormalities associated with ECG pattern.
5. To simulate the defibrillator output waveform.
6. To simulate the pacemaker output waveform.
7. To understand normal EEG waveform and various abnormalities associated with EEG pattern.
8. Visit of Intensive Care Units (ICUs), to study the concept of portable oxygen concentrator and ventilator.
9. Visit of Hospital for familiarization of CAT scan and MRI
10. Measurement of blood sugar of a patient using glucometer.
11. Measurement of SPO_2 using pulse oxymeter.
12. To measure lungs capacity using Spirometer.
13. Familiarization of different types of electrodes used for EEG and EMG.
14. Demonstration of X-ray machine at hospital.
15. Demonstration of Ultrasound in hospital.
16. Demonstration of Ventilators in hospital.

Some of the experiments should be performed on Virtual lab platform which is free source platform

RECOMMENDED BOOKS

1) Biomedical Instrumentation and Measurements by Cromwell; Prentice Hall of India, New Delhi.
2) Hand book of Medical Instruments by RS Khandpur.
3) Medical Electronics and Instrumentation by Sanjay Guha -University Publication.
4) Bio-Medical Instruments by KR Nahar
5) Introduction to Biomedical Equipment Technology by Carr, Pearson Education, Sector- 62, Noida.
6) Servicing Medical and Bio-electronic Equipment by Carl JJ.
7) Electronics for Medical Personnel by Buckstein
8) Electrical and Electronic Measurement and Instrumentation by AK Sawhney; Dhanpat Rai and Co., New Delhi
9) E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.ac.in/course.html
3. https://www.vlab.co.in/

INSTRUCTIONAL STRATEGY

In addition to classroom teaching, maximum stress may be given on practical exposure in nearby hospitals, clinics, biomedical laboratories etc. Expert lectures may be arranged from field/organization related to biomedical instruments and students may be taken to nearby hospitals on visit. This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

6.3 MULTI-DISCIPLINARY ELECTIVE

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RATIONALE

Multidisciplinary electives are very important and play major role in implementation of National Education Policy. Multidisciplinary is a subject which is useful for two or more disciplines in which students are asked to understand the concept of multidisciplinary or interdisciplinary. It will help the students to gain an arsenal of skills that are easily transferable across work environments.

COURSE OUTCOMES

At the end of the multidisciplinary elective, the students will be able to:

CO1: Apply critical thinking in problem solving.
CO2: Demonstrate self and time management.
CO3: Display analytical and research abilities.
CO4: Integrate multiple knowledge domains.
CO5: Enhance the scope and depth of learning.

LIST OF MULTIDISCIPLINARY ELECTIVES

(The list is indicative and not exhaustive)

1. Introduction to Internet of Things
2. Introduction to Robotics
3. Introduction to Embedded System Design
4. Fundamentals of Artificial Intelligence
5. Digital Image Processing
6. Introduction to Machine Learning
7. Block Chain
8. The Joy of Computing Using Python
9. Cloud Computing
10. Introduction to Industry 4.0
11. Industrial Internet of Things
12. Object Oriented System Development using UML, Java and Patterns

GUIDELINES

Multidisciplinary Elective shall be offered preferably in online mode. Online mode multidisciplinary elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of multidisciplinary electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online multidisciplinary electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline multidisciplinary electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs multidisciplinary elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable multidisciplinary elective is available online, only then the course may be conducted in offlinemode. The assessment of offline multidisciplinary elective shall be internal and external. The offline multidisciplinary elective internal assessment of 40 marks shall be based on internal sessional tests, assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

6.4 PROGRAM ELECTIVE II

6.4.1 ADVANCE MEASUREMENT TECHNIQUES

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RATIONALE

The syllabus has been designed to impart knowledge about various measurement techniques to the students. The subject deals with the measurement principles and techniques of process parameters like length, area, angle, vibration, force, density, viscosity, distance and thickness etc.

COURSE OUTCOMES

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

CO1: Comprehend the importance of advance measurement techniques.
CO2: Discuss application of different types of proximity sensors
CO3: Use instruments for measurement of non-electrical quantities.
CO4: Perform troubleshooting of advance measurement instrument.

DETAILED CONTENTS

UNIT I

Review of Measurement System

1.1 Functional elements of a measuring system

1.2 Input – output configuration of instrumentation system

UNIT II

Measurement of (Length, Angle & Area)

2.1 Length Measuring Standard Instruments (Meter Rods, Scale, Tapes, Micrometre, Vernier Calliper)

2.2 Angle Measuring Standard Instruments (Protector, Clinometers and Dial Bevel Protractor)

2.3 Area Measuring Standard Instruments (Graphical Method and Numerical Method)

UNIT III

Measurement of Vibration (Velocity & Vibration)

3.1 Linear Velocity Measurement by using (Electro Magnetic, Seismic, Doppler, Digital Transducer)

3.2 Angular Velocity Measurement by using

3.2.1 Tachogenerator (Photo Electric, Tooth Rotor Variable Reluctance)

3.2.2 Stroboscope Methods

3.3 Vibration Measurement by using Seismic Transducer (Potentiometric, LVDT, Strain Gauge Accelerometers)

UNIT IV

Proximity Sensors and Load Cell

4.1 Definition and importance of proximity sensors in instrumentation field

1.2 Description & application of different types of proximity sensors such as Inductive, optical, magnetic, capacitive, ultrasonic types .

4.3 Load cell- column type, shear type, application of load cells in industries.

UNIT V

Miscellaneous Measurements

5.1 Measurement of density and specific gravity: Hydrometer, LVDT, Gamma Rays, Force Balance Methods.

5.2 Measurement of PH value.

5.3 Measurement of Viscosity: falling sphere, falling piston and rotating cylinder viscometer.

5.4 Measurement of Thickness: Resistive, Capacitive, Inductive, Nuclear and Ultrasonic methods.

RECOMMENDED BOOKS

1. Measurement systems, Application and Design – E.O Doeblin, McGraw Hill International Editions
2. A Course in Electrical and electronics Measurement and Instrumentation by AK Sawhney; Dhanpat Rai and Co Pvt. Ltd., New Delhi

3. Mechanical and Industrial Measurement by R K Jain, Khanna Publishers, New Delhi.
4. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.ac.in/course.html
3. https://www.vlab.co.in/

INSTRUCTIONAL STRAGEGY

Since the subject is of practical nature, it is suggested that teacher must take the students for visit of nearby process industry and show them different measurement devices. It is also recommended that various measurement devices may be brought in the lab for demonstration purpose. Student may be encouraged to explore the information on the Net. In addition, expert lecturers may also be arranged from outside experts. This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

6.4.2 ENERGY MANAGEMENT

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RATIONALE

This course will enable the students to discuss and apply the concept, principle of various energy storage methods and also examine, apply, analyse different energy efficient technologies, various methods of energy conservation and energy audit. The Instrumentation & Control diploma holder must be made aware about latest energy efficient technologies and tackle the problems of environmental pollution as they will have to face this challenge in future life.

COURSE OUTCOMES

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

CO1: Comprehended the importance of non-conventional energy sources

CO2: Detail various Energy storage methods

CO3: Use Energy efficient technology in Domestic and Industrial Sector.

CO4: Perform energy audit using different energy audit instruments.

DETAILED CONTENTS

UNIT I
Introduction

1.1 Energy and its sources.

1.2 Types of Energy Sources and their advantages and disadvantages.

1.3 Difference between renewable and non-renewable energy sources.

1.4 Present energy scenario in India, Sector wise consumption i.e. Domestic, Industrial and Agriculture.

UNIT II
Renewable Energy

2.1 Type of renewable energies.

2.2 Methods of obtaining energy (Thermal and electricity) from solar.

2.3 Concept of MPPT.

2.4 Methods for obtaining energy from bio mass.

2.5 Principle of wind energy conversion.

2.6 Other Non-Conventional Energy Sources –

2.6.1 Magneto Hydro Dynamic Convertor (MHD).

2.6.2 Tidal.

2.6.3 Geo-Thermal.

2.6.4 Ocean.

UNIT III

Energy Conservation

3.1 Definition.

3.2 Need and importance of energy conservation.

3.3 Use of Energy efficient technology in Domestic and Industrial Sector.

3.4 Energy Conservation by Improving Load Factor and Power Factor.

3.5 Type of tariff structure for electricity.

3.6 Use of Instrumentation & Control for energy conservation.

UNIT IV

Energy Storage

4.1 Need of energy storage.

4.2 Energy storage methods and their advantages and disadvantages.

4.3 Working Principle and applications of

4.3.1 Secondary batteries.

4.3.2 Fuel cells.

4.3.3 Hydrogen energy system.

UNIT V

Energy Audit

5.1 Definition.

5.2 Need for Energy Audit.

5.3 Methodology for preliminary and detailed energy audit.

5.4 Energy audit instruments.

RECOMMENDED BOOKS:

1. Solar Energy – Principles of thermal collection and Storage SP Sukhatme, Tata McGraw Hill Publication, New Delhi.
2. Non-Conventional Energy Resources by RK Singal, SK Kataria and Sons, New Delhi.
3. Solar Energy Utilization; GD Rai ; Khanna Publishers, New Delhi.
4. Renewable Energy Sources and Conversion Technology by NK Bansal, Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.
5. Guidebook on Energy Efficiency in Thermal Utilities, Bureau of Energy Efficiency, Government of India.
6. Guidebook on Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency, Government of India.
7. Guidebook on General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, Government of India.
8. Energy Management, Dr. Sanjeev Singh, Umesh Rathore, S.K. Kataria & Sons, 2014.
9. Manual on Energy Efficiency at Design Stage, CII Energy Management Cell.
10. Non – conventional Energy Sources by G. D. Rai, Khanna Publications.
11. E-books / e-tools / relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://nptel.ac.in/course.html

INSTRUCTIONAL STRATEGY

The teacher should make the students aware about the depletion of energy sources and the availability of alternate sources of energy their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. While explaining the need and energy management, the teacher should give students home assignments bases on energy conservation. The students should be made familiar with the energy efficient devices, various approaches to conserve energy, energy auditing procedure etc. Teacher must give practical application of these energy sources in nearby surrounding areas. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

6.4.3 SOLAR PANEL INSTALLATION AND MAINTENANCE

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RATIONALE

To train the person, who checks the installation site, understands the layout requirement as per design, assesses precautionary measures to be taken, installs the solar panel as per customer's requirement and ensures effective functioning of the system post installation.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO1: Check site conditions, collect tools and raw materials
CO2: perform placement of solar panel mounting
CO3: Acquire knowledge about solar tracking system
CO4: Maintain the work area safe and secure

DETAIL CONTENTS

UNIT I

Check site conditions, collect tools and raw materials

1.1. Basics on solar energy and power generation systems
1.2. Use and handling procedure of solar panels
1.3. Energy storage, control and conversion
1.4. Basic electrical system and functioning
1.5. Mechanical equipment and its functioning
1.6. Maintenance procedure of equipment
1.7. Site survey, design and evaluation of various parameters
1.8. Tools involved in installation of system
1.9. Quality and process standards
1.10. Occupational health and safety standards

UNIT II

Installation of Solar Panel

2.1 Solar energy system components such as panels, batteries, charge controllers, inverters.
2.2 Significance of volts, amps and watts: series and parallel connection
2.3 Voltage requirement of various equipment
2.4 Panel mounting and inclination and angle of tilt
2.5 Placement of solar panel mounting
2.6 Sunlight and direction assessment
2.7 Site surveying methods and evaluation parameters
2.8 Tools involved in installation of system

UNIT III

Coordinate colleagues at work

3.1 Company's policies on incentives, delivery standards, and personnel management.
3.2 Importance of the individual's role in the workflow
3.3 Reporting structure
3.4 Communicating effectively
3.5 Building team coordination

UNIT IV

Safety at workplace

4.1 Maintaining the work area safe and secure
4.2 Handling hazardous material
4.3 Operating hazardous tools and equipment
4.4 Emergency procedures to be followed such as fire accidents, etc.

UNIT V

Concept of Solar Tracking System

RECOMMENDED BOOKS

1. Solar Panel Installation Guide & User Manual (Indian Edition) (E book) Solar Electrical Energy By N L Sharman

2. D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, “Principles of Solar Engineering”, Taylor & Francis, 2000, Indian reprint, 20032.
3. “Fundamentals for solar energy conversion” by Edward E. Anderson; Addison Wesley Publ. Co., 1983
4. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

1. http://swayam.gov.in

INSTRUCTIONAL STATREGY

Teachers should lay emphasis on concepts and principles while imparting instructions. As far possible, subject teaching should be supplemented by demonstrations in the laboratory. During practical work, individual students should be given opportunities to perform practicals independently. In addition, expert lecturers may also be arranged from outside experts. This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

6.5 SCADA & HMI LAB

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RATIONALE

In the present global scenario of manufacturing, industries are moving towards complete automation. Small and medium scale industries are in the phase of switching to PLC, SCADA and HMI technology for the data acquisition and control. Therefore, it is necessary for Instrumentation engineers to have knowledge of both SCADA and HMI technology. Hence this course is foundation for the engineers who want to further specialize in the Industrial automation field.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Interface the given PLC with the SCADA system.
CO2: Create and animate graphics for various applications using SCADA software.
CO3: Prepare a simple SCADA application.
CO4: Describe the steps to develop a simple SCADA screen for the given application.
CO5: Perform interfacing of PLC with HMI.

DETAILED CONTENTS

Practical Exercises of SCADA

1. Familiarization with SCADA software.
2. Create a new project in SCADA software.
3. To study various tags & their types.
4. To study different properties of SCADA software.
5. Use various function of SCADA simulation editors to develop simple project.
6. Develop SCADA animation for Flow control of the given system.
7. Design an application for Automatic bottle filling, capping and labelling process.
8. Simulate Tank level control using available SCADA system software.
9. Design a process animation for chemical mixture plant.
10. Design an animation for metal cutting process.
11. Design an animation for metal drilling process in SCADA.

12. Animation for building lift control.
13. Animation for Automatic car parking.
14. How to make a crank simulator using SCADA software.
15. Design an animation for Elevator using SCADA software.
16. Make a traffic light control system using SCADA software.
17. Make a digital clock in SCADA.
18. Make a recipe for soft drinks using SCADA software.

Practical Exercises of HMI

1. Familiarization with HMI Hardware & Software.
2. Interfacing of PLC with HMI.
3. Understanding tags & their types.
4. Features of HMI Software.
5. Design logic for digital I/O.
6. Designed simple program for energising /de-energising the O/P of PLC through HMI.
7. Read/Write the analog I/O of PLC through HMI.
8. Design an animation for P&I diagram of any process.
9. Use HMI software for an application (Teacher may decide any two).

RECOMMENDED BOOKS

1 Mehra, Rajesh, and Vikrant Vij, “PLCs & SCADA Theory and Practices”, Laxmi Publication, Delhi.
2 Supervisory Control and Data Acquisition, Fourth Edition by Stuart A Boyer
3 SCADA: Beginner's Guide by Francis G.L (Author)
4 Human Machine Interface: Concepts and Projects by Dr. Samuel Guccione

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://wonderware-intouch.software.informer.com/10.1/
3. https://citectscada.software.informer.com/download/
4. https://rsview32.software.informer.com/7.0/
5. https://download.rockwellautomation.com/
6. https://www.vlab.co.in/
7. www.amazon.in/PLCs-SCADA-Practice-Rajesh-Mehra-ebook/dp/B07568SYLK

INSTRUCTIONAL STRATEGY

This is hands on practice based laboratory for development of required automation skills in the students. Demo version of any SCADA software may be used to complete the practical tasks if no other software is available for programming. Small industrial problems may be taken as assignments.

6.6 INDUSTRIAL TRAINING / MAJOR PROJECT

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RATIONALE

Industrial Internship / Major project work will help in developing the relevant skills among the students as per National Skill Qualification Framework. It aims at exposing the students to the present and future needs of various relevant industries. It is expected from the students to get acquainted with desired attributes for industrial environment. For this purpose, students are required to be involved in industrial training / Major Project Work in different establishments.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

CO1: Define the problem statement of the Industrial training / Major project according to the need of industry.

CO2: Work as a team member for successful completion of Industrial training / Major project.

CO3: Write the Training / Major project report effectively.

CO4: Present the Training / Major project report using PPT.

GUIDELINES

Depending upon the interest of the students, they can go for Industrial training / Major project as per present and future demand of the industry. The supervisors may guide the students to identify their project work and chalk out their plan of action well in advance. As an Industrial training / Major project activity each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes/activities. The supervisor may create a group of 4-5 students as per their interest to work as a team for successful completion of the Industrial training / Major Project

The supervisor shall evaluate the students along with one external industry / academic expert by considering the following parameters:

	Parameter	**Weightage**
I	Defining problem statement, focus and approach	20%
ii	Innovation / creativity	20%
iii	Report Writing	20%
iv	Power Point Presentation	20%
v	Viva - voce	20%

24. ASSESMENT TOOLS AND CRITERION

The assessment is carried out by conducting:

1. Formative assessments
2. Summative assessments

1. FORMATIVE ASSESSEMENT

The **formative assessment** will be evaluated on the basis of the internal assessments for theory subjects and practical by the concerned teachers for evaluating the knowledge and skill acquired by students and the behavioral transformation of the students. This **internal assessment** is primarily carried out by collecting evidence of competence gained by the students by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports, and sessional marks are awarded to them.

2. SUMMATIVE ASSESSMENT

The **summative assessment** will include end semester examination for theory part for each candidate and practical examination with viva voice. Each Performance Criteria will be assigned marks proportional to its importance and proportion of marks for Theory and Skills Practical for each subject should be laid down.

The following assessment tools are used for effective student evaluation:

1. Theory Examinations
2. Practical Work
3. Internships
4. Professional Industrial Training
5. Project Work (Minor & Major)
6. Massive Open Online Courses (MOOCs)
7. Viva Voce
8. Case Studies

1. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems.

The **formative evaluation** for theory subjects may be caused through

i. Sessional /class-tests,
ii. Quizzes,
iii. Assignments,
iv. Seminars/ Presentations
v. Attendance
vi. Case Studies

For **Summative evaluation** of theory, the question paper may comprise of three sections.

i. It should contain objective type question and multiple choice questions. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.
ii. It should contain short answer questions.
iii. Descriptive type questions, with some internal choice of the questions set may be given in this section.

2. Practical Assessment

Evaluation of students performance in practical work (Laboratory experiments, Workshop practical /field exercises) aims at assessing students ability to apply or practice the concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. This will comprise of a creation of mock environment, wherever applicable in the skill lab which is equipped with all required equipment for development of desired skills. Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. will be ascertained by observation and will be marked in observation checklist along with the assessment of Job carried out in labs and maintenance of Lab Record files.

Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject. The end product will be measured against the specified dimensions and standards to gauge the level of his skill achievements

3. Internship

The two mandatory internships after I Year and II Year of the programme are to be assessed in 3rd and 5th semester subsequently. The internships should be preferably done in the field/ in the industry, can be in house depending upon the stream and availability of resources in and around the institute.

Every faculty should be assigned the students and made responsible for the evaluation and assessment of the internship. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weightages on the basis of report submission/ presentation followed by viva-voce of the relevant subject.

4. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject.

The formative assessment should include the evaluation from the employer where the student is doing his training or Project work in the ratio of 40:60. The final assessment will be the combination of the employer assessment and evaluation by the faculty of the institute which shall include report submission/ presentation/ seminar followed by viva-voce of the relevant subject.

5. Project Work Assessment

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The project work assigned should be of

relevance to the core skill, state of the art topics and the project areas that are pertaining to enhance job skill and enhance occupational opportunities. For both, minor and major project, Formative and summative evaluation may comprise of weightages to performance on task, quality of product, nature and relevance of project and general behavior.
The formative assessment should include the continuous assessment based on the work allocated and mid semester viva voice or presentation. The final assessment will be the combination of the project undertaken, report submission and should be followed by viva-voce of the relevant subject.

In case of the assessment of this component, the team of examiners should be constituted on 50 – 50 % basis. i.e. half of the examiners in the team should be invited from outside the institute conducting examination.

6. MOOC COURSES (Open Elective and Multi-Disciplinary Elective)

Massive Open Online Courses (MOOCs) platforms promise open, online courses to massive numbers of students as they are free to join, they provide a wide range of courses, they allow for space and time flexibility and their participants can benefit from various online communication tools and access to quality content.

The coordinating Department/Centre/Office shall monitor every student to adopt the courses online of their choice and preference on Swayam portal. The duration of courses will vary depending on the level and credit points. Courses offered in the duration of 4-10 weeks for 2 to 3 credits at diploma level are to be opted. Students, after they have registered, can get a certificate after attending the classes and submitting the assignments/quizzes and qualifying nationwide exam conducted written exam at the institute close to the one where the student is enrolled.

On successful completion of each course, the institution offering the MOOCs course would issue the certificate, along with the number of credits and grades, through which the student can get credits transferred into his marks certificate issued by his parent institution. Guidelines for credit sharing will be issued by concerned Regulators such as UGC, AICTE, etc. for consideration by various Institutes. There may be standard norms for the host Institution to conduct the course that may include continuous evaluation through assignments, online quizzes, case studies, online writing exercises, term examinations, student feedback, online forum management, etc.

The coordinating Department/Centre/Office of the respective department shall monitor every student and submit to the Office of Examinations, a score sheet (marks card) during the last 10 days prior to the close of the even semester.

7. Viva Voce

This tool will be used to assess the conceptual understanding and the behavioral aspects as regards the job role and the specific task at hand. It will also include questions on safety, quality, environment and equipment's etc. Ask questions on non-prescribed tasks to ensure that the learners have complete knowledge on the assessment

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the marks scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course and Gi is the marks scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

25. TEACHING LEARNING TOOLS FOR EFFECTIVE IMPLEMENTATION

For effective implementation of curriculum, the faculty and staff of institutions have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that only a proper mix of different teaching methods in all these places of instruction can bring the changes in students behavior as stipulated in the curriculum document. It is important to understand curriculum document holistically and further be aware of intricacies of Teaching-Learning Tools for achieving curriculum objectives. Given below are certain recommendations which may help in carrying out teaching-learning effectively:

PROGRAMME LEVEL RECOMMENDATIONS

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2. An academic plan needs to be prepared at institute level. The Head of the institute have a great role to play in its dissemination and percolation up to grass-root level.

3. Head of Department are required to prepare academic plan at department level referring to institutional academic plan.

COURSE LEVEL RECOMMENDATIONS

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives. Teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period which is made available to them in the academic plan at Board level. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of

the plan effectively. Following is the gist of suggestions for subject teachers for effective utilization of Teaching Learning Tools to achieve the course objectives:

1. Teachers need to ensure attainment of course outcomes so as to help the students achieve program outcomes and also meet the desired learning outcomes in five domains of NSQF i.e. Process, Professional knowledge, Professional skills, Core skills and Responsibility.

2. Teachers are required to prepare a course plan, taking into account number of weeks available and courses to be taught.

3. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan.

4. Teachers are required to plan for expert lectures from field/industry. For this, necessary steps need to be taken such as planning in advance, identifying field experts, making correspondence to invite them, taking necessary budgetary approval etc.

5. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.

6. Concept based industrial/field visits may be planned and executed for such contents of course which are abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

7. Lot of focus needs to be laid on skill development. There is need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning and experiential learning effectively. The development and use of lab manuals will enable the institutes to provide lab experiences effectively.

8. Emphasis should to lay on developing soft skills like communication skills, personality Development, self-learning, inter personal skills, problem solving, and creativity etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

11. Students be made aware about issues related to ecology and environment, safety, concern f for wastage of energy and other resources etc.

12. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be o offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

13. For effective implementation of Massive Open Online Courses (MOOCs), a faculty member in the department may be identified and given the responsibility to coordinate various activities related to MOOCs. The concerned faculty member will facilitate in registration of students for MOOCs. The faculty member will also be responsible for compiling the result of students on the completion of MOOCs and pass on the information to the concerned authority.

14. Flexibility has been provided in the curriculum for the students to choose a course related to the discipline as per their interest. For effective implementation of discipline-specific electives, the institute should identify some courses from the list of courses prescribed in the curriculum. The courses should be selected and offered keeping in mind the interest of students, infrastructure and expertise available in and around the institute related to the courses. Option for discipline-specific elective may be taken from students through a form and a course, with more than 10 students opting for it, may be run.

15. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

16. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

17. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

18. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

26. LIST OF EXPERTS

1.	Controller of Examination, Haryana State Board of Technical Education, Panchkula.
2.	Controller of Finance, Haryana State Board of Technical Education, Panchkula.
3.	Joint Secretary, Haryana State Board of Technical Education, Panchkula.
4.	Deputy Secretary Training & Placement Haryana State Board of Technical Education, Panchkula,
5.	Deputy Secretary (Examination), Haryana State Board of Technical Education, Panchkula,
6.	Deputy Secretary (Acd.), Haryana State Board of Technical Education, Panchkula.
7.	Assistant Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
8.	Sh. Naresh Kumar Ghangas, Senior Lecturer, Instrumentation & Control Engineering, Government Polytechnic, Hisar, Haryana.
9.	Sh. Rajat Thakral, Senior Lecturer, Instrumentation & Control Engineering, Government Polytechnic, Hisar, Haryana.
10.	Sh. Kanwal Sachdeva, Senior Lecturer, Instrumentation & Control Engineering, Government Polytechnic, Umri, Haryana.
11.	Dr. Jitendra Virmani, Senior Technical Officer, Central Scientific Instruments Organisation, Chandigarh.
12.	Dr. Babban, Scientist, Central Scientific Instruments Organisation, Chandigarh.
13.	Dr. Jitender Kr Jain, Assistant Professor, Department of Electronic Instrumentation & Control Engineering, Engineering College, Bikaner.
14.	Sh. Rajesh Dewsal, Vice President, Emmtech Calibration, D1/90, Sanjay Colony Sector 23, Faridabad-121005.
15.	Dr. Ashok Kumar Nehra, Director, Belz Instruments Pvt Ltd, 5L/123, NIT, Faridabad-121001.
16.	Smt. Roshni, Lecturer, Instrumentation & Control Engineering, Government Polytechnic, Hisar, Haryana.
17.	Er. Vikash, Lecturer, Instrumentation & Control Engineering, Baba Kheta Nath Government Polytechnic, Narnaul.
18.	Er. Roshan Lal, Sr. Service Engineer, Agilent Technologies, Chandigarh.
19.	Smt. Pushpa Rani, Senior Lecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.
20.	Smt. Krishna Bhoria, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.

21.	Smt. Preetpal Kaur, Guest Faculty, Applied Science Department, Government Polytechnic, Ambala, Haryana.
22.	Ms. Monika, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
23.	Dr. Neena Sharma, English Department, MCM College, Chandigarh.
24.	Dr. Bhajan Lal, Lecturer, Applied Science Department, Government Polytechnic, Sirsa, Haryana.
25.	Sh. Anil Nain, Lecturer, Applied Science Department, Government Polytechnic, Hisar, Haryana.
26.	Dr. Sarita Mann, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.
27.	Smt. Bindu Verma, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
28.	Dr. Pankaj Sharma, Professor, Applied Science Department, NITTTR, Chandigarh.
29.	Dr. Ashok Kumar, Associate Professor, Applied Science Department, NITTTR, Chandigarh.
30.	Mr. Satyawan Dhaka, Senior Lecturer, Applied Science Department, Government Polytechnic, Nilokheri.
31.	Mrs. Sapna Sang, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.
32.	Mr. Ravi Bansal, Lecturer, Applied Science Department, Government Polytechnic, Manesar.
33.	Mrs. Kiran, Lecturer, Applied Science Department, Government Polytechnic, Sonepat.
34.	Dr. Naveen Jha, Assistant Professor, Department of Mathematics, Government Engineering College, Bharatpur.
35.	Dr. KC Lachhwani, Assistant Professor, Applied Science, NITTTR, Chandigarh
36.	Mr. KG Srinivasa, Professor, Information Management & Emerging Engineering, NITTTR, Chandigarh.
37.	Dr. Vidhi Grover, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.
38.	Mr. Tavinder Singh, Lecturer, Applied Science Department, Government Polytechnic, Sirsa.
39.	Ms. Sunita Rani, Lecturer, Applied Science Department, Government Polytechnic, Ambala.
40.	Mr. Subhash Chandra Bhoria, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Hisar.
41.	Mr. Jagjit Singh Narang, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Ambala.

42.	Mr. Pardeep Kumar, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri.
43.	Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.
44.	Dr. AB Gupta, Professor, Education & Educational Management Department, NITTTR, Chandigarh.
45.	Er. PK Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
46.	Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
47.	Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

27. APPENDIX

Sr. No.	LIST OF EQUIPMENTS
1.	UV Spectrometer
2.	MASS Spectrometer
3.	Conductivity meter
4.	Water quality testing kit (TDS And PH meter, Turbidity meter)
5.	Food beverage testing kit
6.	Gas and liquid Chromatography
7.	Digital CRO with Accessories
8.	Digital Multimeter with Accessories
9.	Demonstration kit for Ohm's law
10.	KCL and KVL trainer kit
11.	Demonstration kit for different network theorems.
12.	Demonstration kit for RLC circuit.
13.	Demonstration kit for Lead acid battery.
14.	Demonstration kit for PN junction diode.
15.	Demonstration kit for Zener diode.
16.	Demonstration kit for half wave, full wave and bridge rectifier
17.	Demonstration kit for different configuration of transistor.
18.	Logic gate trainer kit
19.	Encoder and Decoder trainer kit
20.	MUX – DEMUX trainer kit
21.	Ratio Controller Kit
22.	Cascade Controller Kit
23.	Feed forward Controller Kit
24.	On-off Controller Kit
25.	P/I Converter Module
26.	I/P Converter Module with valve operating system
27.	Process plant of electronic proportional controller
28.	Demonstration kit for butterfly, solenoid, globe & diaphragm valve
29.	Process plant of electronic proportional Integral controller
30.	Demonstrate model of pneumatic pressure supply
31.	Auto transformer
32.	Process plant of proportional Integral derivative controller
33.	Hydraulic trainer kit

34.	Electrically operated valve system
35.	Pressure switch demonstration kit
36.	Float type level switch kit
37.	Control value trainer kit
38.	Pneumatic trainer kit
39.	Scilab/Matlab software
40.	Synchro error detector kit
41.	Open Loop control system kit
42.	Closed loop control system kit
43.	Demonstration kit for servomechanism
44.	Demonstration kit for different non-linearity like backlash, dead zone and hysteresis
45.	Keil software
46.	Universal programmer kit of 8051
47.	Stepper motor module
48.	A/D Converter kit
49.	D/A Converter kit
50.	LCD for interfacing
51.	Analog PLC
52.	Digital PLC
53.	HMI
54.	SCADA Software
55.	Wire, Cable, Switches, Electronics component
56.	Instrument panel trainer kit
57.	Screw and hang type instrument
58.	Pressure/ Flow/ Level/temperature kit
59.	Electromagnetic trainer kit
60.	Solenoid trainer kit
61.	Callibrate ammeter, voltmeter trainer kit
62.	Calibration kit for RTD, Thermocouple, Thermistor
63.	Piezoelectric trainer kit
64.	Solar power cell installation kit
65.	3 Phase star delta (automatic) switch
66.	Single layer and double layer PCB design kit
67.	DC power supply
68.	Function generator

69.	Digital Storage oscilloscope (DSO)
70.	Strain guage trainer kit
71.	Temperature measurement (RTD, Thermocouple, Thermistor) trainer kit
72.	LVDT Displacement trainer kit
73.	Angular displacement capacitive transducer trainer kit
74.	Resistance measurement using LDR trainer kit
75.	Photodiode characteristics trainer kit
76.	Photo transistor trainer kit
77.	Load cell measurement trainer kit
78.	Ammeter and voltmeter. Strip chart & circular chart printer demonstration kit
79.	Analog multimeter
80.	Seven segment display experiment kit using LED
81.	fourteen segment display experiment kit using LED
82.	LED and LCD based word making experiment kit
83.	Fluorescent display experiment kit
84.	Various sensors &transducers
85.	Rotameter demonstration kit
86.	Venturimeter trainer kit
87.	U-tube manometer trainer kit
88.	Level measurement using capacitance trainer kit
89.	Level measurement using resistance trainer kit
90.	Bourdon tube trainer kit
91.	IR detectors based temp measuring trainer kit
92.	Hydraulic transmitter trainer kit
93.	Level measurement using Gamma rays trainer kit
94.	Level measurement using inductance trainer kit, ultrasonic method trainer kit
95.	DC regulated low voltage variable power supply
96.	DC regulated multiple output power supply
97.	Dual trace CRO with accessories
98.	Digital LCR- Q meter
99.	Mains Voltage stabilizer(3 KVA)
100.	AC Millivoltmeters
101.	DC Millivoltmeters
102.	Battery of different voltage and Ampere hour
103.	Single Phase variac

104.	Rheostat of different wattage and resistance
105.	IC Bread Boards
106.	Decade resistance, capacitance and inductance
107.	Digital frequency meter
108.	Digital Storage Oscilloscope (DSO)
109.	Maxwell's Bridge Kit
110.	Wein's Bridge Kit
111.	Q. Meter (Digital) Kit
112.	Ammeter, Voltmeter, Wattmeter and Energy Meters (3- phase and 1- phase)
113.	3-Phase Resistive load
114.	Tacho meters (digital)
115.	Meggar (Insulation Tester)
116.	Earth Tester
117.	Ammeter(Moving Coil and Moving iron type)
118.	Defibrillator-simulation through V lab. (Hospital visit)
119.	Pacemaker(Hospital Visit) simulation through V lab
120.	EEG Trainer kit
121.	B P measurement Apparatus (digital and analog)
122.	Glucometer
123.	SPO_2 Meter
124.	ECG and EMG Trainer Kit with leads
125.	EEG Trainer Kit with leads
126.	Portable oxygen concentrator and ventilator
127.	Spirometer
128.	Bluetooth based trainer kit for body parameters


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