COMPETENCY BASED CURRICULUM

DIPLOMA
IN
AUTOMATION AND ROBOTICS

(Duration 03 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.

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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

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Professor & Head
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1. SALIENT FEATURES

1.	Name	:	**Diploma in Automation and Robotics**
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	:	**Multi Point Entry and Exit**
8.	NSQF Level	:	**5**
9.	Theory Practical Ratio	:	**35 : 65**
10.	Project Work	:	**Minor and Major Project**
11.	In-house/Industrial Training	:	**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.

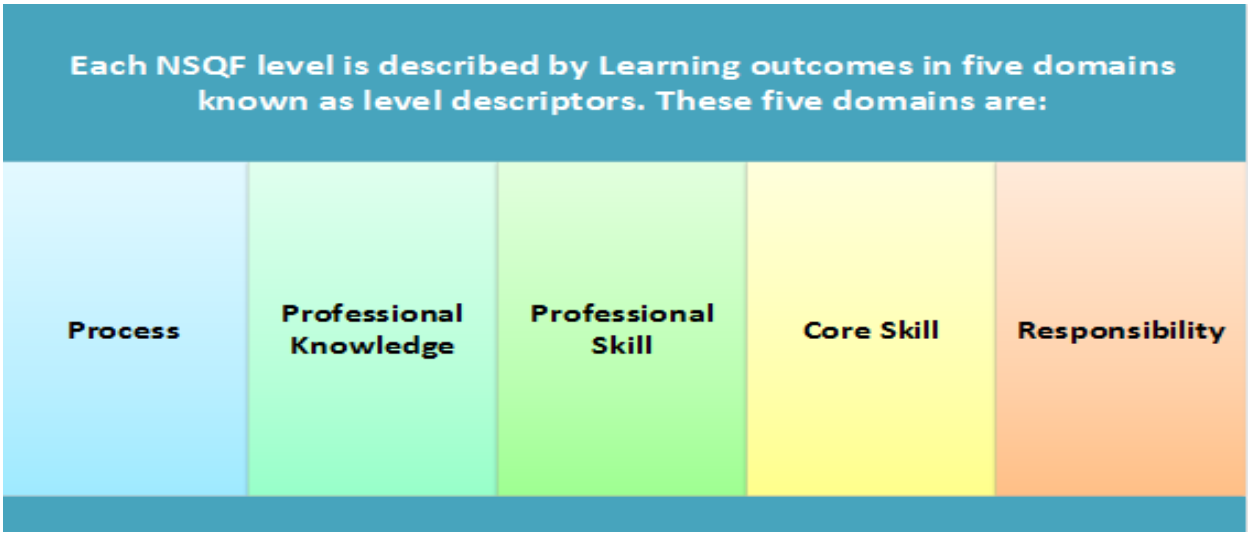

Fig1: NSQF Domains

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.

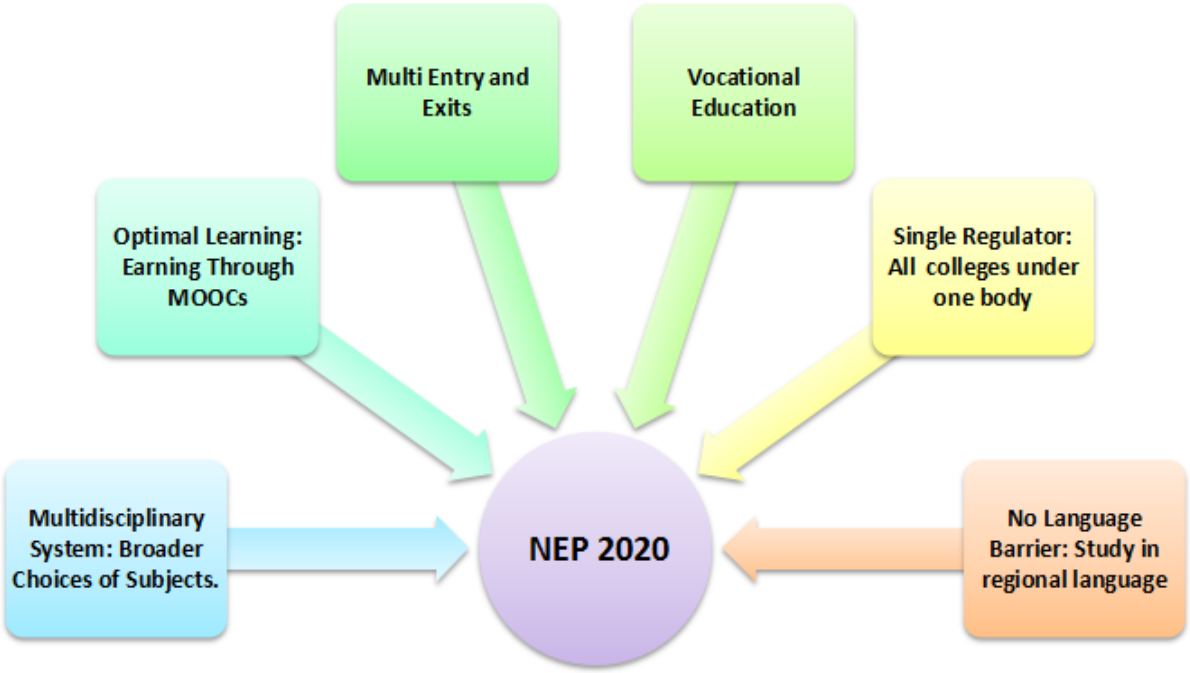

Fig 5: NEP 2020

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. DIPLOMA PROGRAMME OUTCOMES

The programme 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: Perform tasks in limited range of activities, familiar situation with clear choice of procedures.

PO2: Acquire knowledge of principles and processes in the field of Automation and Robotics.

PO3: Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information**.**

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

PO5: Take the responsibility of own works and supervises others work.

PO6: Select multidisciplinary and open subjects of own interest and perform self learning through Massive Open Online Courses.

5. DERIVING CURRICULUM AREAS FROM DIPLOMA PROGRAMME OUTCOMES

The following curriculum areas have been derived from Diploma Programme Outcomes:

Sr. No.	Programme Outcomes	Curriculum Subjects / Areas
1.	Perform tasks in limited range of activities, familiar situation with clear choice of procedures.	• Applied Physics - I • Fundamentals of Electrical Engineering. • Electrical & Electronics Workshop-I • Electronic Devices & Circuits -1 • Applied Physics - II • Applied Mechanics. • Engineering Graphics • Drives and Control Systems • Digital Electronics • Robotics • Python Programming • AutoCAD and 3 D Printing • Microprocessor & Micro-controllers • Sensors and Actuators • Fluid Power System • Electronic Instrumentation and Measurements • PLC and SCADA • Industrial IoT • CAD and CAM • Programme Elective – I • Programme Elective - II
2.	Acquire knowledge of principles and processes in Electronics and Communication Engineering related field.	• Applied Physics - I • Fundamentals of Electrical Engineering. • Electronic Devices & Circuits - I • Applied Physics - II

		• Applied Mechanics. • Drives and Control Systems • Digital Electronics • Robotics • Python Programming • AutoCAD and 3 D Printing • Microprocessor & Micro-controllers • Sensors and Actuators • Fluid Power Systems • Electronic Instrumentation and Measurements • PLC and SCADA • Industrial IoT • CAD and CAM • Programme Elective – I • Programme Elective - II
3.	Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information**.**	• Fundamentals of Electrical Engineering. • Electrical & Electronics Workshop-I • Electronic Devices & Circuits – I • Applied Mechanics • Electrical & Electronics Workshop –II • Drives and Control Systems • Digital Electronics • Robotics • Python Programming • AutoCAD and 3 D Printing • Industrial/In-House Training – I • Microprocessor & Micro-controllers • Sensors and Actuators • Fluid Power Systems • Industrial Training – II • Electronic Instrumentation and Measurements • PLC and SCADA

		• Industrial IoT • CAD and CAM • Programme Elective – I • Programme Elective - II
4.	Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• English and Communication Skills - I • Applied Mathematics - I • Fundamentals of IT • Applied Mathematics - II • Environmental Studies & Disaster Management • Industrial/In-House Training – I • English and Communication Skills – II • Minor Project • Industrial Training – II • Entrepreneurship Development & Management • Humanities & Life Skills • Industrial Training / Major Project
5.	Take the responsibility of own works and supervises others work.	• Electrical & Electronics Workshop-I • Electrical & Electronics Workshop –II • Industrial/In-House Training – I • Minor Project • Industrial Training – II • Industrial Training / Major Project
6.	Select multidisciplinary and open subjects of own interest and perform self learning through Massive Open Online Courses.	• Open Elective • Multidisciplinary Elective

FIRST YEAR

NSQF LEVEL - 3

FIRST YEAR
6. STUDY CUM 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	Total	Th	Pr	Total	
1.1	*English and Communication Skills - I	2	2	2 + 1 = 3	40	40	80	60	60	120	200
1.2	*Applied Mathematics - I	4	-	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	*Engineering Graphics	-	6	0 + 3 = 3	-	40	40	-	60	60	100
1.5	**Fundamental of Electrical Engineering.	3	4	3 + 2 = 5	40	40	80	60	60	120	200
1.6	***Electrical & Electronics Workshop-I	-	4	0 + 2 = 2	-	40	40	-	60	60	100
# Student Centered Activities(SCA)		-	6	-	-	-	-	-	-	-	-
Total		**11**	**24**	**20**	**160**	**200**	**360**	**240**	**300**	**540**	**900**

* Common with other Diploma Courses.

** Common with Electronics and Communication Engineering, Instrumentation and Control Engineering

*** Common with Electronics and Communication Engineering

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

FIRST YEAR

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	Total	Th	Pr	Total	
2.1	**Electronic Devices & Circuits - I	3	4	3 + 2 = 5	40	40	80	60	60	120	200
2.2	*Applied Mathematics-II	4	-	4 + 0 = 4	40	-	40	60	-	60	100
2.3	*Applied Physics - II	2	2	2 + 1 = 3	40	40	80	60	60	120	200
2.4	***Applied Mechanics	3	2	3 + 1 = 4	40	40	80	60	60	120	200
2.5	*Fundamentals of IT	2	4	2 + 2 = 4	40	40	80	60	60	120	200
2.6	**Electrical & Electronics Workshop -II	-	4	0 + 2 = 2	-	40	40	-	60	60	100
2.7	*Environmental Studies & Disaster Management	2	-	2 + 0 = 2	40	-	40	60	-	60	100
# Student Centered Activities (SCA)		-	3	-	-	-	-	-	-	-	-
Total		**16**	**19**	**24**	**240**	**200**	**440**	**360**	**300**	**660**	**1100**

* Common with other Diploma Courses

** Common with Electronics and Communication Engineering

*** Common with Mechanical Engineering

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

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

7. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	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.	Engineering Graphics	6	-
5.	Fundamentals of Electrical Engineering	7	-
6.	Electrical & Electronics Workshop-I	4	-
7.	Electronic Devices & Circuits - I	-	7
8.	Applied Mathematics-II	-	4
9.	Applied Physics - II	-	4
10.	Applied Mechanics	-	5
11.	Fundamentals of IT	-	6
12.	Electrical & Electronics Workshop -II	-	4
13.	Environmental Studies & Disaster Management	-	2
14.	Student Centered Activities	6	3
	Total	**35**	**35**

8. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

In government and private sectors related to **Automation and Robotics**, **"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 Automation and Robotics.

Automation and Robotics NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of related applications. They should understand the concepts of information technology and its scope, operating a computer and should be able to use internet and mobile applications etc. They should have the basic knowledge of principles of DC and AC fundamental, ac circuits, batteries, electromagnetic induction, voltage and current sources etc. They should demonstrate general manual and machining skills along with awareness of dignity of labour, safety at work place, team working and right attitude.

They should have good knowledge of physical principles and analysis in various technical fields. They are expected to have knowledge of fundamental concepts and principles of basic electronics such as conductors, semiconductors, insulators, extrinsic and intrinsic semi-conductors, FETs, MOSFETs and their applications. They are expected to know about basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines. They should be able to design basic Electronic circuits on Printed Circuit Board using software. They are expected to show their capability to design their own projects on PCB as per industrial requirement.

They will have scope of wage employment in organizations like Railways, Defence Services, Para-military Forces**,** Civil Aviation**,** Defence Organizations**,** automation and manufacturing industries like wireless mobile equipment, PCB Design and Fabrication**,** Consumer Electronics**,** Electronic Components and Devices Manufacturing and Installation**,** Computer Assembling and Computer Peripheral, Computer Software Areas for Electronic Design and Semi Conductor Manufacturing**,** Instrumentation and Control**,** Mobile Phone assembly**,** Medical Electronics**,** etc**.** They will also have scope in establishing small start ups in the area of Marketing and Sales, Manufacturing Unit like Bulb manufacturing, circuit manufacturing units etc and training in the area of robotics.

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 level, the student will be able to:

PO1: Carry out a task which may require limited range of predictable activities.

PO2: Acquire knowledge of Basic facts, process and principles related to Automation and Robotics for employment.

PO3: Demonstrate practical skill in narrow range of Automation and Robotics applications.

PO4: Communicate in written and oral, with minimum required clarity along with skill of basic arithmetic and algebraic principles, personal banking and basic understanding of social and natural environment.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.

10. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	• 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. • Apply the knowledge of basic circuital law and simplify the network • Understand the fundamental behaviour of AC circuits and solve AC circuit problems. • Comprehend the concept of Electrostatics and magentostatics and apply the knowledge. • Identify tools, equipments and their respective functions. • Prepare independently simple jobs and inspect the same. Select proper tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Take measurements with basic measuring tools/equipment. • Describe the VI characteristics of PN junction diode and Zener diode. Fabricate half wave, full wave and bridge rectifier and observe waveforms of each • Measure voltage gain, input and output impedance in a single state CE amplifier circuit. • Differentiate between types of waves and their motion. • Illustrate laws of reflection and refraction of light.

	• Demonstrate competency in phenomena of electrostatics and electricity. • Draw free body diagrams by analyzing different types of forces acting on a body. • Solve problems by using principle of moment. • Calculate the least force required to maintain equilibrium on an inclined plane. • 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.
PO2: Acquire knowledge of Basic facts, process and principles related to Automation and Robotics.	• 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. • Acquire knowledge and understand the elements of electricity and DC circuits. • Explain the various batteries as storage devices and be aware of safe disposal of batteries. • Demonstrate competency in phenomena of electrostatics and electricity. • Characterize properties of material to prepare new materials for various technical applications. • Identify and able to understand physics behind various types of materials.

	• Describe the VI characteristics of PN junction diode and Zener diode. Fabricate half wave, full wave and bridge rectifier and observe waveforms of each • Draw input and output characteristics of transistor in CB and CE mode • Analyse the characteristics of FET and MOSFET. • Determine the resultant of coplanar concurrent forces. • Determine the centroid/centre of gravity of plain and composite laminar and solid bodies. • Determine velocity ratio, mechanical advantage and efficiency of simple machines.
PO3: Demonstrate practical skill in narrow range of Automation and Robotics.	• 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. • Demonstrate the use of physical principles and analysis in various technical fields. • Prepare independently simple jobs and inspect the same. Select proper tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Take measurements with basic measuring tools/equipment. • Characterize properties of material to prepare new materials for various technical applications. • Demonstrate a strong foundation on Modern Physics to use at various technical applications. • Describe the VI characteristics of PN junction diode and Zener diode. Fabricate half wave, full wave and bridge rectifier and observe waveforms of each • Measure voltage gain, input and output

	impedance in a single state CE amplifier circuit. • Measure frequency, voltage, time period and phase using CRO and DSO. • Draw free body diagrams by analyzing different types of forces acting on a body. • Solve problems by using principle of moment. • Calculate the least force required to maintain equilibrium on an inclined plane. • Prepare independently simple jobs and inspect the same. • Select and handle tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Take measurements with basic measuring tools/equipment. • Perform safety procedures to maintain good housekeeping practices. • Handle materials, sequence of operations, tools to make a given job based on interpretation of drawing as per given specification • Develop a job using resources of shops and compare the job with given specifications. Analyze a given job and identify various operations required to make it. • Design and simulate the PCB using EDA Tools. • Acquire hands-on experience of PCB fabrication.
PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political 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. • Understand the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, coordinate 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. • 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. • Calculate the approximate area under a curve by applying integration and numerical methods. • Understand 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. • Comprehend the importance of sustainable ecosystem

	• Demonstrate interdisciplinary nature of environmental issues • Implement corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Manage various types of disasters
PO5: Perform task under close supervision with some responsibility for own work within defined limit.	• Identify tools, equipments and their respective functions. • Prepare independently simple jobs and inspect the same. • Select and Handle tools for a particular operation. • Handle safety equipment, follow safety procedures and measures. • Take measurements with basic measuring tools/equipment. • Perform safety procedures to maintain good housekeeping practices. • Handle materials, sequence of operations, tools to make a given job based on interpretation of drawing as per given specification • Develop a job using resources of shops and compare the job with given specifications. Analyze a given job and identify various operations required to make it. • Design and simulate the PCB using EDA Tools. • Acquire hands-on experience of PCB fabrication.

11. SUBJECTS & CONTENTS

(FIRST YEAR)

FIRST SEMESTER

1.1	English and Communication Skills - I	23 - 25
1.2	Applied Mathematics - I	26 - 29
1.3	Applied Physics - I	30 - 33
1.4	Engineering Graphics	34 - 36
1.5	Fundamental of Electrical Engineering.	37 - 40
1.6	Electrical & Electronics Workshop-I	41 - 45

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 ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

After undergoing this course, 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; Apologising 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 in the Lab regularly for development of required communication skills in the students. This subject contains four units of equal weight age.

1.2 APPLIED MATHEMATICS - I

L	P
4	-

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

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

CO1: Understand 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
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 technical fields are given prominence in the course content.

COURSE OUTCOMES

After completing this course, student should be able to:

CO1: Identify physical quantities, select their units 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- aaddition of vectors, Triangle & Parallelogram law (statement and formula only),

2.3 Scalar and vector pproduct (statement and formula only)

2.4 Force and its units, rresolution 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- ddefinition, ssymbol, fformula and SI unit, types of work (zero work, positive work and negative work) with example

3.2 Friction– ddefinition and its simple daily life aapplications

3.3 Power- definition, formula and units

3.4 Energy- ddefinition and its SI unit, eexamples 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

LIST OF PRACTICALS

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 weight age. 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 ENGINEERING GRAPHICS

L	P
-	6

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.

1.5 FUNDAMENTAL OF ELECTRICAL ENGINEERING

L	P
3	4

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 successful completion of the course, the student 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: Understand the fundamental behaviour of AC circuits and solve AC circuit problems.
CO4: Comprehend the concept of Electrostatics and magentostatics and apply the knowledge.
CO5: Explain the 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.

PRACTICE 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 and draw their impedance triangles.
13. To find the voltage current relationship in a single R-C Series circuits, and 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.

1.6 ELECTRICAL AND ELECTRONICS WORKSHOP – I

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RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. This workshop is included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

COURSE OUTCOMES[i]

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

CO1: Identify tools, equipments and their respective functions.
CO2: Prepare independently simple jobs and inspect the same.
CO3: Select and handle tools for a particular operation.
CO4: Handle safety equipment, follow safety procedures and measures.
CO5: Take measurements with basic measuring tools/equipment.

DETAILED CONTENTS-CUM-PRACTICAL EXERCISES

Workshop Safety Induction Session

First turn of each shop shall be dedicated to safety practices and the contribution of safety to quality. The safety aspects can be categorized 3 categories

1. PSS (Process Safety System)
2. SSS (Safety Shutdown System)
3. ESD (Emergency Shutdown) or Emergency Depressurization System.

The following practices should be included:

i. Use of PPE (Personal Protection Equipment)
ii. Use of Safety Equipment like fire extinguishers etc.)
iii. Paramedic teaching suite, First –Aid
iv. Reports to be prepared for the damages
v. At the end of this session the student must sign “Student Safety Declaration form”.

The following shops are included in the syllabus:

1. Welding Shop
2. Fitting Shop
3. Sheet Metal Shop
4. Electric Shop – I
5. Electronic Shop – I

UNIT I

Welding Shop

1.1 Introduction and importance of welding process as compared to other material joining processes. Specifications and type of ARC welding machines, parts identification, classification, selection and coding of electrodes, welding parameters, welding joints and welding positions. Common weldable Materials, safety precautions, use of PPEs, welding screens, Hazards and remedies during welding, Elementary symbolic representations, demo of types of welding defects.

1.2 Jobs to be prepared Job I Practice of striking arc (Minimum 4 continuous beads on 100 mm long M.S. flat).

Job II Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level and differentiating their characteristics).
Types of joints and their edge preparations:

Job III Preparation of lap joint using arc welding process.

Job IV Preparation of butt joint using arc welding process. (100 mm long).

Job V Preparation of T Joint using arc or gas welding (100mm x 6 mm M.S. Flat).

UNIT II

Fitting Shop

2.1 Introduction and Practical Importance of fitting jobs

2.2 Basic deburring processes.

2.3 Introduction to fitting shop tools, marking and measuring devices/equipment.

2.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminum etc.)

2.5 Identification of various steel sections (flat, angle, channel, bar etc.).

2.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing). Demonstration of wrong fitting practices causing damage to filed surfaces (outsized, out angled etc.) and tool/blade breakages.

2.7 Jobs to be prepared:

Job I Marking of job, use of marking tools and various types of files, use of tri square, surface plate, filing and use of measuring instruments. (Zero error and least count of Vernier calliper, Micrometer and Vernier height gauge).

Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of ±0.5 mm.

Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping.

UNIT III

Sheet Metal Shop

3.1. Introduction and practical importance of sheet metal jobs, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.

3.2 Introduction and demonstration of hand tools used in sheet metal shop.

3.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine, Turning Machine, Wiring Machine, Setting down Machine, Forming Machine, Brake etc.

3.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.

3.5 Study of various types of nuts, bolts, rivets, screws etc.

Any Two Jobs to be prepared

Job I Shearing practice on a sheet using hand shears.

Job II Prepare a seam joint of G.I. Sheet

Job III Practice on making Single riveted lap joint/Double riveted lap Joint.

Job IV Development of sheet for preparation of cubical container (300x150x25 mm)

UNIT IV

Electric Shop – I

4.1 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.

4.2 Study of electrical safety measures and protective devices.

Job I Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs. Difference between series and parallel wiring.

Job II Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping. Demo of conduit wiring through junctions

Job III To prepare a three level Godown wiring circuit with PVC conduit wiring system.

4.3 Introduction to the construction of lead acid battery, its working and its specification parameters (mAH, sp gravity), precautions while handling battery, Introduction to battery charger and its functioning. Types of charging

Job IV Installation of battery and connecting two or three batteries in series and parallel and its effect. Charging a battery and testing with hydrometer and cell tester

4.4 Introduction to solar energized lighting or water heater system and their defects.

Job V Installation of Solar cells, costing according to capacity

UNIT V

Electronic Shop – I

Safety precautions to be observed in the Electronics Shop:

Identification and familiarization with the following tools used in electronic shop such as Tweezers, Screw drivers (different sizes), Insulated Pliers, Cutter, Sniper, Screw Driver (Star Screw Driver), L- Keys, Identification, familiarization and uses of commonly used components ; active and passive components; colour code and types of resistor and potentiometers ,Diode, Transistor, LED, LDR, SCR, TRIAC,DIAC, Thermistor etc.

Identification, familiarization, demonstration and use of the following electronic instruments:

a) Analog multimeter
b) Digital multimeter

Identification, familiarization, demonstration and use of the following electronic instruments:

a) Simple CRO, function of every knob on the front panel
b) Power supply, fixed voltage and variable voltage, single output as well as dual output.
c) Function generator

Job I Practice in the use of above mentioned tools and instruments. For this a small experimental set up may be done

RECOMMENDED BOOKS

1. SK Hajra, Choudhary and AK Choudhary, “Workshop Technology” I, II, III by Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Manchanda, “Workshop Technology” Vol. I, II, III by India Publishing House, Jalandhar.
3. S.S. Ubhi, “Workshop Training Manual” Vol. I, II by Katson Publishers, Ludhiana.
4. K Venkata Reddy, “Manual on Workshop Practice” by MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by; Vikas Publishing House (P) Ltd., New Delhi
6. T Jeyapoovan, “Workshop Technology” by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi

7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is hands on practice based workshop and topics taught in the class should be practiced in the lab regularly for development of required skills in the students. This workshop contains five units equal weightage. The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

SECOND SEMESTER

SECOND SEMESTER

2.1	Electronic Devices & Circuits - I	46 - 49
2.2	Applied Mathematics-II	50 - 53
2.3	Applied Physics - II	54 - 57
2.4	Applied Mechanics	58 - 60
2.5	Fundamentals of IT	61 - 64
2.6	Electrical & Electronics Workshop -II	65 - 67
2.7	Environmental Studies & Disaster Management	68 - 70

2.1 ELECTRONIC DEVICES AND CIRCUITS - I

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3	4

RATIONALE

This subject gives the knowledge of fundamental concepts and principles of basic electronics. It's aims to provide the students with basic understanding of various types of materials such as conductors, semiconductors, insulators, extrinsic and intrinsic semi-conductors. Students will study p-n junction, need of rectifiers, significance, use of filters in rectifiers, basic structure and working principle of transistors in various configurations. This also covers fundamental knowledge of FETs & MOSFETs and their applications.

COURSE OUTCOMES

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

CO1: Identify and able to understand physics behind various types of materials.

CO2: Describe the VI characteristics of PN junction diode and Zener diode. Fabricate half wave, full wave and bridge rectifier and observe waveforms of each

CO3: Draw input and output characteristics of transistor in CB and CE mode

CO4: Measure voltage gain, input and output impedance in a single state CE amplifier circuit.

CO5: Analyse the characteristics of FET and MOSFET.

DETAILED CONTENTS

UNIT I

Semiconductor Physics

1.1 Review of basic atomic structure and energy levels, concept of insulators, conductors and semiconductors, atomic structure of Germanium (Ge) and Silicon (Si), covalent bonds.

1.2 Concept of intrinsic and extrinsic semiconductor, process of doping.

1.3 Energy level diagram of conductors, insulators and semiconductors; minority and majority charge carriers.

1.4 P and N type semiconductors and their conductivity, effect of temperature on conductivity of intrinsic semiconductors.

UNIT II

Semiconductor Diode

2.1 PN junction diode, mechanism of current flow in PN junction, forward and reverse biased PN junction, potential barrier, drift and diffusion currents, depletion layer, concept of junction capacitance in forward and reverse biased condition.

2.2 V-I characteristics, static and dynamic resistance and their value calculation from the characteristics.

2.3 Application of diode as half-wave, full wave and bridge rectifiers. Peak Inverse Voltage, rectification efficiencies and ripple factor calculations, shunt capacitor filter, series inductor filter, LC and π filters.

2.4 Types of diodes, characteristics and applications of Zener diodes. Zener and avalanche breakdown

2.5 Introduction to Clipping and Clamping Circuits

UNIT III

Introduction to Bipolar-Transistors

3.1 Concept of a bipolar transistor, its structure, PNP and NPN transistors, their symbols and mechanism of current flow; Current relations in a transistor; concept of leakage current;

3.2 CB, CE, CC configurations of a transistor; Input and output characteristics in CB and CE configurations; input and output dynamic resistance in CB and CE configurations; Current amplification factors, relation between α, β and γ. Comparison of CB, CE and CC Configurations;

3.3 Transistor as an amplifier in CE Configuration; concept of DC load line and calculation of current gain and voltage gain using DC load line.

UNIT IV

Transistor Biasing Circuits

Concept of transistor biasing and selection of operating point. Need for stabilization of operating point. Different types of biasing circuits. Single stage transistor amplifier circuit, concept of dc and ac load line and its use. Explanation of phase reversal of output voltage with respect to input voltage.

UNIT V

Field Effect Transistors

Construction, operation and characteristics of FETs and their applications.

5.1 Construction, operation and characteristics of a MOSFET in depletion and enhancement modes and its applications.

5.2 Comparison of JFET, MOSFET and BJT.

PRACTICALS EXERCISES

1. Plotting of V-I characteristics of a PN junction diode
2. Plotting of V-I characteristics of a Zener diode
3. To observe input and output of series clipping circuits.
5. To observe input and output of shunt clipping circuits.
6. To observe input and output of positive clamping circuit.
7. To observe input and output of negative clamping circuit.
8. Fabrication of Half-wave rectifier circuit on breadboard and observe the output
9. Fabrication of Full-wave rectifier circuit on breadboard and observe the output
10. Plotting of the wave shape of full wave rectifier with
    a. Shunt capacitor filter
    b. Series inductor filter
11. Plotting of input and output characteristics and calculation of parameters of transistors in CE configuration.
12. Plotting of input and output characteristics and calculation of parameters of transistors in CB configuration.
13. Measurement of voltage gain, input and output impedance in a single stage CE amplifier circuit.
14. Plotting of V-I characteristics of FET.

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. SM Dhir, “Electronic Components and Materials” by Tata McGraw Hill Education Pvt Ltd., New Delhi.
4. SK Bhattacharya and Renu Vig, “Principles of Electronics” by, SK Kataria and Sons, Delhi
5. Millman and Halkias, “Electronics Devices and Circuits” by McGraw Hill.
6. Albert Paul Malvino, “Principles of Electronics” by Tata McGraw Hill Education Pvt Ltd., New Delhi.
7. Albert Malvino and David J. Bates, “Basic Electronics – Problems and Solutions” by Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi.

8. J.S. Katre, Sandeep Bajaj, “Basic Electronics” by Tech. Max. Publications, Pune.
9. SK Sahdev, “Electronic Principles” by Dhanpat Rai& Co., New Delhi
10. JC Karhara, “Analog Electronics” by King India Publication, New Delhi
11. Rama Reddy, “Electrical Devices and Circuits” by Narosa Pulishing House Pvt. Ltd., New Delhi
12. Dharma Raj Cheruku and Battula Tirumala Krishna, “Electronic Devices and Circuits” by Pearson Education (Singapore) Pvt Ltd., Indian Branch, 482 F.I.E Patparganj, Delhi- 92
13. JB Gupta, “Basic Electronics” BY SK Kataria and Sons, New Delhi
14. Schultz, “Grob’s Basic Electronics- A text Lab Manual” (Special Indian Edition) by Tata McGraw Hill Education Pvt Ltd, New Delhi.
15. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

Note: 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 weight age.

2.2 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: Understand 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.

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

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

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

2.3 APPLIED PHYSICS-II

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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 are given prominence in the course content to prepare students for various engineering 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 eenergy level, eenergy 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, pprinciple, aabsorption, sspontaneous 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, aapplications 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 weight age. 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.

2.4 APPLIED MECHANICS

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RATIONALE

This course Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

COURSE OUTCOMES

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

CO1: Draw free body diagrams by analyzing different types of forces acting on a body.

CO2 : Determine the resultant of coplanar concurrent forces.

CO3 : Solve problems by using principle of moment.

CO4: Calculate the least force required to maintain equilibrium on an inclined plane.

CO5: Determine the centroid/centre of gravity of plain and composite laminar and solid bodies.

CO6: Determine velocity ratio, mechanical advantage and efficiency of simple machines.

DETAILED CONTENTS

UNIT 1

Introduction

Concept of mechanics, Classification of mechanics, utility of mechanics in engineering field, Concept of rigid body, scalar and vector quantities

Laws of forces

Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force, Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of superposition, Free body diagram, Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, parallelogram law of forces (with derivation), triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components, Lami's theorem, Simple numericals, Equilibrium of forces and its determination

UNIT II

Moment

Concept of moment, Moment of a force and units of moment, Varignon's theorem (definition only), Principle of moment and its applications (Levers – simple and compound, steel yard,

safety valve), Simple numericals. Parallel forces (like and unlike parallel force), calculating their resultant, Concept of couple, its properties and effects, General conditions of equilibrium of bodies under coplanar forces, Position of resultant force by moment

UNIT III

Friction

Definition and concept of friction, types of friction, force of friction, Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction, Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane. Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force acting along the inclined plane and subjected to a force acting at some angle with the inclined plane, Simple numerical.

UNIT IV

Centre of Gravity and Centroid

Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies. Axis of symmetry, Reference axis. Determination of centroid of plain and composite lamina (T, L, C and I shape) using moment method only, centroid of bodies with removed portion.
Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed.

Laws of Motion

Newton's laws of motion and their applications, Concept of momentum. Derivation of force equation from second law of motion, numerical problems on second law of motion. Bodies tied with string, Newton's third law of motion, numerical problems, conservation of momentum, impulse and impulsive force.

UNIT V

Simple Machines

Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines, Simple and compound machine (Examples). Definition of ideal machine, reversible and self locking machine. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency, Simple numericals. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency. Working principle and application of wheel and axle, Weston's Differential Pulley Block, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application

PRACTICAL EXERCISES

1. Verification of polygon law of forces using universal force table/Gravesend apparatus.
2. Verification of Lami's theorem.
3. To verify law of moments by using Bell crank lever.
4. To verify the forces in different members of jib crane.
5. To determine coefficient of friction between three pairs of given surface.
6. To find out center of gravity of regular lamina.
7. To find out center of gravity of irregular lamina.
8. To find the mechanical advantage, velocity ratio and efficiency of a screw jack.
9. To find the mechanical advantage, velocity ratio and efficiency of worm and worm wheel.
10. To find mechanical advantage, velocity ratio and efficiency of single purchase crab.

RECOMMENDED BOOKS

1. Birinder Singh,"Text Book of Applied Mechanics", Katson Publishing House, New Delhi.
2. A. K. Upadhyay, " Text Book of Applied Mechanics", SK Kataria & Sons, New Delhi.
3. S. Ramamurtham,"A Text Book of Applied Mechanics", Dhanpat Rai Publishing Company Pvt. Ltd, Delhi.
4. R. S. Khurmi, "A Text Book of Engineering Mechanics (Applied Mechanics)", S Chand and Co. Ltd., New Delhi.
5. R. K. Rajput, "A Text Book of Applied Mechanics", Laxmi Publications, New Delhi.
6. D. S. Bedi,"Engineering Mechanics", Khanna Publishing House, New Delhi.

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 weight age.

2.5 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 course 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
    a. Addition of n numbers and display result
    b. To convert temperature from Celsius to Fahrenheit
    c. To find Area and Perimeter of Square
    d. Swap Two Numbers
    e. find the smallest of two numbers
    f. Find whether given number is Even or Odd
    g. To print first n even Numbers
    h. find sum of series 1+2+3+…..+N
    i. print multiplication Table of a number
    j. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)
    k. sum and average of given series of numbers
    l. Factorial of number n (n!=1x2x3x…n)
    m. Armstrong Number
    n. 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. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett
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, 4th Edition, 2008

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.

2.6 ELECTRICAL AND ELECTRONICS WORKSHOP -II

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RATIONALE

Psychomotor skills are mastered through practice, an opportunity therefore, has been extended to students through this course to refine their skills in different trades. The basic skills developed during first semester will be refined during this course by doing higher order skill jobs. In addition to developing general machining skills in the students, the objective of development of sense of dignity of labour, precision, safety at work places, team working and right attitude among the students will also be met. In addition a basic course for designing of Printed Circuit Board using software. PCB designing is an integral part of each electronics products. This program is designed to make students capable to design their own projects on PCB as per industrial requirement.

COURSE OUTCOMES

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

CO1: Perform safety procedures to maintain good housekeeping practices.

CO2: Handle materials, sequence of operations, tools to make a given job based on interpretation of drawing as per given specification

CO3: Develop a job using resources of shops and compare the job with given specifications. Analyze a given job and identify various operations required to make it.

CO4: Design and simulate the PCB using EDA Tools.

CO5: Acquire hands-on experience of PCB fabrication.

DETAILED CONTENTS

UNIT I

Electric Shop- II

1.1 Introduction to single phase and three phase supply and wiring system. Importance of three phase supply (RYB) & its sequence and wiring system.

Job I Connecting Generator and 3 phase wiring through Change over Switch.

1.2 Estimating and costing of power consumption

Job II Connecting single phase energy meter with supply and load. Reading and working out power consumption and cost of energy.

1.3 Study of internal wiring diagram of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc. Demonstration of dismantling, servicing and reassembling of table/ceiling fan, air-cooler, auto electric iron, heater etc.

Job III Dismantling, servicing and reassembling of any of the above electrical appliances, finding faults with series testing lamp and multimeter.

1.4 Identification and familiarization with the following tools: Soldering Iron and its use.

Job IV Practice on joining using soldering flux and removing components/wires by desoldering

UNIT II

Electronic Shop - II

Various types of protective devices such as: wire fuse, cartridge fuse etc.

Demonstrate the joining (or connecting) methods/mounting and dismantling method, as well as uses of the items mentioned below:

a) 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.

b) Various types of switches such as: normal/miniature toggle, slide, push button piano key, rotary, SPST, SPDT, DPST, DPDT, band selector, multi-way Master Mains Switch.

Job-I Cut, bend, tin component, leads, inserts. Solder components e.g. resistor, capacitor, diodes, transistors on a PCB

Job-II Wiring of a small circuit on a PCB/tag strip involving laying, sleeving and use of identifier tags

Job-III De-soldering practice with de-soldering pump and with de-soldering wick.

Job-IV Cut, strip, join and insulate two lengths of wires/cables (repeat with different types of cables/ wires)

UNIT III

Printed Circuit Board (PCB) shop

Introduction: What is PCB, Difference between PWB and PCB, Types of PCBs: Single/Double Sided and Multi-Layer PCBs, PCB Layer Masks: Top Layer Mask, Bottom Layer Mask, Solder Mask, Legend Print or Silk screen Mask, Hand-Taping Vs CAD

PCB Materials: FR-2 and FR-4 material advantages and disadvantages, PCB Design Rules.

UNIT IV

Computer Aided Design

Brief History of EDA, Latest Trends in Market, How it helps and Why it requires, Different EDA Tools (Licensed like Orcad or Free Open Source Software like Circuit Maker or Dip Trace or Eagle etc.), Schematic Entry, Net listing, Electrical Rule Check (ERC), PCB Layout Designing, Auto and Manual Routing, Design Rule Check (DRC), Gerber Generation, Creating Library, Creating component, Symbols and Footprints for components.

UNIT V

Fabrication

Photo Processing for Pattern Transfer, Etching, Drilling, Component Mounting, Soldering and De-soldering, PCB Testing, PCB design and fabrication of Basic Analog Electronic Circuits, Power Supplies, 555 Based circuits etc.

RECOMMENDED BOOKS

1. SK Hajra, Choudhary and AK Choudhary, "Workshop Technology" I, II, III, by Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Manchanda, "Workshop Technology" Vol. I, II, III by India Publishing House, Jalandhar.
3. S.S. Ubhi, "Workshop Training Manual" Vol. I, II by Katson Publishers, Ludhiana.
4. K Venkata Reddy, "Manual on Workshop Practice" by MacMillan India Ltd., New Delhi
5. T Jeyapoovan,"Basic Workshop Practice Manual" by Vikas Publishing House (P) Ltd., New Delhi
6. B.S. Raghuwanshi, "Workshop Technology" by Dhanpat Rai and Co., New Delhi
7. HS Bawa, "Workshop Technology" by Tata McGraw Hill Publishers, New Delhi
8. Bosshart, "Printed Circuit Boards: Design and Technology" by TMH, 2008 or latest edition
9. Al Williams, "Build Your Own Printed Circuit Board" by Mc GrawHill, 2003 or latest edition
10. Jan Axelsen, "Making Printed Circuit Boards" by Mc GrawHill, 1993 or latest edition
11. "Complete PCB Design Using" Or "CAD Capture and PCB" Editor Paperback – Illustrated, 28 May 2009
12. "User Manual Circuit Maker" for Computer Aided PCB Design.
13. R. S. Khandpur, "Printed Circuit Boards" by McGraw-Hill, 2005
14. Chris Schroeder, "PCB Design Using AutoCAD
15. Module on "CAD for PCBs using EAGLE" by Prof.(Dr.) Rajesh Mehra, NITTTR, Chandigarh.
16. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is hands on practice based workshop 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.

2.7 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: Demonstrate interdisciplinary nature of environmental issues
CO3: Implement corrective measures for the abatement of pollution.
CO4: Identify the role of non-conventional energy resources in environmental protection.
CO5: Manage 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. Environmental Studies by S.C. Sharma & M.P. Poonia, Khanna Publishing House, New Delhi
2. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.

5. Environmental Engineering and Management by Suresh K Dhamija; S K KatariaandSons, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
7. Disaster Management by Dr. Mrinalini Pandey, Wiley India Pvt. Ltd.
8. Disaster Science and Management by Tushar Bhattacharya, 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 weight age.

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-House Training - I	-	2	0+1=1	-	40	40	-	60	60	100
3.2	Drives and Control Systems	2	4	2+2 =4	40	40	80	60	60	120	200
3.3	**Digital Electronics	3	4	3+2 =5	40	40	80	60	60	120	200
3.4	Robotics	2	4	2+2 =4	40	40	80	60	60	120	200
3.5	***Python Programming	3	4	3+2 =5	40	40	80	60	60	120	200
3.6	AutoCAD and 3 D Printing	2	4	2+2 =4	40	40	80	60	60	120	200
	# SCA	-	1	-	-	-	-	-	-	-	-
	Total	**12**	**23**	**23**	**200**	**240**	**440**	**300**	**360**	**660**	**1100**

** Common with Electronics and Communication Engineering
*** Common with Computer 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.

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	**Microprocessor & Micro-controllers	3	4	3+2=5	40	40	80	60	60	120	200
4.3	Sensors and Actuators	3	4	3+2=5	40	40	80	60	60	120	200
4.4	Fluid Power Systems	3	2	3+1=4	40	40	80	60	60	120	200
4.5	Open Elective (MOOCs^{+}/Offline)	2	-	2+0=2	40	-	40	60	-	60	100
4.6	Minor Project	-	8	0+4=4	-	40	40	-	60	60	100
# Student Centered Activities (SCA)		-	2	-	-	-	-	-	-	-	-
Total		**13**	**22**	**23**	**200**	**200**	**400**	**300**	**300**	**600**	**1000**

* Common with other Diploma Courses

** Common with Electronics and Communication Engineering

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

\# 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.

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.	Drives and Control Systems	6	-
3.	Digital Electronics	7	-
4.	Robotics	6	-
5.	Python Programming	7	-
6.	AutoCAD and 3 D Printing	6	-
7.	English and Communication Skills - II	-	4
8.	Microprocessor & Micro-controllers	-	7
9.	Sensors and Actuators	-	7
10.	Fluid Power Systems	-	5
11.	Open Elective (MOOCs/Offline)	-	2
12.	Minor Project	-	8
13.	Student Centered Activities	1	2
	Total	**35**	**35**

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Automation and Robotics** require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They are expected to have factual knowledge of automation and robotics field. They shall be able to write and speak with required clarity. 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.

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.

Automation and Robotics NSQF Level – 4 pass out students are expected have the knowledge of drives and controls used for automation in robotic industries. They are expected to have good knowledge of digital circuit's logic and should be able to apply it in automation. They are expected to have good knowledge of some programming languages and should able to use it for programming of robots. Level 4 pass out students should have good knowledge of various controllers, fluid power systems, sensors and actuators and should be able to utilize them for automation in industries or other fields.

Automation and Robotics students are required to work for a wide variety of employers as Automation specialist, Robotics specialist, Machine Learning Specialist, Software Specialist, Electrical Maintenance Engineer, Robotics Machine Operator, Automation Programmer, Robot Programmer and Sales Executive etc. They might find work with a manufacturing company and spend time maintaining, or even designing, the machines that perform much of the automations. They might also work in relavant laboratories for any institute, university or even a private company. They will also have scope in establishing small start ups in the area of Marketing and Sales, Repair and Maintenance etc**.**

15. PROGRAMME OUTCOMES

The programme 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: Work in familiar, predictable, routine situation of clear choice.

PO2: Acquire factual knowledge in the field of automation and robotics for employment.

PO3: Demonstrate routine and repetitive skills in narrow range of applications using appropriate rules and tools for quality.

PO4: Communicate with required clarity along with social and natural environment understanding.

PO5: Perform tasks with responsibility for own work and learning.

PO6: Select open elective of own interest to develop self-learning habit through online courses.

16. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Work in familiar, predictable, routine situation of clear choice.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Use Thyristor in various control circuits • Implement various applications using Inverters, Choppers, Dual Converters • Design Control circuit of DC and AC Drives using Thyristors • Develop applications of Thyristor in Uninterrupted Power Supplies. • Describe the logic gates and able to perform logics simplification. • Design various combinational circuits • Develop various sequential circuits. • Analyze A/D & D/A converters and various memories. • Describe the structure and working of different types of robots and end-effectors and select the same for a given application • 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 • Operate a robot, write programs for simple applications and execute the programs • Understand the concepts of Computer Aided Design & Drafting and make 2D drawings in AutoCAD software. • Develop 3D CAD models of engineering components and prepare the CAD files for 3D printing. • Describe the need & principle 3D printing,

	Operate a 3D printer and use 3D printing software for setting process parameters. • Select a 3D printing technique for a given application based upon the principle & technologies of various 3D printing techniques and select optimum process parameters for 3D printing of given parts. • Use suitable techniques & equipment for post-processing of 3D printed parts and inspect/test 3D printed parts. • Interpret the program for 8051 in C language. • Interpret the program for serial communication in C. • Interface the I/O devices to 8051. • Explain the functioning of proximity, pressure and motion sensors. • Describe the working of various types of actuators. • Differentiate various smart sensors and actuators. • Select different types of control valves on the basis of construction and applications for fluid power circuits • Select different types of linear and rotary actuators on the basis of construction and applications for fluid power circuits • Make connections between different components for implementing simple pneumatic and hydraulic power circuits for different applications • Work as a team member for successful completion of minor project. • Acquire Life Long Learning skills.
PO2: Acquire factual knowledge in the field of automation and robotics for employment	• Understand the working environment of industries. • Learn about present and future requirement of industries. • Understand various types of controlled rectifiers

	• Understand various types of number systems and digital codes. • Describe the logic gates and able to perform logics simplification. • Understand the concepts of robotics and the need of robots in industrial applications • Describe the structure and working of different types of robots and end-effectors and select the same for a given application • 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 • Explain the function of different types of sensors for robot operation and its interaction with the environment • Understand the concepts of Computer Aided Design & Drafting and make 2D drawings in AutoCAD software. • Describe the need & principle 3D printing, Operate a 3D printer and use 3D printing software for setting process parameters. • Analyse Architecture of 8051 microcontroller IC. • Understand the Timer and I/O ports of 8051 and its programming in C • Understand the working of sensors, classify the sensors and explain the types of sensors. • Explain the functioning of proximity, pressure and motion sensors. • Learn the working of sensors used for temperature, flow and level measurement. • Describe the working of various types of actuators. • Differentiate various smart sensors and actuators. • Understand the applications of different types of industrial prime movers on the basis of their functional characteristics

	• Understand the working of fluid power supplies and the functions of different components in them • Identify present and future requirements of relevant industries.
PO3: Demonstrate routine and repetitive skills in narrow range of applications using appropriate rules and tools for quality.	• Understand the working environment of industries. • Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Use Thyristor in various control circuits • Implement various applications using Inverters, Choppers, Dual Converters • Design Control circuit of DC and AC Drives using Thyristors • Develop applications of Thyristor in Uninterrupted Power Supplies. • Describe the logic gates and able to perform logics simplification. • Design various combinational circuits • Develop various sequential circuits. • Analyze A/D & D/A converters and various memories. • Describe the structure and working of different types of robots and end-effectors and select the same for a given application • 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 • Operate a robot, write programs for simple applications and execute the programs • Understand the concepts of Computer Aided Design & Drafting and make 2D drawings in AutoCAD software. • Develop 3D CAD models of engineering

	components and prepare the CAD files for 3D printing. • Describe the need & principle 3D printing, Operate a 3D printer and use 3D printing software for setting process parameters. • Select a 3D printing technique for a given application based upon the principle & technologies of various 3D printing techniques and select optimum process parameters for 3D printing of given parts. • Use suitable techniques & equipment for post-processing of 3D printed parts and inspect/test 3D printed parts • Interpret the program for 8051 in C language. • Interpret the program for serial communication in C. • Interface the I/O devices to 8051. • Explain the functioning of proximity, pressure and motion sensors. • Describe the working of various types of actuators. • Differentiate various smart sensors and actuators. • Select different types of control valves on the basis of construction and applications for fluid power circuits • Select different types of linear and rotary actuators on the basis of construction and applications for fluid power circuits • Make connections between different components for implementing simple pneumatic and hydraulic power circuits for different applications • Identify present and future requirements of relevant industries. • Work as a team member for successful completion of minor project. • Acquire Life Long Learning skills.
PO4: Communicate with required clarity	• Develop required competencies for effective

along with social and natural environment understanding.	communication and presentation. • 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. • Write the minor project report effectively. • Present the minor project report using PPT.
PO5: Perform tasks with responsibility for own work and learning.	• Understand the working environment of industries. • Take necessary safety precautions and measures. • Learn about present and future requirement of industries. • Work in team for solving industrial problems. • Develop required competencies and skills for relevant industries. • Select the minor project according to the need of relevant industries. • Work as a team member for successful completion of minor project. Acquire Life Long Learning skills.
PO6: Select open elective of own interest to develop self-learning habit through online courses.	• State the basic concepts and principles about the subject of interest. • 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.

17. SUBJECTS & CONTENTS

(SECOND YEAR)

THIRD SEMESTER

3.1	Industrial/In-House Training - I	82 - 83
3.2	Drives and Control Systems	84 - 87
3.3	Digital Electronics	88 - 91
3.4	Robotics	92 - 95
3.5	Python Programming	96 - 103
3.6	AutoCAD and 3 D Printing	104 - 107

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 training, 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 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 / 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 DRIVES & CONTROL SYSTEMS

L	P
2	4

RATIONALE

Drives and control systems play a very vital role in the field of control engineering specifically in the modern industries as they mostly use electronic controls, which are more efficient, effective and precise as compare to the conventional methods. Automation and Robotics diploma holders many times have 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.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:
CO1: Use Thyristor in various control circuits
CO2: Understand various types of controlled rectifiers
CO3: Implement various applications using Inverters, Choppers, Dual Converters
CO4: Design Control circuit of DC and AC Drives using Thyristors
CO5: Develop applications of Thyristor in Uninterrupted Power Supplies

DETAILED CONTENTS

UNIT I

1.1. Construction and working principles of an SCR, two transistor analogy and characteristics of SCR
1.2. SCR specifications and rating
1.3. Construction, working principles and V-I characteristics of DIAC, TRIAC and Quadriac
1.4. Basic idea about the selection of heat sinks for SCR and TRIACS
1.5. Study of triggering circuits of a Thyristor.
1.6. Commutation of Thyristors
1.7. Series and parallel operation of Thyristors
1.8. dv/dt and di/dt protection of SCR.

1.9. Applications of SCR, TRIACS and Quadriac such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger etc.

1.10 Relay and Contactors

UNIT II

Fundamentals of Communication

2.1 Single phase half wave controlled rectifier with resistive load and inductive load, concept of free wheeling diode.

2.2 Single phase half controlled full wave rectifier

2.3 Single phase fully 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

3.1 Inverter-introduction, working principles, voltage and current driven series and parallel inverters and applications

3.2 Choppers-introduction, types of choppers and their working principles and applications

3.3 Dual converters-introduction, working principles and applications

UNIT IV

Thyristorised Control of Electric Drives

4.1 DC drives Control – Introduction to Thyristor controlled DC Drives, Control of DC Drives using Single Phase, Three Phase Semi and Fully Controlled Converters, Choppers

4.2 AC drives control- Concept of Phase control, Variable frequency a.c. drives, Constant V/F application, Voltage controlled inverter drives, Constant current inverter drives

4.3 Use of Variable Frequency Drive (VFD), Block diagram, basic principle and working, Functions and applications of VFD, Troubleshooting of VFD

UNIT V

Uninterrupted power supplies

5.1 Working of UPS with block diagram

5.2 Battery charger circuit using SCR with the help of a diagram.

5.3 Basic Switched mode power supply (SMPS) - its working & applications

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. Observe the output wave of an UJT relaxation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC Quadriac (fabrication of this circuit)
8. Speed-control of a DC shunt motor or universal motor
9. To observe the output wave shape on CRO of (a) Single phase half controlled full wave rectifier (b) Single phase controlled rectifier.
10. Speed control of induction motor using VFD.
11. Construction and troubleshooting of Basic battery charger.
12. Troubleshooting and fault finding in SMPS.
13. Troubleshooting and fault finding in UPS.

RECOMMENDED BOOKS

1. John Webb, Kevin Greshock, and 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. PC Sen, “Power Electronics”
5. Dr. PS Bhimbra, “Power Electronics” Khanna Publishers, New Delhi.
6. SK Bhattacharya and S Chatterji, “Industrial Electronics & Control by New Age”, International Publications(P) Ltd, New Delhi.
7. M.D.Singh and K. B. Khanchandani, “Power Electronics”, TMH Publishers.
8. JC Karhava, “Industrial Power Electronics”, King India Publication.
9. Samir K Datta, “Power Electronics and Controls”, Prentice Hall of India, New Delhi.
10. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.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. The students may also be taken to an industry using robots for various tasks. This subject contains five units of equal weight age.

3.3 DIGITAL ELECTRONICS

L	P
3	4

RATIONALE

This course has been designed to make the students know about the fundamental principles of digital electronics and gain familiarity with the available IC chips. This subject aims to give a detailed exposure of number systems and various codes. The students will understand various logic gates and their logic simplification. It will help the students to design various combinational, sequential circuits, converters and memories.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:
CO1: Understand various types of number systems and digital codes.
CO2: Describe the logic gates and able to perform logics simplification.
CO3: Design various combinational circuits
CO4: Develop various sequential circuits.
CO5: Analyze A/D & D/A converters and various memories.

DETAILED CONTENTS

UNIT I

Number Systems and Codes

1.1 Introduction to analog and digital signal
1.2 Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa.
1.3 Binary addition and subtraction including binary points. 1's and 2's complement method of addition/subtraction.
1.4 Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code.
1.5 Concept of parity, single and double parity and error detection

UNIT II

Logic Gates and Logic Simplifications

2.1 Concept of negative and positive logic

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

2.3 Introduction to TTL and CMOS logic families

2.4 Postulates of Boolean algebra, De Morgan's Theorems. Implementation of Boolean

2.5 Karnaugh map (upto 4 variables) and simple application in developing combinational logic circuits

UNIT III

Combinational Circuits

3.1 Half adder, Full adder circuit, design and implementation.

3.2 4 bit adder circuit

3.3 Four bit decoder circuits for 7 segment display and decoder/driver ICs.

3.4 Basic functions and block diagram of MUX and DEMUX with different ICs

3.5 Basic functions and block diagram of Encoder

UNIT IV

Sequential Circuits

4.1 Concept and types of latch with their working and applications

4.2 Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops. Difference between a latch and a flip flop

4.3 Introduction to Asynchronous and Synchronous counters. Binary counters, Divide by N ripple counters, Decade counter, Ring counter

4.4 Introduction and basic concepts including shift left and shift right.

4.5 Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.

4.6 Universal shift register

UNIT V

Converters and Memories

5.1 Working principle of A/D and D/A converters

5.2 Brief idea about different techniques of A/D conversion and study of :

a) Stair step Ramp A/D converter

b) Dual Slope A/D converter
c) Successive Approximation A/D Converter

5.3 Detail study of :
a) Binary Weighted D/A converter
b) R/2R ladder D/A converter

5.4 Applications of A/D and D/A converter.

5.5 Memory organization, classification of semiconductor memories (RAM, ROM, PROM, EPROM, EEPROM), static and dynamic RAM, introduction to 74181 ALU IC

PRACTICAL EXERCISES

1. Verification and interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) and Exclusive NOR(EXNOR) gates
2. Realisation of logic functions with the help of NAND or NOR gates
3. To design a half adder using XOR and NAND gates and verification of its operation
4. To design of a full adder circuit using XOR and NAND gates and verify its operation
5. To design circuit for 7 segment display ICs.
6. Verification of truth table for positive edge triggered, negative edge triggered, level triggered IC flip-flops (At least one IC each of D latch, D flip-flop, JK flip-flops).
7. Verification of truth table for encoder and decoder ICs.
8. Verification of truth table for Multiplexers and x and De-Multiplexers
9. To design a 4 bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flops and verification of their operation.
10. To design a 4 bit ring counter and verify its operation.
11. Use of Asynchronous Counter ICs (7490 or 7493)
12. To design and verification of A/D converter
13. To design and verification of D/A converter
14. To design and verification of 74181 ALU IC

RECOMMENDED BOOKS

1. Malvino Leach, “Digital Electronics and Applications”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 8th Edition, 2015.
2. Morris Mano, “Digital Logic Designs”, Prentice Hall of India, New Delhi, 6th Edition, 2018.
3. Soumitra Kumar Mandal, “Digital Electronics”, Tata McGraw Hill Education Pvt. Ltd., 2010.

4. V K Sangar, “Digital Electronics”, Raj Publishers, Jalandhar, 2017.
5. Tokheim, “Digital Electronics”, Tata McGraw Hill Education Pvt. Ltd, 4th Edition, 2007.
6. Thomas Floyds, “Digital Fundamentals”, Universal Book Stall, 11th Edition, 2017.
7. RP Jain, “Digital Electronics”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 4th Edition, 2010.
8. KS Jamwal, “Digital Electronics”, Dhanpat Rai and Co., New Delhi, 2010.
9. Yashpal and Sanjeev Kumar, “Digital Electronics”, North Publication, Ambala City, 1st Edition, 2020.
10. BR Gupta, “Digital Electronics”, Dhanpat Rai & Co., New Delhi, 2020.
11. RJ Tocci, “Digital Systems: Principles and Applications”, Prentice Hall of India, New Delhi, 2000 Edition.
12. V. Rajaraman, “Digital Electronics by Prentice Hall of India”, New Delhi, 5th Edition, 2007.
13. Naresh Gupta, “Fundamentals of Digital Electronics”, Jain Brothers, New Delhi, 2005.
14. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.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. This subject contains five units of equal weight age. All experiments may preferably be done on Bread Boards.

3.4 ROBOTICS

L	P
2	4

RATIONALE

Robots are widely employed in the industry to enhance productivity, meet stringent quality requirements and implement frequent setup changes. Therefore, this subject gives the knowledge of fundamental concepts, components and working of robots and the skill to operate and program a robot. Students will study various types of robotic configurations, actuators and sensors to enable them to select a robotic system for a given application. Students will also learn the operation and control of a robot through teach pendant and programming.

COURSE OUTCOMES

After undergoing this subject, the students 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: Operate a robot, write programs for simple applications and execute the programs

DETAILED CONTENTS

UNIT I

Introduction to Robotics

1.1 History of Robots and Laws of Robotics

1.2 Robot Definitions – by International Organizations for Standardization (ISO) and Robotics Institute of America (RIA)

1.3 Robot Subsystems – Motion, recognition, control

1.4 Classification of Robots – Industrial robots, non-industrial robots, special purpose robots
1.5 Industrial Applications – material handling, welding, painting, assembly

UNIT II

Robot Configurations and Grippers

2.1 Kinematic chains – closed, open, degrees of freedom
2.2 Robot Links and Joints – revolute, prismatic, helical, cylindrical, spherical, Concept of work Volume/envelope.
2.3 Robot Configurations – Cartesian, cylindrical, polar, articulated, SCARA and their work volumes.
2.4 Grippers – mechanical, magnetic, vacuum, adhesive, hooks, scoops
2.5 Selection of Robot and End-Effector

UNIT III

Actuators

3.1 Electric Actuators – stepper motors, dc motors, ac motors, solenoids
3.2 Electric Motors Control – pulse width modulation, direction control, speed control
3.3 Fluid Power Actuators – hydraulic, pneumatic, components
3.4 Fluid Power Actuators Control - circuits, force control, speed control
3.5 Advantages and disadvantages – electric, pneumatic and hydraulic actuators
3.6 Selection of Actuator

UNIT IV

Sensors

4.1 Robotic Sensors – functions, classification
4.2 Internal Sensors – position: encoder, potentiometer, LVDT, velocity: tachometer, Hall-effect, acceleration, force: strain gauge based, piezoelectric based, current based
4.3 External Sensors – limit switches, proximity sensors, displacement
4.4 Vision System – functions, elements, overview of steps in vision sensing
4.5 Sensor Selection

UNIT V

Robot Operation & Programming

5.1 Teach Pendants – keypad layout, teach mode, play mode
5.2 Operation in Joint Mode – joint selection, joint movement
5.3 Operation in Cartesian Mode – axis selection, movement along x, y and z axes

5.4 Teaching Robot Wrist Positions – manual positioning, setting speed, recording positions

5.5 Programming using Teach Pendant– making simple programs, homing, using recorded positions

5.6 Programming using Arduino microcontroller – layout, interfacing sensors with Arduino, simulating circuits with Tinker CAD, simple robot programs using Arduino and proximity sensors

PRACTICAL EXERCISES

1. Study of a robotic manipulator and its components.
2. Study of working of 2-Finger and 3-Finger mechanical grippers.
3. Study of working of vacuum / magnetic end-effectors.
4. Study of functioning of proximity sensor and potentiometer using digital multimeter.
5. Study of sensors used for sensing/measuring various parameters e.g. Position, temperature etc. in robotic systems.
6. Study of robot Teach-pendant functions
7. Use of Teach-Pendant in moving robot wrist in joint space mode and Cartesian space mode
8. Use of teach-pendant for recording wrist positions and speed control.
9. Use of teach-pendant for making a program for simple pick and place operations from the recorded wrist positions.
10. Use of teach-pendant for making a program for picking objects from one location and placing them on a stack in another location
11. Arduino programming and simulation for 3 LEDs in sequence in TinkerCAD
12. Ultrasonic sensor interface with Arduino and distance measurement testing
13. DC motor directional control using Arduino
14. Obstacle detection using ultrasonic sensor and Arduino

RECOMMENDED BOOKS

1. S. K. Saha, “Introduction to Robotics”, TATA McGraw Hills Education, 2014.
2. S. Mukherjee, “Essentials of Robotics Process Automation”, Khanna Book Publishing Co., 2019.
3. S. B. Nikku, “Introduction to Robotics – Analysis, Control, Applications”, John Wiley & Sons Ltd., 3rd Edition, 2020.
4. Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, “Industrial Robotics”, SIE , McGraw Hill Education (India) Pvt Ltd, 2nd Edition, 2012.

5. R. D. Klafter, Thomas A. Chmielewski, and Michael Negin, “Robotic Engineering – An Integrated Approach”, EEE, Prentice Hall India, Pearson Education Inc., 2009.

SUGGESTED WEBSITES

1. RoboAnalyzer - RoboAnalyzer: 3D Model Based Robotics Learning Software: Home Page
2. https://www.tinkercad.com/learn/circuits
3. https://www.arduino.cc/en/software
4. https://swayam.gov.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. The students may also be taken to an industry using robots for various tasks. This subject contains five units of equal weight age.

3.5 PYTHON PROGRAMMING

L	P
3	4

RATIONALE

This subject introduces to the students the Python language. Upon completion of this subject, the student will be able to write non trivial Python programs dealing with a wide variety of subject matter domains. Topics include language components, the IDLE/IDE environment, control flow constructs, strings, I/O, collections, classes, modules, and regular expressions

COURSE OUTCOMES

After undergoing this subject, the students will be able to:
CO1: Implement Python programs utilizing arithmetic expressions, repetition, file Input and Output.
CO2: Demonstrate the use of the built-in data structures in Python.
CO3: Employ control structures, functions, and arrays to create Python programs.
CO4: Understand the concepts of object-oriented programming as used in Python.
CO5: Define the use of GUI and databases using Python.

DETAILED CONTENTS

UNIT I

The way of the program: The Python programming language, What is a program? What is debugging?, Syntax errors, Runtime errors, Semantic errors, Experimental debugging.
Variables, Expressions and Statements: Values and data types, Variables, Variable names and keywords, Statements, Evaluating expressions, Operators and operands, Type converter functions, Order of operations, Operations on strings, Input, Composition, The modulus operator.

Conditionals: Boolean values and expressions, Logical operators, Simplifying Boolean Expressions, Conditional execution, Chained conditionals, Nested conditionals, The return statement, Logical opposites.

UNIT II

Iteration: Assignment, Updating variables, The for loop, The while statement, The Collatz 3n + 1 sequence, Tables, Two-dimensional tables, Paired Data, Nested Loops for Nested Data.
Strings: Working with strings as single things, Working with the parts of a string, Length, Traversal and the for loop, Slices, String comparison, Strings are immutable, The in and not in operators, A find function, Looping and counting, Optional parameters, The built-in find method, The split method, Cleaning up your strings, The string format method.
Tuples: Tuples are used for grouping data, Tuple assignment, Tuples as return values, Composability of Data Structures.
Lists: List values, Accessing elements, List length, List membership, List operations, List slices, Lists are mutable, List deletion, Objects and references, Aliasing, Cloning lists, Lists and for loops, List parameters, List methods, Pure functions and modifiers, Functions that produce lists, Strings and lists, list and range, Nested lists, Matrices.
Functions: Functions with arguments and return values

UNIT III

Modules: Random numbers, The time module, The math module, Creating your own modules, Namespaces, Scope and lookup rules, Attributes and the dot operator.
Files: About files, Writing our first file, Reading a file line-at-a-time, Turning a file into a list of lines, Reading the whole file at once, Working with binary files, Directories, fetching something from the web. **List Algorithms:** Linear search, Binary search, Merging two sorted lists

UNIT IV

Object oriented programming: Classes and Objects — The Basics, Attributes, Adding methods to our class, Instances as arguments and parameters, Converting an instance to a string, Instances as return values, Objects are mutable, Sameness, Copying.
Exceptions: Catching exceptions, Raising our own exceptions, The finally clause of the try statement **Inheritance:** Polymorphism, Generalization, Pure functions

UNIT V

GUI: Creating Graphical User Interfaces, Using Module Tkinter, Building a Basic GUI, Models, Views, and Controllers, Customizing the Visual Style, Few More Widgets.
Databases: Overview, Creating and Populating, Retrieving Data, Updating and Deleting, Using NULL for Missing Data, Using Joins to Combine Tables, Keys and Constraints, Advanced Features.

PRACTICAL EXERCISES

Part A

1. Let list1 and list2 be two lists of integers. Implement function sublist() that takes as input lists list1 and list2 and returns True if list1 is a sublist of list2, and False otherwise.

   ```
   >>> sublist([15, 1, 100], [20, 15, 30, 50, 1, 100])
   True
   >>> sublist([15, 50, 20], [20, 15, 30, 50, 1, 100])
   False
   ```

2. Write function vowelCount() that takes a string as input and counts and prints the number of occurrences of vowels in the string.

   ```
   >>> vowelCount('Le Tour de France')
   a, e, i, o, and u appear, respectively, 1, 3, 0, 1, 1 times.
   ```

3. The cryptography function crypto() takes as input a string (i.e., the name of a file in the current directory). The function should print the file on the screen with this modification: Every occurrence of string 'secret' in the file should be replaced with string 'xxxxxx'.

   ```
   >>> crypto('crypto.txt')
   I will tell you my xxxxxx. But first, I have to explain
   why it is a xxxxxx.
   And that is all I will tell you about my xxxxxx.
   ```

4. Write a function stats() that takes one input argument: the name of a text file. The function should print, on the screen, the number of lines, words, and characters in the file; your function should open the file only once.

   ```
   >>>stats('example.txt')
   line count: 3
   word count: 20
   character count: 98
   ```

5. Implement function distribution () that takes as input the name of a file (as a string). This one-line file will contain letter grades separated by blanks. Your function should print the distribution of grades, as shown.

```
>>> distribution('grades.txt')
6 students got A
2 students got A-
3 students got B+
2 students got B
2 students got B-
4 students got C
1 student got C-
2 students got F
```

6. The function censor () takes the name of a file (a string) as input. The function should open the file, read it, and then write it into file censored.txt with this modification: Every occurrence of a four-letter word in the file should be replaced with string 'xxxx'.

```
>>> censor ('example.txt')
```

Note that this function produces no output, but it does create file censored.txt in the current folder.

7. Create a dictionary for phones and their prices. Write functions to add a new entry (phone:price) ,search for a particular phone and retrieve it's price, given price find phones with same price , remove an entry, display all phones sorted according to price. [Program must be menu driven]
8. Write a Python program that prompts the user to enter a list of first names and stores them in a list. The program should display how many times the letter 'a' appears within the list.
9. Write a Python program that prompts the user to enter integer values for each of two lists. It then should displays whether the lists are of the same length, whether the elements in each list sum to the same value, and whether there are any values that occur in both lists.
10. Implement and test a Python program that determines if all parentheses in an entered line of code form matching pairs. Note: Pairs of parentheses may be nested.
11. Suppose variable s has been assigned in this way:

```
s = '''It was the best of times, it was the worst of times; it
was the age of wisdom, it was the age of foolishness; it was the
epoch of belief, it was the epoch of incredulity; it was ...'''
```

Then do the following, in order, each time:

(a) Write a sequence of statements that produce a copy of s, named newS, in which characters ., ,, ;, and \n have been replaced by blank spaces.

(b) Remove leading and trailing blank spaces in newS (and name the new string newS).

(c) Make the all characters in newS lowercase (and name the new string newS).

(d) Compute the number of occurences in newS of string 'it was'.

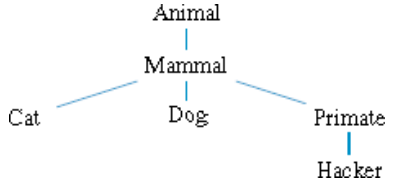
(e) Change every occurence of was to is (and name the new string newS).

(f) Split newS into a list of words and name the list listS.

12. The function avgavg() takes as input a list whose items are lists of three numbers. Each three-number list represents the three grades a particular student received for a course. For example, here is an input list for a class of four students:
[[95,92,86], [66,75,54],[89, 72,100],[34,0,0]]
The function avgavg() should print, on the screen, two lines. The first line will contain a list containing every student's average grade. The second line will contain just one number: the average class grade, defined as the average of all student average grades.
>>> avgavg([[95, 92, 86], [66, 75, 54],[89, 72, 100], [34, 0, 0]])
[91.0, 65.0, 87.0, 11.333333333333334]
63.5833333333

13. Implement function names () that takes no input and repeatedly asks the user to enter the first name of a student in a class. When the user enters the empty string, the function should print for every name the number of students with that name.
>>> names ()
Enter next name: Valerie
Enter next name: Bob
Enter next name: Valerie
Enter next name: Amelia
Enter next name: Bob
Enter next name:
There is 1 student named Amelia
There are 2 students named Bob
There are 2 students named Valerie

14. Consider the class tree hierarchy:



Implement six classes to model this taxonomy with Python inheritance. In class Animal, implement method speak() that will be inherited by the descendant classes of Animal as is. Complete the implementation of the six classes so they exhibit this behavior:

```
>>> garfield = Cat()
>>> garfield.speak()
Meeow
>>> dude = Hacker()
>>> dude.speak( )
Hello world!
```

Part B

1. Numerologists claim to be able to determine a person's character traits based on the numeric value" of a name. The value of a name is determined by summing up the values of the letters of the name where 'a' is 1, 'b' is 2, 'c' is 3 etc., up to 'z' being 26. For example, the name ""Zelle""would have the value 26+5+12+12+5=60 (which happens to be a very auspicious number, by the way). **Write a program that calculates the numeric value of a single name provided as input.** (Hint: Use dictionary, strings and its methods)
2. Expand your solution to the previous problem to allow the **calculation of a complete name** such as "John Marvin Zelle"" or ""John Jacob Jingleheimer Smith". The total value is just the sum of the numeric values of all the names.
3. **Write a python program with function inner_product(x,y)** that computes the inner product of two (same length) lists. For example: list1=[1,2,3,4,5] and list2=[1,2,3,4,5]. The inner product list is inner_product=[1,4,9,16,25].
4. The **Sieve of Eratosthenes** is an elegant **algorithm** for finding all of the prime numbers up to some limit n. The basic idea is to first create a list of numbers from 2 to n. The first number is removed from the list, and announced as a prime number, and all multiples of this number up to n are removed from the list. This process continues until the list is empty.
    a) For example, if we wished to find all the primes up to 10, the list would originally contain 2, 3, 4, 5, 6, 7, 8, 9, 10.
    b) The 2 is removed and announced to be prime.
    c) Then 4, 6, 8, and 10 are removed, since they are multiples of 2.
    d) That leaves 3, 5, 7, 9.
    e) Repeating the process, 3 is announced as prime and removed, and 9 is removed because it is a multiple of 3.

f) That leaves 5 and 7. The algorithm continues by announcing that 5 is prime and removing it from the list.

g) Finally, 7 is announced and removed, and we're done.

Write a program that prompts a user for n and then uses the sieve algorithm to find all the primes less than or equal to n. (Hint: Use list. Remove () method)

5. Write a function that returns the index of the smallest element in a list of integers. If the number of such elements is greater than 1, return the smallest index. Use the following header:

   def index Of Smallest Element (lst):

   Write a program that prompts the user to enter a list of numbers, invokes this function to return the index of the smallest element, and displays the index.

6. **(Count occurrences of numbers)** Write a program that reads an unspecified number of integers and finds the ones that have the most occurrences. For example, if you enter 2 3 40 3 5 4 –3 3 3 2 0, the number 3 occurs most often. Enter all numbers in one line. If not one but several numbers have the most occurrences, all of them should be reported. For example, since 9 and 3 appear twice in the list 9 30 3 9 3 2 4, both occurrences should be reported

7. **Morse Code Encryption/Decryption Program:** Develop and test a Python program that allows a user to type in a message and have it converted into Morse code, and also enter Morse code and have it converted back to the original message. The encoding of Morse code is given below.

A	.-	N	-.
B	-...	O	---
C	-.-.	P	.--.
D	-..	Q	--.-
E	.	R	.-.
F	..-.	S	...
G	--.	T	-
H	....	U	..-
I	..	V	...-
J	.---	W	.--
K	-.-	X	-..-
L	.-..	Y	-.--
M	--	Z	--..

Format the original message (containing English words) so that there is one sentence per line. Format the Morse code fi le (containing dots and dashes) so that there is one letter per line, with a blank line following the last letter of each word, and two blank lines following the end of each sentence (except the last).

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 2", M/S Abhishek Publications, Chandigarh.
2. A Downey, J. Elkner, and C. Meyers, "How to think like a computer scientist: learning with python. Green Tea Press", Wellesley, Massachusetts, 2002.
3. J. Campbell, P. Gries, J. Montojo, and G. Wilson, "Practical programming: an introduction to computer science using Python", Pragmatic Bookshelf, Second Edition, 2013.
4. A. B. Downey, "Python for software design: how to think like a computer scientist", Cambridge University Press, 2009.
5. Z. A. Shaw, "Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code", Addison-Wesley, 2013.

SUGGESTED WEBSITES

1. http://swayam.gov.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. The students may also be taken to an industry using robots for various tasks. This subject contains five units of equal weight age.

3.6 AUTOCAD AND 3D PRINTING

L	P
2	4

RATIONALE

Additive manufacturing offers the ability to produce personalized products, develop new products with lower developmental costs and manufacture complex parts using 3D CAD models. This technology is finding increasing use in the industry globally. Therefore, it is necessary to impart relevant knowledge and skills to the students. Students will learn CAD modelling, different types of 3D printing techniques and working of related hardware/software to enable them to select a 3D printing technique for a given application. Students will also learn the basic operation of a 3D printer and 3D printing application software.

COURSE OUTCOMES

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

CO1: Understand the concepts of Computer Aided Design & Drafting and make 2D drawings in AutoCAD software.

CO2: Develop 3D CAD models of engineering components and prepare the CAD files for 3D printing.

CO3: Describe the need & principle 3D printing, Operate a 3D printer and use 3D printing software for setting process parameters.

CO4: Select a 3D printing technique for a given application based upon the principle & technologies of various 3D printing techniques and select optimum process parameters for 3D printing of given parts.

CO5: Use suitable techniques & equipment for post-processing of 3D printed parts and inspect/test 3D printed parts.

DETAILED CONTENTS

UNIT I

Introduction to AutoCAD

1.1 Computer Aided Drafting and Design – Graphic standards, Coordinate systems, Difference of UCS and WCS coordinates, Applications.

1.2 AutoCAD User Interface – AutoCAD window, Menus, Toolbars, Opening new/existing files, Saving a file.

1.3 Geometric Constructions– Making lines, circles, rectangles, polylines, splines(Keyboard shortcuts for these commands); Specifying polar and relative coordinates; Using symbols and blocks; Creating and assigning layers; Editing existing drawing elements, Basic editing commands and their applications for making drawing, creating viewports and PAN command.

1.4 Productivity Tools – Using fillet/chamfering tools; Copying objects; Making polar and rectangular arrays; Drawing parallel lines; Finding distances along arcs; Using grid and snap modes.

1.5 Annotation and Dimensioning – Adding text and special characters to drawing; Creating dimension style; Dimensioning lines, curves and angles; Editing dimensions, Hatching for showing sectioning , Prepare drawings & detailing: Named views, standard 3views, auxiliary views, section views and detail views.

UNIT II

CAD for 3D Printing

2.1 Creating 3D Models – Using UCS and WCS; Using 3D primitives; Drawing 3D surfaces; Making a solid model from 2D drawing; sketching and extruding, Isometric and orthogonal views.

2.2 3DModeling Tools – Union, Subtract, Revolve, Sphere, Slicing, Sectioning, Fillet, Chamfer, Threading; Interference checking; Converting 3D solid model to 2D drawing.

2.3 Calculation Tools –Mass properties, Area of an object, Area of complex shapes, Location of an object.

2.4 File format for 3D Printing –Working with meshes, Stereo-lithography (STL) file format; Problems with STL files, Optimizing design for 3D printing; Saving AutoCAD file as STL file.

UNIT III

Introduction to 3D Printing

3.1 Fundamentals – Definition, Core process, Terminology, Applications

3.2 Classification – Process category, Technology, Metal Systems, Hybrid systems, Materials

3.3 Additive Manufacturing(AM) Equipment – Components, Features, Steps in AM, Uploading CAD files for 3D printing, Operation, AM Process Chain, Applications of AM - Automotive Industries and Suppliers, Toy Industry.

3.4 Materials – Polymers, relate polymer properties to their processing and uses for 3D Printing, Metals, Bio-gels, Use of Multiple Materials in 3D Printing-Porous, Blended.

3.5 3D Printing Software – Commercial and Open-source software, Features, 3D Printing Simulation.

3.6 Additive v/s Conventional Manufacturing – Benefits and Limitations.

UNIT IV

3D Printing Techniques

4.1 Vat Photo-polymerization – Principle, Technologies, Parameters, Benefits, Limitations.

4.2 Material Extrusion – Principle, Technologies, Parameters, Benefits, Limitations.

4.3 Powder Bed Fusion – Principle, Technologies, Parameters, Benefits, Limitations.

4.4 Material Jetting – Principle, Technologies, Parameters, Benefits, Limitations.

4.5 Direct Energy Deposition – Principle, Technologies, Parameters, Benefits, Limitations.

4.6 Design Considerations – Layer height, Part shrinkage, Part warping, Part support, Fillets.

4.7 Process Selection Factors – Part design, Quality, Part Volume, Aesthetics, Price.

UNIT V

Post-Processing and Product Quality

5.1 Requirements – Support removal, Smooth surface, Mechanical properties, Aesthetics.

5.2 Techniques – Hand tools, Ultrasonic tank, Industrial ovens, Band saw, Wire-cut EDM, CNC Machine, Heat treatment equipment.

5.3 Inspection and Testing–Visual inspection, Metrology, Non-destructive testing, Surface roughness measurement, Mechanical testing, In-process testing.

5.4 Defects and their causes–Shrinkage, Warping, Porosity, Cracks.

PRACTICAL EXERCISES

1 Making 2D drawings of simple components in AutoCAD.

2 Applying Editing, Dimensioning etc. commands.

3 Making 3D models using solid primitives.

4 Making 3D models from 2D drawings and vice-versa.

5 3D Modelling of a threaded bolt with square head.

6 3D Modelling of a hexagonal nut with internal threads.

7 Assembly modeling of nut and bolt.

8 Generation of .stl files of identified products from AutoCAD files.

9 Setting parameters in 3D printing software and simulating 3D printing.

10 Printing of identified product on an available AM machine.
11 Post processing of additively manufactured product.
12 Dimensional inspection and surface roughness measurement of the additively manufactured product.
13 Non-destructive testing of the additively manufactured product.
14 Comparison of mechanical properties of additively manufactured product with conventionally manufactured counterpart.
15 Converting CT/MRI scan data into STL file using MIMICS software (Demo).

RECOMMENDED BOOKS

1. Sandeep Dogra, "AutoCAD 2022: A Power Guide for Beginners and Intermediate Users", CAD Artifex, 2021.
2. C.P. Paul, and A.N. Jinoop, "Additive Manufacturing", McGraw Hill, 2021.
3. Sabrie Soloman, "3D Printing and Design", Khanna Book Publishing Co.", 2018.
4. Chee Kai Chua, Kah Fai Leong, "3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping", World Scientific, 2003.

SUGGESTED WEBSITES

1 https://www.autodesk.in/products/autocad/free-trial
2 https://pinshape.com/
3 http://swayam.gov.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. The students may also be taken to an industry using robots for various tasks. This subject contains five units of equal weight age.

FOURTH SEMESTER

4.1	English and Communication Skills - II	108 - 112
4.2	Microprocessor & Micro-controllers	113 - 115
4.3	Sensors and Actuators	116 - 118
4.4	Fluid Power Systems	119 - 122
4.5	Open Elective (MOOCs/Offline)	123 - 125
4.6	Minor Project	126 - 127

4.1 ENGLISH AND COMMUNICATION SKILL - 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 MICROPROCESSOR AND MICRO-CONTROLLERS

L	P
3	4

RATIONALE

Microprocessor and microcontrollers are the most useful electronic chips which are used to design and develop processor and computer based automatic smart electronics systems for home and industry application. This subject is devoted to the study of microprocessor and microcontroller interfacing of memory and I/O devices like A to D converter, D to A converter LED, LCD etc. The students learn Programming of microcontroller using C language. The subject will help the students to study concepts of embedded system. It will also help to understand design of simple microcontroller systems.

COURSE OUTCOMES

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

CO1: Analyse Architecture of 8051 microcontroller IC.
CO2: Interpret the program for 8051 in C language.
CO3: Understand the Timer and I/O ports of 8051 and its programming in C
CO4: Interpret the program for serial communication in C.
CO5: Interface the I/O devices to 8051.

DETAILED CONTENTS

UNIT I

Introduction to Microprocessors and Microcontrollers

1.1 Basic Introduction and comparison of Microcomputer, Microprocessor, and Microcontroller, Selection of Microcontroller
1.2 Introduction to 8051- History, Architecture, Pin Diagram, Crystal Circuit, Reseat Circuit.

UNIT II

Programming Languages and Instruction Set

2.1 Different Types of Programming languages for 8051, Advantages of Programming in C
2.2 Addressing Modes

2.3 Instruction Set of 8051
2.4 Types of Instructions
2.5 Data types and time delay in 8051, I/O programming in 8051 C,
2.6 Hex file generation using Keil Compiler

UNIT III

8051 Timers

3.1 Timers and Registers of 8051, Timer / Counter logic and modes
3.2 Programming of 8051 timers, Programming Timer 1 using C

UNIT IV

Serial Port Communication

4.1 Serial Port of 8051 –Basics of serial communication, Serial Communication-SCON, SBUF; Modes of serial communication
4.2 8051 connection to RS232
4.3 Interrupts

UNIT V

Real World Interfacing with 8051

5.1 I/O Interfacing – LED, LCD and Keyboard Interfacing
5.2 Interfacing ADC and DAC
5.3 Sensor Interfacing and Signal Conditioning

PRACTICAL EXERCISES

1. Understand 8051 development board
2. Generating Hex File using Keil Compiler
3. Programming and interfacing of RELAY and Buzzer
4. Programming to interface switches and LEDs
5. Programming and interfacing of LCD
6. Programming for A/D converter, result on LCD.
7. Programming for D/A converter, result on LCD
8. Interfacing Stepper Motor with 8051.
9. Interfacing different sensors with 8051.

RECOMMENDED BOOKS

1. "8051 Microcontroller, Architecture programming & application", K. J. Ayala EEE/ Prentice Hall of India.
2. Mohmad-ali-mazidi, Janice-elispe- Mazidi, Roline D. Mckinlay, "The 8051 microcontroller & embedded system", Pearson / Prentice hall.
3. Satish Shaha, "8051 Microcontroller Mcs-51 family and its variant", Oxford.
4. Rajkamal, "Microcontroller Architecture, programming, interfacing, & system design", Pearson.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. http://www.nitttrchd.ac.in/nctel/electrical.php

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 weight age.

4.3 SENSORS AND ACTUATORS

L	P
3	4

RATIONALE

This subject plays very important role in automation of various processes for industries. Automation and Robotics students at this level must have the required knowledge of various sensors and actuators used for automation of different processes. This subject will give exposure to the students about various sensors like proximity, pressure, motion, temperature, flow and level sensors. It will further help the students to acquire knowledge about various actuators used in process automation like electrical and micro actuators.

COURSE OUTCOMES

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

CO1: Understand the working of sensors, classify the sensors and explain the types of sensors.
CO2: Explain the functioning of proximity, pressure and motion sensors.
CO3: Learn the working of sensors used for temperature, flow and level measurement.
CO4: Describe the working of various types of actuators.
CO5: Differentiate various smart sensors and actuators.

DETAILED CONTENTS

UNIT I

Introduction to Sensors

Sensors, Classification of sensors, Static and Dynamic.

Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers.

UNIT II

Proximity, Pressure and Motion Sensors

Inductive Proximity sensor- Capacitive Proximity sensor -Pneumatic Proximity sensors- Proximity Switches.

Diaphragm Pressure Sensor- Capsule Pressure sensors- Bellows Pressure Sensor- Bourdon tube pressure sensor- Piezoelectric Sensor – MEMS Sensors.

UNIT III

Temperature, Flow and Level Sensors

Thermocouples, Thermistors, Resistance Temperature Detector, Infrared Thermography.

Flow Measurement: Orifice plate, Venturi tube, Rotameter, Electromagnetic flow meter, Ultrasonic flow sensor.

Level Measurement: Float level sensor, Variable capacitance sensor.

UNIT IV

Actuators

Definition, types and selection of Actuators; linear; rotary; Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Hydraulic actuator.

Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C.

UNIT V

Smart Sensors and Actuators

Introduction to smart sensors, bio-sensors, nano-sensors and micro Sensors: Principles and examples.

PRACTICAL EXERCISES

1. Demonstrate the working of sensors to detect the presence of an object.
2. Design circuit for reading resistive type sensor in microcontroller.
3. Testing of resistive type sensor working using Tinkercad simulator.
4. Demonstrate the working of sensors to measure the flow and speed of any fluid.
5. Demonstrate the working of sensors to detect and measure the movement of an object.
6. Demonstrate the working of sensors to monitor and control the temperature in a room or factory floor.
7. Demonstrate the working of sensors to monitor the level of a liquid in a tank.
8. Demonstrate the working of actuators to convert a control signal into mechanical motion.
9. Learn the working of smart sensors and actuators in various automation processes.

RECOMMENDED BOOKS

1. Patranabis. D, “Sensors and Transducers”, Wheeler Publisher, 1994.
2. Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” Fourth Edition, Springer, 2010.
3. Robert H Bishop, “The Mechatronics Hand Book”, CRC Press, 2002.
4. Thomas. G. Bekwith and Lewis Buck.N, “Mechanical Measurements”, Oxford and IBH Publishing Co. Pvt. Ltd.
5. Massood Tabib and Azar, “Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures”, First edition, Kluwer academic publishers, Springer, 1997.
6. Manfred Kohl, “Shape Memory Actuators”, first edition, Springer.

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://nptel.ac.in
3. www.tinkercad.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 weight age.

4.4 FLUID POWER SYSTEMS

L	P
3	2

RATIONALE

Fluid power systems offer many advantages vis-à-vis electrical actuation systems. Hydraulic and Pneumatic power systems are widely used in the industry for manufacturing and material handling applications. These systems are also used in automobiles, marine and aerospace applications for lifting heavy loads and control. This course will impart relevant knowledge and skills to the students for assembling and operating fluid power circuits using different types of cylinders and control valves.

COURSE OUTCOMES

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

CO1: Understand the applications of different types of industrial prime movers on the basis of their functional characteristics

CO2: Understand the working of fluid power supplies and the functions of different components in them

CO3: Select different types of control valves on the basis of construction and applications for fluid power circuits

CO4: Select different types of linear and rotary actuators on the basis of construction and applications for fluid power circuits

CO5: Make connections between different components for implementing simple pneumatic and hydraulic power circuits for different applications

DETAILED CONTENTS

UNIT I

Introduction

1.1 Industrial Prime Movers – Definition, Types, Characteristics.

1.2 Major Parameters - Mass, Force, Pressure, Temperature, Flow, Work, Energy, Power, Torque.

1.3 Principles - Pascal’s Law, Gas Laws

1.4 Fluid power circuit components – Power supplies, cylinders, control valves, piping, hoses and connections

1.5 Applications - Manufacturing, Automation, Automobile, Aerospace, Marine

UNIT II

Hydraulic and Pneumatic Power Supplies

2.1 Types of Hydraulic Pumps - Gear, Vane, Piston

2.2 Hydraulic Power Supply - Sump, Pump, Accumulator, Filters, Load, Pressure Regulation

2.3 Types of Air Compressors - Piston, Screw, Rotary

2.4 Pneumatic Power Supply - Compressor, Air Receiver, Filters, Air Dryers, Lubricators, Pressure Regulation

2.5 Working Fluids - Types, Properties

UNIT III

Control Valves

3.1 Graphic Symbols - Two position valves, Three position valves, Valve Actuation, Connecting lines

3.2 Construction - Poppet, Spool, Rotary Valves

3.3 Types of Control Valves - Directional, Pressure, Flow Control, Pilot Operated, Check Valves

3.4 Special Valves - Shuttle & Quick-Exhaust, Sequence, Time Delay, Proportional, Servo valves

UNIT IV

Actuators

4.1 Linear Actuators - Construction, Cylinder Cushioning, Single Acting, Double Acting, Telescopic

4.2 Cylinder Dynamics – Pressure variation in cylinder chambers and Piston Acceleration during Working Stroke

4.3 Mounting Arrangements and Seals – Cylinder Mounting Methods, Different Types of Seals for preventing Internal and External Leakage in Cylinders

4.4 Rotary Actuators – Hydraulic and Pneumatic Rotary Actuators, Starting Torque, Stall Torque, Rotary Actuator Symbols

UNIT V

Fluid Power Circuits

5.1 Directional control of a single acting pneumatic cylinder using push-button operated 3/2 DC valve

5.2 Directional control of a double acting hydraulic cylinder using lever operated 4/2 DC valve

5.3 Directional Control of a double acting pneumatic cylinder using a 3/2 push-button operated pilot valve with a 5/2 DC valve as final control element

5.4 Meter-in and Meter-out based speed control of a hydraulic cylinder using flow control valves

5.5 Sequencing operation of two hydraulic/pneumatic cylinders using (a) roller operated valves and (b) pressure based sequencing valve

PRACTICAL EXERCISES

1. To study components and functioning of a hydraulic power pack.
2. To study components and functioning of a pneumatic fluid power supply.
3. To study different types of DC control valves and actuators in hydraulic fluid power system.
4. To study different types of DC control valves and actuators in pneumatic fluid power system.
5. To study the working of speed and pressure control valves in fluid power circuits.
6. To study a pneumatic logic circuit using a pilot operated DC valve.
7. To operate a linear hydraulic actuator using 4/2 and 4/3 DC valves.
8. To operate rotary pneumatic or hydraulic motors using two and three position DC valves.
9. To operate single acting and double acting linear pneumatic actuators using 3/2 and 5/2 DC electro-pneumatic valves respectively.
10. To study the application of fluid power circuits in robots.

RECOMMENDED BOOKS

1. S Majumdar, “Pneumatic Systems: Principles and Maintenance”, McGraw Hill Education, 2017.
2. S. Majumdar, “Oil Hydraulic Systems: Principles and Maintenance”, McGraw Hill Education, 2017.
3. Andrew Parr, “Hydraulics and Pneumatic: A Technician’s and Engineer’s Guide”, Jaico

Publishing House, 1993.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://fluidsim.en.softonic.com/
3. https://softadvice.informer.com/Free_Hydraulic_Simulation_Software.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.

4.5 OPEN ELECTIVE

L	P
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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 different 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/

4.6 MINOR PROJECT

L	P
-	8

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 acquainted with desired attributes for industrial environment. For this purpose, students are required to be involved in Minor Project Work 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 interest of the students, they can develop minor projects as per present and future demand of the 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 4-5 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 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%

THIRD YEAR

NSQF LEVEL - 5

18. STUDY AND EVALUATION SCHEME

FIFTH 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	
5.1	Industrial Training - II	-	2	0+1=1	-	40	40	-	60	60	100
5.2	Electronic Instrumentation and Measurements	3	4	3+2 =5	40	40	80	60	60	120	200
5.3	**PLC and SCADA	2	4	2+2 =4	40	40	80	60	60	120	200
5.4	Industrial IoT	2	4	2+2 =4	40	40	80	60	60	120	200
5.5	CAD and CAM	3	4	3+2 =5	40	40	80	60	60	120	200
5.6	Multidisciplinary Elective (MOOCs+/Offline)	2	-	2+0 =2	40	-	40	60	-	60	100
	# SCA	-	5	-	-	-	-	-	-	-	-
	Total	**12**	**23**	**21**	**200**	**200**	**400**	**300**	**300**	**600**	**1000**

** Common with Electronics and Communication 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	Total	Th	Pr	Total	
6.1	*Humanities & Life Skills	3	-	3+0=3	40	-	40	60	-	60	100
6.2	*Entrepreneurship Development & Management	3	-	3+0=3	40	-	40	60	-	60	100
6.3	Programme Elective - I	2	2	2+1=3	40	40	80	60	60	120	200
6.4	Programme Elective - II	2	2	2+1=3	40	40	80	60	60	120	200
6.5	Major Project/Industrial Training	-	16	0+8=8	-	40	40	-	60	60	100
# Student Centered Activities (SCA)		-	5	-	-	-	-	-	-	-	-
Total		**10**	**25**	**20**	**160**	**120**	**280**	**240**	**180**	**420**	**700**

* Common with other Diploma Courses

Programme Elective I: 6.3.1 Solid Mechanics & Mechanisms 6.3.2 Product Design and Process Planning 6.3.3 Manufacturing Technologies and Applications

Programme Elective II: 6.4.1 Embedded Systems (Common with ECE) 6.4.2 Cloud Computing (Common with AI & ML) 6.4.3 Modeling, Simulation and Analysis of Manufacturing Systems

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	
		Fifth Semester	Sixth Semester
1.	Industrial Training - II	2	-
2.	Electronic Instrumentation and Measurements	7	-
3.	PLC and SCADA	6	-
4.	Industrial IoT	6	-
5.	CAD and CAM	7	-
6.	Multidisciplinary Elective (MOOCs+/Offline)	2	-
7.	Humanities & Life Skills	-	3
8.	Entrepreneurship Development & Management	-	3
9.	Programme Elective - I	-	4
10.	Programme Elective - II	-	4
11.	Major Project/Industrial Training	-	16
12.	Student Centered Activities	5	5
	Total	**35**	**35**

20. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Automation and Robotics** require **supervisors** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to automation and robotics field. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall have understanding of desired mathematical skills and understanding of social and natural environment. They are expected to collect, organize and communicate information effectively.

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.

Automation and Robotics diploma pass out students 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. They are expected have the knowledge of PLCs and SCADA for automation in robotic industries. They are also expected to have good knowledge of Industrial IoT to meet the Industry 4.0 requirements along with good exposure of CAD and CAM for automation in industries and other relevant areas.

Automation and Robotics diploma students are expected to work for a wide variety of employers as Automation specialist, Robotics specialist, Machine Learning Specialist, Software Specialist, Electrical Maintenance Engineer, Robotics Machine Operator, Automation Programmer, Robot Programmer and Sales Executive etc. They might find work with a manufacturing company and spend time maintaining, or even designing, the machines that perform much of the automations. They might also work in relevant laboratories for any institute, university or even a private company. They are expected to have good exposure of humanities, life skills, entrepreneur development and management to establish small start-ups in the area of Marketing, Sales, Repair and Maintenance etc**.**

21. PROGRAMME OUTCOMES

The programme 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: Perform task that require well developed skills with clear choice of procedures.

PO2: Acquire knowledge of facts, principles and processes related to automation and robotics.

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.

PO4: Develop skills to collect, organize and communicate information.

PO5: Accomplish own work and supervise others work.

PO6: Select online multidisciplinary electives of own interest to promote self-learning.

22. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform task that require well developed skills with clear choice of procedures.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Perform basic measurements like voltage, current and resistance • Operate CRO and DSO for various measurements. • Handle signal generator and analytical instruments. • Handle digital instruments for various measurements. • Define addressing formats for various instructions. • Write program in ladder logic for various applications. • Describe IoT technologies, architectures, and standards. • Collect, communicate and manage the data from connected devices. • Develop and implement own IoT technologies, solutions, and applications. • Describe the geometric modelling of curves and surfaces. • Use software tools for solid and geometric modelling. • Program various parts of NC machine. • Handle and operated CNC machines for automation. • Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal

	forces • Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams for point loads and UDL • Calculate bending stresses, safe load, safe span, dimensions of cross section and deflections of the given beam • Comprehend failure mode in a column and determine crippling loads for columns using Euler's theory. • Select appropriate process planning technique based on part families. • Compute cost of manufacturing a product. • Select relevant manufacturing process for a given application. • Implement C programming for interfacing PIC microcontroller with various peripherals. • Develop complete system using PIC microcontroller. • Illustrate the fundamental concepts of cloud storage and apply the concept of virtualization. • Verify and validate simulation models using statistical techniques • Analyse and interpret simulation results • Build simulation models for applications in manufacturing
PO2: Acquire knowledge of facts, principles and processes related to automation and robotics.	• Describe impedance bridges and Q meter. • Describe PLC architecture and its working. • Understand Ladder diagram and logic functions. • Define addressing formats for various instructions. • Understand the creation and animation of graphics for various applications. • Understand the IIoT concepts, sensors, wireless protocols, data storage and security. • Describe IoT technologies, architectures, and

	standards. • Understand the automation concepts using CAD and CAM. • Describe the geometric modelling of curves and surfaces. • Explain working of different types of mechanisms and draw their inversion. • Understand and explain the concept of Industrial design and robust design concepts. • Understand the concept of Design for manufacture and assembly. • Understand the steps in planning the manufacturing of a component from design stage. • After undergoing the subject, the students will be able to: • Understand the mechanics of metal cutting, cutting fluids and lubricants. • Understand the applications of metal cutting, forming and joining techniques, their tooling and equipment. • Understand the fundamentals and applications of finishing processes. • Understand principles and working of non-conventional and CNC machining processes. • Understand the concept of Embedded System. • Explain the architecture of PIC microcontroller. • Explain core concepts of cloud computing paradigm. • Describe various Service and Deployment Models • Detail SLA management in Cloud Computing • Understand the basic concepts and applications of continuous & discrete event simulation
PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by

	relevant industries. • Perform basic measurements like voltage, current and resistance • Operate CRO and DSO for various measurements. • Handle signal generator and analytical instruments. • Handle digital instruments for various measurements. • Define addressing formats for various instructions. • Write program in ladder logic for various applications. • Describe IoT technologies, architectures, and standards. • Collect, communicate and manage the data from connected devices. • Develop and implement own IoT technologies, solutions, and applications. • Describe the geometric modelling of curves and surfaces. • Use software tools for solid and geometric modelling. • Program various parts of NC machine. • Handle and operated CNC machines for automation. • Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces • Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams for point loads and UDL • Calculate bending stresses, safe load, safe span, dimensions of cross section and deflections of the

	given beam • Comprehend failure mode in a column and determine crippling loads for columns using Euler's theory. • Select appropriate process planning technique based on part families. • Compute cost of manufacturing a product. • Select relevant manufacturing process for a given application. • Implement C programming for interfacing PIC microcontroller with various peripherals. • Develop complete system using PIC microcontroller. • Illustrate the fundamental concepts of cloud storage and apply the concept of virtualization. • Verify and validate simulation models using statistical techniques • Analyse and interpret simulation results • Build simulation models for applications in manufacturing. • Define the problem statement of the Major project / Industrial Training according to the need of industry. • Work as a team member for successful completion of Major project / Industrial Training.
PO4: Develop skills to collect, organize and communicate information.	• Understand the working environment of industries • Learn about present and future requirement of industries. • Develop writing, speaking and presentations skills. • Observe technological developments as per present and future needs of industries. • Collect, communicate and manage the data from connected devices. • Discover personal competence and techniques of building emotional intelligence.

	• Demonstrate a set of non-cognitive skills such as empathy, teamwork, collaboration, interpersonal skills, and resilience for smooth and efficient functioning at the workplace • Demonstrate the dynamics of individual, interpersonal and group processes that influence behaviour within teams and organizations. • Reflect ethical behaviour with a sense of right and wrong leading to practical ethical behaviour. • Demonstrate leadership qualities with balance of emotional and social quotient. • Comprehend the importance of entrepreneurship and its role in nation's development. • Classify the various types of business and business organizations. • Identify the various resources / sources and / or schemes for starting a new venture. • Explain the principles of management including its functions in an organisation. • Conduct market survey and prepare project report. • Define the problem statement of the Major project / Industrial Training according to the need of industry. • Write the Major project / Industrial Training report effectively. • Present the Major project / Industrial Training report using PPT.
PO5: Accomplish own work and supervise others work.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Define the problem statement of the Major project / Industrial Training according to the need of industry. • Work as a team member for successful

	completion of Major project / Industrial Training. • Write the Major project / Industrial Training report effectively. • Present the Major project / Industrial Training report using PPT.
PO6: Select online multidisciplinary electives of own interest to promote self-learning.	• 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	140 - 141
5.2	Electronic Instrumentation andMeasurements	142 - 144
5.3	PLC and SCADA	145 - 147
5.4	Industrial IoT	148 - 150
5.5	CAD and CAM	151 - 154
5.6	Multidisciplinary Elective(MOOCs/Offline)	155 - 156

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: 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 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 ELECTRONIC INSTRUMENTATION AND MESUREMENTS

L	P
3	4

RATIONALE

In the real world of work the technician is required to handle wide variety of instruments while testing, trouble shooting, calibration etc. This subject will help the students to gain the knowledge of working principles and operation of different instruments. During practical sessions, students will acquire the requisite skills.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:
CO1: Perform basic measurements like voltage, current and resistance
CO2: Operate CRO and DSO for various measurements.
CO3: Handle signal generator and analytical instruments.
CO4: Describe impedance bridges and Q meter.
CO5: Handle digital instruments for various measurements.

DETAILED CONTENTS

UNIT I

Basic Measurements

Measurement, methods of measurement, types of instruments. Specifications of instruments: Accuracy, precision, sensitivity, resolution, range, Errors types in measurement, sources of errors, limiting errors, Loading effect, Importance and applications of standards and calibration. Moving iron type instruments, measurement of D.C voltage and current, Block diagram, working principle, application of digital Multimeter. Specifications of multimeter and its applications. Limitations with regard to frequency and input impedance.

UNIT II

CRO and DSO

Construction and working of Cathode Ray Tube (CRT). Block diagram, description of a basic CRO and triggered sweep oscilloscope, front panel controls. Specifications of CRO and their explanation.

Measurement of voltage, current, frequency, time period and phase using CRO. CRO probes, special features of dual beam, dual trace, delay sweep. Digital storage oscilloscope (DSO), block diagram and working principle.

UNIT III

Signal Generators and Analytical Instruments

Explanation of block diagram specifications of low frequency and RF generators, pulse generator, function generator. Wave analyzer, distortion measurement and spectrum analyzer.

UNIT IV

Impedance Bridges and Q Meters

Wheat stone bridge, AC bridges: Maxwell's induction bridge, Hay's bridge and Wheat Stone Bridge. Block diagram description of laboratory type RLC bridge, specifications of RLC bridge. Block diagram and working principle of Q meter

UNIT V

Digital Instruments

Comparison of analog and digital instruments. Working principle of ramp, dual slope and integration type digital voltmeter. Measurement of time interval, time period and frequency using universal counter/frequency counter. Working principle of logic probe, logic pulser, logic analyzer, logic comparator, signature analyzer

PRACTICAL EXERCISES

1. Measurement of voltage, resistance, frequency, using digital multimeter.
2. Measurement of voltage, frequency, time period and phase using CRO.
3. Measurement of phase difference between two waveforms using CRO.
4. Measurement of unknown frequency from Lissajous figures using CRO.
5. Measurement of voltage, frequency, time and phase using DSO.
6. Measurement of phase difference between two waveforms using DSO.
7. Measurement of unknown frequency from Lissajous figures using DSO.

8. Interfacing of DSO with printer.
9. Measurement of rise time and fall time using DSO.
10. Measurement of Q of a coil and its dependence on frequency.
11. Measurement of resistance and inductance of coil using RLC Bridge.
12. Use of logic pulser and logic probe.
13. Measurement of time period, frequency, average period using universal counter/ frequencycounter.
14. Measurement of Impedance using Maxwell Induction Bridge.
15. To find the value of unknown resistance using Wheat Stone Bridge.

RECOMMENDED BOOKS

1. Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Sons, New Delhi
2. Electronics Measurement and Instrumentation by Oliver, Tata McGraw Hill Education Pvt Ltd, New Delhi
3. Electronics Instrumentation by Cooper, Prentice Hall of India, New Delhi
4. Electronics Test and Instrumentation by Yashpal and Sanjeev Kumar, North Publications, Jalandhar
5. Electronics Instrumentation by JB Gupta, Satya Prakashan, New Delhi

SUGGESTED WEBSITES

1. https://swayam.gov.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. This subject contains five units of equal weight age.

5.3 PLCs AND SCADA

L	P
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RATIONALE

Automated industrial process controls or automated power stations require skilled manpower with knowledge of Programmable Logic Controllers (PLCs) and Supervisory Control and Data Acquisition system (SCADA). PLCs and SCADA are widely used in all industries for efficient automatic control operations. Looking at the industrial applications, this subject finds its usefulness in the present curriculum.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:
CO1: Describe PLC architecture and its working.
CO2: Understand Ladder diagram and logic functions.
CO3: Define addressing formats for various instructions.
CO4: Write program in ladder logic for various applications.
CO5: Understand the creation and animation of graphics for various applications.

DETAILED CONTENTS

UNIT I

PLC Overview

Introduction, limitations of relays and advantages of PLCs over electromagnetic relays. PLC Operation or working, PLC Architecture and building blocks, Functions of various blocks, Different programming languages, PLC applications and manufacturers, PLC selection criteria.

UNIT II

Numeric Systems and Logic Concepts for Ladder Programming

Introduction, Number systems and conversions, Binary arithmetic, Binary codes, Boolean algebra, logic gates, Introduction to Ladder logic, Basic components and their symbols, Fundamental of ladder diagrams, Ladder logic functions, Boolean logic and relay logic.

UNIT III

File structure and addressing formats

Introduction, Input and output data files, status file, Bit data file, Timer data file, Counter data file, Control data file, Integer data file and Float data file.

UNIT IV

Ladder Programming Instructions

Introduction, Bit instructions, Timer instructions, Counter instructions, Reset instruction, Data handling instructions, Comparison Instructions, Sequencer instructions.

UNIT V

SCADA

Introduction, Project and Tag creation, Visibility and text animation, Numeric display and Numeric input, String display and String input, Concept of Label, Arrow, vertical slider, horizontal slider, Creation of various animations like color, fill, horizontal position, vertical position, height, width and touch. Alarming, Data Logging.

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. Write a ladder diagram program for switching ON-OFF light.
4. Write a ladder diagram program for liquid level control.
5. Write a ladder diagram program for industry process control.
6. Write a ladder diagram program for main door control.
7. Write a ladder diagram program for vehicle parking control.
8. Write a ladder diagram program for bottling plant.
9. Write a ladder diagram program for drink dispenser.
10. Write a ladder diagram program for traffic light control.
11. Write a ladder diagram program for temperature control.
12. Show online videos to demonstrate the creation and animation of graphics for various applications using SCADA.
13. Industrial visit to monitor the actual working of PLC and SCADA.

RECOMMENDED BOOKS

1. Mehra, Rajesh, and Vikrant Vij, "PLCs & SCADA Theory and Practices", Laxmi Publication, Delhi.
   www.amazon.in/PLCs-SCADA-Practice-Rajesh-Mehra-ebook/dp/B07568SYLK

2. Dunning, Gary, "Introduction to PLCs", McGraw Hill.
3. Otter, Job Dan, "Programmable Logic Controller", P.H. International, Inc, USA.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. http://www.bytronic.net/downloads/
3. https://download.rockwellautomation.com/esd/directdownload.aspx?sessionid=4mhxwrflrsz1tie1bacq5ewg637271102079911981

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. This subject contain five units of equal weight age.

5.4 INDUSTRIAL IOT

L	P
2	4

RATIONALE

This subject will help the students to learn the new evolution in hardware, software, and data. Industrial Internet of Things (IIoT) brings many new business prospects along with significant challenges ranging from technology architectural choices to security concerns. Students will acquire the required knowledge and skills to overcome the challenges related to this field.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:
CO1: Understand the IIoT concepts, sensors, wireless protocols, data storage and security.
CO2: Describe IoT technologies, architectures, and standards.
CO3: Collect, communicate and manage the data from connected devices.
CO4: Observe technological developments as per present and future needs of industries.
CO5: Develop and implement own IoT technologies, solutions, and applications.

DETAILED CONTENTS

UNIT I

Overview and Architecture

Introduction, Industrial IoT and connected world, IoT Vs Industrial IoT, Industrial IoT architecture, IOT node, Industrial IOT challenges.

UNIT II

Industrial IoT Modules

Control System Fundamentals, components, closed loop & open loop system. Introduction to Sensors, Types of sensors, working principle of Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors, Digital switch, Electro Mechanical switches.

UNIT III

Communication Protocols and Technologies

Communication Protocols like IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID,

Industry standards communication technology like LoRAWAN, OPC UA, MQTT, Connecting into existing Modbus and Profibus technology, Wireless network communication.

UNIT IV

Industrial IoT Data Types and Configuration

Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud data base, Could computing, Fog or Edge computing.

Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, configuring your Arduino/Raspberry pi board for the IoT.

UNIT V

Data Handling & Trouble Shooting

Data handling from the Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

PRACTICAL EXERCISES

1. Introduction to Arduino, ESp8266, Introduction to raspberry Pi.
2. Measurement of temperature & pressure of the process using Arduino or raspberry pi.
3. Modules and Interfacing of sensors like IR sensor, Ultrasonic sensors, Soil moisture sensor using Arduino or raspberry pi.
4. Modules and Interfacing of actuators like Relay, Motor, Buzzer using Arduino or raspberry pi.
5. Demonstration of MQTT communication.
6. Demonstration of LoRa communication.
7. Visualization of diverse sensor data using dashboard of control panel.
8. Sending alert message to the user to control and interact with your environment.
9. Device control using mobile Apps or through Web pages.
10. Demonstration of Machine to Machine communication.
11. Industrial visit to monitor the actual working of Industrial IoT.

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. https://swayam.gov.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. This subject contain five units of equal weight age.

5.5 CAD AND CAM

L	P
3	4

RATIONALE

This subject will help the students to create and manipulate geometric models using curves, surfaces and solids. Students will acquire knowledge related to principles, methods and techniques of 3D modelling CAD/CAM software. It will introduce the students to the standard manufacturing terminologies, conventions, processes, operations, design. It will further give exposure about operational characteristics of key hardware components, programming techniques, applications, merits and demerits of Computer Numerical Controlled (CNC) machines.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:
CO1: Understand the automation concepts using CAD and CAM.
CO2: Describe the geometric modelling of curves and surfaces.
CO3: Use software tools for solid and geometric modelling.
CO4: Program various parts of NC machine.
CO5: Handle and operated CNC machines for automation.

DETAILED CONTENTS

UNIT I

CAD/CAM Overview

Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process. Need of CAD/CAM integration through computers, CAD/CAM integration, Benefits of Automation Concepts, DNC based factory management and control of CAD/CAM systems, Need of NC CNC technology, Fundamental concepts in numeric control: structure and functions of NC System, advantages of NC technology over conventional manufacturing. Transformations, 2D and 3D transformations. CAD/CAM Data Exchange Formats, Types of file formats & their exchange process, Various Graphics standards.

UNIT II

Curves and Surfaces

Analytical, Synthetic curves with advantages, Disadvantages, Comparison with parametric curves, Bezier , b spline and cubic spline curves, Geometric modeling curves and surfaces, Representation of Wire frame models, surface models and solid models , Parametric representations of curves and surfaces, DDA, Bresenham's / Midpoint, line, circle, ellipse algorithms.

UNIT III

Solid modeling and Geometric Modeling

Fundamentals of solid modeling, Different solid representation schemes, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Perspective, Parallel projection, Hidden line removal algorithms. Use of CATIA, IDEAS SOLID WORKS etc. software's. Parametric sketching, Constrained model dimensioning, command of Extrusion , Revolved, Swept and blended features, References and construction features of points, Axis, Curves, Planes, Surfaces and customized analysis features and sequence of feature editing. Cosmetic features, Chamfers, Rounds, Standard holes. Feature patterns, Duplication, Grouping, Suppression, Assembly modeling, Assembly analysis tools/ Constraints. Software automation and customization tools, Colors, Advanced features for non-parallel, blend, Helical sweep, Swept blend, Variable section sweep, Draft, Ribs, Sketched holes, Mechanism design and assembly.

UNIT IV

NC Machine Tools and NC Part Programming

Types, Definition and designation of control axes, Special constructional and design characteristics of NC machine tools, Standard tooling used for NC turning and millingcenters. Work holding and tool setting procedure for NC turning and milling centers, Tool zero presetting, Block formats and introduction to ISO based G & M codes for NC part programming, Concepts of tool length and radius compensation, Standard canned cycles usedin CNC turning and milling centers, Introduction to automatic NC part program generation from CAD models and using standard CAD/CAM software for machining of surfaces, moulds and dies etc.

UNIT V

Computer Numerical Control of Machine Tools

Types and functions of computer numeric control (CNC), Types and functions of direct numeric control (DNC), Need of adaptive control types, functions and types of adaptive control, its uses & benefits, Advantages of combined CNC/DNC systems. Hyd/Pneumatic Drives, Feedback devices,

Interpolator systems, Control loop circuit elements in point to point (PTP) and contouring system, Interpolation schemes for linear and circular interpolations.

PRACTICAL EXERCISES

1. Geometric modeling of different Curves, Surfaces and Solid primitives.
2. Geometric modeling, surface modeling wireframe modeling.
3. Solid modeling by CATIA IDEAS SOLID WORKS etc.
4. Part modeling, adv modeling and assembly modeling examples.
5. Exercises in tool presetting and work piece referencing on CNC machine tools.
6. Manual part programming for CNC turning and milling centres.
7. Use of CNC software for simulation of turned and milled parts and simple surfaces.
8. Automatic Cutter location data generation from CAD Models in APTformat.
9. Post-processing for machining on CNC machines using standard CAD/CAM software.
10. Manual part programming and automatic CAPP programming.

RECOMMENDED BOOKS

1 Zeid, I., CAD/CAM, McGraw Hill (2008).

2. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill (2008).

3 Rooney, J. and Steadman, P., Principles of Computer Aided Design, prentice Hall (1988).

4. Radhakrishnan, P. and Kothandaraman, C. P., Computer Graphics & Design, Dhanpat Rai Publication (2005).

5. Rao, P. N., Tewari, N. K. and Kundra, T. K., Computer Integrated Manufacturing, McGraw Hill (1998).

6. Koren, Y., Computer Control of Manufacturing systems, McGraw Hill (2009).

7. Groover, M. P. and Zimmers, E. W., CAD/CAM: Computer Aided Design & Manufacturing, 2006, Pearson Education India

8. Reddy, J. N., An Introduction to the Finite Element Method, McGraw Hill (2001).

9. Chandrupatla, T. R. and Belgundu, A. D., Introduction to Finite Elements in Engineering, Prentice Hall of India (1997).

10. Sehrawat MS and J S Narang CNC Machines, Dhanpat Rai & Co. (P) Limited (2016)

SUGGESTED WEBSITES

1. https://swayam.gov.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. This subject contain five units of equal weight age.

5.6 MULTIDISCIPLINARY ELECTIVE

L	P
2	-

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. Fundamentals of Artificial Intelligence
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/

SIXTH SEMESTER

6.1	Humanities & Life Skills	157 - 160
6.2	Entrepreneurship Development & Management	161 - 163
6.3	Programme Elective - I	164 - 173
6.4	Programme Elective - II	174 – 183
6.5	Major Project/Industrial Training	184 - 185

6.1 HUMANITIES & LIFE SKILLS

L	P
3	-

RATIONALE

It is important to facilitate the development of a holistic perspective among students towards life and profession, as well as towards happiness and prosperity, based on a correct understanding of the human reality and the rest of existence. This course is designed to help students understand the importance of values and ethics in their development as professionals, responsible citizens and understand the significance of emotional intelligence in self-growth and building effective relationships. Understanding the value of harmonious relationship based on trust and respect in their life and profession, they will better be able to ensure harmony in society and nature.

COURSE OUTCOMES

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

CO1: Discover personal competence and techniques of building emotional intelligence.

CO2: Demonstrate a set of non-cognitive skills such as empathy, teamwork, collaboration, interpersonal skills, and resilience for smooth and efficient functioning at the workplace

CO3: Demonstrate the dynamics of individual, interpersonal and group processes that influence behaviour within teams and organizations.

CO4: Reflect ethical behaviour with a sense of right and wrong leading to practical ethical behaviour.

CO5: Demonstrate leadership qualities with balance of emotional and social quotient.

DETAILED CONTENTS

UNIT-I

Personal and Social Competence

Introduction and concept of emotional intelligence, its models and components, understand the significance of emotional intelligence in self-growth and building effective relationships.

Building blocks to develop emotional intelligence: self-awareness, self-management, social awareness, and relationship management.
Self-Awareness: Observing and recognizing one's own feelings, Knowing one's strengths and areas of development. Self-Management: Managing emotions, anxiety, fear, and anger.
Social Awareness: Others' Perspectives, Empathy and Compassion
Relationship Management: Collaboration, Teamwork, and Conflict management

UNIT II

Developing Professional Skills

Process of Career Exploration, Knowing Yourself — Personal Characteristics, Knowledge about the World of Work, Requirements of Jobs Including Self-employment, Sources of Career Information, Preparing for a Career Based on Potentials of Learners and Availability of Opportunities.

Career Skills: Introduction and significance of Résumé and Related Terms, Difference between a CV, Résumé, and Biodata, Essential Components and format of a Good Résumé.

Group discussions Meaning and Importance of Group Discussion Types of Group Discussions, Format of a Group Discussion, Evaluation of Group Discussion, Common Errors and tips to crack Group discussion.

Preparation for interviews, Types of Interviews, STAR Approach for Facing an Interview, Common Errors, tips to crack Interview.

UNIT III

Interpersonal Skills

Variants of Interpersonal Skills
Teamwork: Meaning, Advantages of Using Teams, Factors Contributing to the Success of a Team, Strategies to Deal with Conflict among Team Members,

Collaboration: Meaning, Types of Collaboration, Team collaboration, Network collaboration, Video collaboration, Cloud collaboration, Contextual collaboration, Cross-functional collaboration, Community collaboration, Social collaboration, Virtual collaboration, Process of Collaborative Learning

Introduction to Perseverance, Self-Control, Peer Pressure, Aspects of Social and Cultural Etiquette in Promoting Teamwork, Mannerism and Grooming

Unit IV

Values and Professional Ethics

Importance of ethics, Code of Ethics- Concept & Significance, Personal and professional moral codes of conduct of an Engineer

Work Ethics: Punctuality, Cleanliness Law abidingness and work place behaviour and professional ethics

Multinational corporations - Environmental ethics - computer ethics - - engineers as managers-moral leadership. Concept of Ethical leadership

Unit V

Leadership and Management Skills

Leadership and Its Importance, Models of Leadership, Basic Leadership Skills: Motivation, Teamwork, Negotiation, Networking, Innovative Leadership

Basic Managerial and Life Skills: Planning for Effective Management, Time Management, Conflict and Stress Management

Self-Management Skills: Time Management, Stress Management, Developing Self-Awareness with JOHARI Window, Self-examination and Self-regulation, Scope of Leadership in college

RECOMMENDED BOOKS

1. Goleman, D " Emotional Intelligence", New Delhi: Bloomsbury Publishing IndiaPrivate Limited.
2. Robbins, S. P., Coulter M., and Fernandez, " Management (14th edition). Noida, India: Pearson Education.
3. Premvir Kapoor, "Professional Ethics and Human Values", Khanna Book Publishing, New Delhi, 2022.
4. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

5. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.

SUGGESTED WEBSITES

1. https://ipindia.gov.in/
2. Knowledge at Wharton. (2008, April 3). APJ Abdul Kalam:”A Leader should know how tomanage failure”. https://www.youtube.com/watch?v=laGZaS4sdeU.

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. In addition, different activities group discussions, mock interviews, resume presentation, role play, extension lecturers by outside experts, may also be organised. This subject contains five units of equal weightage.

6.2 ENTREPRENEURSHIP DEVELOPMENT AND 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 organisation.
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 organisations, 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: Organising Process - Meaning and Definition, Characteristics Process, Need and Importance, Principles, Span of Management, Organisational Chart - Types, Contents, Uses, Limitations, Factors Affecting Organisational 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.

6.3 PROGRAMME ELECTIVE - I
6.3.1 SOLID MECHANICS AND MECHANISMS

L	P
2	2

RATIONALE

Solid Mechanics encompasses the behaviour of solid materials, indispensable for designing and predicting how structures will react under various conditions such as stress, strain, temperature, and pressure. This course will impart relevant knowledge to the students for understanding and applying the concepts of solid mechanics in design of machines and structures.

COURSE OUTCOMES

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

CO1: Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces

CO2: Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams for point loads and UDL

CO3: Calculate bending stresses, safe load, safe span, dimensions of cross section and deflections of the given beam

CO4: Comprehend failure mode in a column and determine crippling loads for columns using Euler's theory.

CO5: Explain working of different types of mechanisms and draw their inversion.

DETAILED CONTENTS

UNIT I

Engineering Materials

Classification of Engineering Materials – metals, ceramics and polymers; Physical properties of materials; Mechanical properties of common engineering materials; Introduction to heat

treatment of steels and effect of different heat treatment processes on mechanical properties of steels

Simple Stresses and Strains

Stress – Strain diagram for M.S. and C.I. specimens and Significance of various points on it; Significance of factor of safety; Hooke's Law, Relation between elastic constants; Longitudinal and lateral strain, Poisson's ratio; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces

UNIT II

Shear Force and Bending Moment

Types of beams and loads; Shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method for - Cantilever with point loads and uniformly distributed load (UDL),Simply supported beam with point loads and UDL, Over hanging beam with point loads, at the centre and at free ends, Over hanging beam with UDL throughout; Point of contraflexure.

UNIT III

Theory of Simple Bending & Deflection of Beams

Introduction of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation $M/I = \sigma/y = E/R$ (without derivation); Calculation of safe loads and safe span and dimensions of cross- section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL

UNIT IV

Columns & Struts

Types of columns, Axially loaded long and short columns, Crushing load, Euler's theorem for long columns, derivation of Euler's critical load formulae for various end conditions, Equivalent length of a column, slenderness ratio, Euler's critical stress, Limitations of Euler's theory

UNIT V

Kinematics of Machines

Definition of Kinematics, Dynamics, Statics, Kinetics, Kinematic link, Kinematic Pair and its types, constrained motion and its types, Kinematic chain and its types, Mechanism, inversion, machine and structure.

Inversions of Kinematic Chains

Inversion of four bar chain, coupled wheels of Locomotive & Pantograph. Inversion of Single Slider Crank chain- Rotary I.C. Engines mechanism, Crank and Slotted lever quick return mechanism. Inversion of Double Slider Crank Chain- Scotch Yoke Mechanism & Oldham's Coupling.

PRACTICAL EXERCISES

1. To conduct tensile test on mild steel specimen and determine Yield stress, Ultimate stress, Breaking stress, Percentage elongation and Percentage reduction in area
2. To determine the compressive strength of a given material specimen.
3. To conduct deflection test on a simply supported beam carrying a point load at a distance from one end.
4. To find the Brinell & Rockwell Hardness numbers for the given metal specimen.
5. To determine the Impact toughness (strain energy) of given brittle and ductile material specimens.
6. To determine the rigidity modulus of the spring
7. Explain the working of different types of mechanisms and draw their inversion.

RECOMMENDED BOOKS

1. Timoshenko, S., Strength of Materials, Vol. I, CBS, New Delhi.
2. Khurmi, R.S., Strength of Materials, S Chand and Co. Ltd. New Delhi.
3. Kirpal Singh, Mechanics of Materials, Standard Publishers, New Delhi.
4. S. S. Rattan, Theory of Machines, McGraw Hill Education

SUGGESTED WEBSITES

1. https://sm-nitk.vlabs.ac.in/
2. https://mrmsmtbs-iitk.vlabs.ac.in/

INSTRUCTIONAL STRATEGY

The students may also be taken to an industry for observing heat treatment of steels. This subject contains five units of equal weight age.

6.3.2 PRODUCT DESIGN AND PROCESS PLANNING

L	P
2	2

RATIONALE

For manufacturing any component / product the engineer needs the knowledge of design procedure and approach according the needs of the consumer, and steps needed for converting the design to a physical product. By going through this subject, the student will be able to carry out design of components as per the consumer needs as well as manufacturing point of view.

COURSE OUTCOMES

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

CO1: Understand and explain the concept of Industrial design and robust design concepts
CO2: Understand the concept of Design for manufacture and assembly
CO3: Understand the steps in planning the manufacturing of a component from design stage
CO4: Select appropriate process planning technique based on part families
CO5: Compute cost of manufacturing a product

DETAILED CONTENTS

UNIT I

Introduction to Product Development

Stages of Product Development, The Feasibility Study, Types of design, Developing the Design and Selecting Materials and Processes, Launching the Product, Product Life Cycle

Elements of Engineering Design

Factors Influencing Design, Major Phases of Design, Factor of Safety and Derating Factor, Modeling and Simulation in Design

UNIT II

General Design Considerations

Selection of materials for static strength, stiffness, fatigue resistance and toughness, Functional Requirements, Effect on Environment, Life, Reliability, Safety, Protection from Foreign Bodies,

Standardization, Assembly, Maintenance, Costs, Quantity, Legal Matters, Patents, Asthetics, Materials and Manufacturing Processes, Energy considerations

UNIT III

Engineering Materials

Classification of Engineering Materials – metals, ceramics and polymers; Physical properties of materials; Mechanical properties of common engineering materials; Introduction to heat treatment of steels and effect of different heat treatment processes on mechanical properties of steels

Effect of Material Properties on Design

Stress concentration, Designing for static strength, simple axial loading, torsional loading, bending and combined load; Designing with high strength low toughness materials; Designing against fatigue

UNIT IV

Effect of Manufacturing Processes on Design

Design Considerations for Cast Components, Design Considerations for Moulded Plastic Components, Design Consideration for Forged Components, Design of Sheet Metal Parts, Design Involving Heat treatment, Designing for Corrosive Environments, Value engineering

UNIT V

Process Planning

Design and Manufacturing Cycle, Planning function, Steps of Process Planning, Operation Planning Sheet, Group Technology and part coding, Computer Aided Process Planning, Retrieval and generative process planning systems, Benefits of Computer Aided Process Planning

Cost Estimation

Objectives of Cost Estimation; Costing Elements - Material, Labour, Production, Overhead expenses, Factory expenses, Administrative expenses, Selling & Distributing expenses etc.; Depreciation, Causes of depreciation, Calculation of depreciation; Machine Time Estimation

PRACTICAL EXERCISES

1. To unassemble a consumer product like sewing machine and study the components and their functionality.

2. To select a component from experiment no. 1 and study its design, linkage mechanisms.
3. Redesign the component selected in experiment no. 2, for the same function and list the improvements/changes
4. To conduct tensile test on a medium carbon steel specimen and determine Yield stress, Percentage elongation and Percentage reduction in area.
5. To perform tempering on a medium carbon steel specimen (as in experiment no. 4).
6. To conduct tensile test on the specimen of experiment no. 5 and compare the results for Yield stress, Percentage elongation and Percentage reduction in area with those of experiment no. 4
7. To prepare a process plan sheet for manufacturing a connecting rod.
8. To carry out cost estimation for manufacturing a connecting rod.
9. To carry out value engineering exercise on any product around in the lab (e.g. Computer cabinet, Black Board duster etc.) and evaluate the alternates.

RECOMMENDED BOOKS

1. Chitale, A K, Product Design & Manufacturing, 2013, 6th Edition, PHI publication, India
2. M. Adithan and B.S. Pabla, Estimation and Costing, Konark publishers Pvt. Ltd., 1990
3. GBS Narang, Production Costing, Khanna Publishers, New Delhi, 2000.
4. Dieter George E., “Engineering Design: A Material and Processing Approach”, McGraw Hill, 2000.
5. Groover M. P. and Zimmers E. W., “Computer Aided Design and Manufacturing”, Pearson Education, New Delhi, 2003

SUGGESTED WEBSITES

1. https://archive.nptel.ac.in/courses/112/107/112107217/
2. https://onlinecourses.nptel.ac.in/noc21_me66/preview

INSTRUCTIONAL STRATEGY

The students may also be taken to an industry for observing various activities related to product design, process planning and cost estimation. This subject contains five units of equal weight age.

6.3.3 MANUFACTURING TECHNOLOGIES & APPLICATIONS

L	P
2	2

RATIONALE

The knowledge of different metal cutting, metal forming and joining processes and the corresponding tooling & equipment is necessary for an engineer to make realistic designs. This course will impart basic knowledge to the students about different manufacturing processes and their applications.

COURSE OUTCOMES

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

CO1: Understand the mechanics of metal cutting, cutting fluids and lubricants.

CO2: Understand the applications of metal cutting, forming and joining techniques, their tooling and equipment.

CO3: Understand the fundamentals and applications of finishing processes.

CO4: Understand principles and working of non-conventional and CNC machining processes.

CO5: Select relevant manufacturing process for a given application.

DETAILED CONTENTS

UNIT I

Engineering Materials

Classification of Engineering Materials – metals, ceramics and polymers; Physical properties of materials; Mechanical properties of common engineering materials; Introduction to heat treatment of steels and effect of different heat treatment processes on mechanical properties of steels.

Cutting Fluids & Lubricants

Introduction; Types of cutting fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching; Selection of cutting fluids, methods of application of cutting fluid; Classification of lubricants (solid, liquid, gaseous), Properties and applications of lubricants.

UNIT II

Turning

Types of lathes – light duty, Medium duty and heavy duty geared lathe, Specifications; Basic parts and their functions; Operations and tools – Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning. Cutting parameters.

Milling

Introduction; Types of milling machines: plain, Universal, vertical; constructional details – specifications; Milling operations: simple, compound and differential indexing; Milling cutters – types; Tool signature of milling cutter; Tool & work holding devices.

Drilling

Classification; Basic parts and their functions; Radial drilling machine; Types of operations; Specifications of drilling machine; Types of drills and reamers.

UNIT III

Press Working

Types of presses and Specifications, Press working operations - Cutting, bending, drawing, punching, blanking, notching, lancing; Die set components- punch and die shoe, guide pin, bolster plate, stripper, stock guide, feed stock, pilot; Punch and die clearances for blanking and piercing, effect of clearance.

Welding

Classification; Gas welding techniques; Types of welding flames; Arc Welding – Principle, Equipment, Applications; Shielded metal arc welding; Submerged arc welding; TIG / MIG welding; Resistance welding - Spot welding, Seam welding, Projection welding; Welding defects; Brazing and soldering: Types, Principles, Applications.

UNIT IV

Grinding

Principles of metal removal by Grinding; Abrasives – Natural & Artificial; Bonds and binding processes; size and shape of wheel, kind of abrasive, grain size, grade and strength of bond, structure of grain, spacing, kinds of bind material; Cylindrical, Surface, Tool & Cutter grinding machines; Construction details; Principle of centreless grinding; Advantages & limitations of centre less grinding; Finishing by grinding: Honing, Lapping, Super finishing.

Electroplating

Basic principles, Plating metals, applications; Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing

UNIT V

CNC Machines

Constructional features, Axis identification, Electronic control system. Automatic tool changer and tool magazine. CNC programming: Preparatory functions (G code), miscellaneous functions (M code), Part programming for simple machining operations.

Modern Machining Processes

Electric Discharge Machining (EDM): Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications; Wire cut EDM: Principle, Description of equipment, Controlling parameters; applications; Abrasive Jet Machining: principle, description of equipment, application; Electro Chemical Machining: description of equipment, application.

PRACTICAL EXERCISES

1. To study the construction details and working of a lathe, milling and drilling machine.
2. Demo of the different tools used in turning, milling and drilling operations.
3. To study the effect of variation of cutting parameters on formation of different types of chip during turning and drilling processes.
4. To machine a work piece by facing, and plain turning operation using a lathe
5. To machine a work piece by facing, and taper turning operation using a lathe.
6. To machine a work piece by external thread cutting operations on previously plain turned job using a lathe.
7. To make a Keyway in a workpiece using milling machine.
8. To perform drilling operation using vertical drilling machine.
9. To study the components and working of a Spark Erosion and Wire-cut Electric Discharge Machines.
10. To study the components and working of a Electro-Chemical Machine.
11. Simple facing and cleaning cut on a CNC Lathe machine.

RECOMMENDED BOOKS

1. Sharma, P. C., "A Textbook of Production Technology: Manufacturing Processes", S. Chand, 7th Edition, 2007

2. Juneja B. L. & Sekhon G. S., "Fundamentals of Metal Cutting and Machine Tools", New Age International (P) Ltd., Publishers, New Delhi, Reprint, 2008.

3. M. Adithan & B. S. Pabla, "CNC Machines", New Age International (P) Ltd., Publishers, New Delhi, 2018.

4. P. Pandey and H. S. Shan, "Modern Machining Processes", McGraw Hill Education, 2017

SUGGESTED WEBSITES

1. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpMM/
2. http://www.nitttrkol.ac.in/virlab.php#top
3. https://msvs-dei.vlabs.ac.in/

INSTRUCTIONAL STRATEGY

The students may also be taken to an industry for observing various manufacturing operations specially press working, welding, non-conventional machining & CNC machining and their applications. This subject contains five units of equal weight age.

6.4 PROGRAMME ELECTIVE - II
6.4.1 EMBEDDED SYSTEMS

L	P
2	2

RATIONALE

This subject plays very important role in designing embedded systems for various processes for industries. Diploma students at this level must have the required knowledge of PIC microcontroller and its programming for automation of different processes. This subject will give exposure to the students about the architecture of PIC microcontroller along with its interfacing with various peripheral devices.

COURSE OUTCOMES

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

CO1: Understand the concept of Embedded System.
CO2: Explain the architecture of PIC microcontroller.
CO3: Implement C programming for interfacing PIC microcontroller with various peripherals.
CO4: Develop complete system using PIC microcontroller.

DETAILED CONTENTS

UNIT I
Introduction

Embedded system, history of embedded systems, embedded system architecture, Functional structure of embedded system.

UNIT II
PIC Microcontroller

Introduction to PIC Microcontroller: History and Features, Architecture, Pin Diagram of PIC18F458, I/O port pins and their functions, PIC18 Configuration Registers.

UNIT III

PIC Programming in C

Data types and time delays in C, I/O Programming in C, Logic operations in C, Data conversion programs in C, Data serialization in C, Program ROM allocation in C18, Data RAM allocation in C18, PIC18 timer programming in C, PIC18 serial port programming in C.

UNIT IV

Real World Interfacing with PIC18

LCD and keyboard Interfacing, ADC, DAC and Sensor Interfacing.

UNIT V

Motor Control Using PIC 18

Relays and optoisolators, Stepper motor Interfacing with PIC18, DC Motor Interfacing with PIC18.

PRACTICAL EXERCISES

1. Performing experiments on PIC microcontroller kits
2. Interfacing LCD and keyboard with PIC microcontroller
3. Interface PIC microcontroller with Sensors
4. Interface PIC microcontroller with stepper motor
5. Control speed of DC motor using PIC microcontroller
6. Development of a complete system using PIC microcontroller

RECOMMENDED BOOKS

1. PIC Microcontroller and Embedded systems using assembly and C for PIC18, Muhammad Ali Mazidi, Rolin D and Danny Causey, Pearson Education,
2. PIC Microcontroller: An Introduction to Software & Hardware Interfacing, Han-Way Huang, Course Technology
3. Programming and customizing the PIC Microcontroller, Myke Predko, Tata McGraw Hill Education Pvt Ltd.

4. Programmable Digital Signal Processors: Architecture: Programming, and Applications, Yu Hen Hu, CRC Press

SUGGESTED WEBSITES

1. https://swayam.gov.in
2. https://nptel.ac.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. This subject contains five units of equal weight age.

6.4.2 CLOUD COMPUTING

L	P
2	2

RATIONALE

This course offers a good understanding of cloud computing concepts and challenges faced in implementation of cloud computing. It also offers the concept of Virtualization along with security issues faced in the field of cloud computing.

COURSE OUTCOMES

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

CO1: Explain core concepts of cloud computing paradigm.

CO2: Describe various Service and Deployment Models

CO3: Detail SLA management in Cloud Computing

CO4: Illustrate the fundamental concepts of cloud storage and apply the concept of virtualization.

DETAILED CONTENTS

UNIT I

Introduction

Evolution of Cloud Computing, Cloud Computing Overview, Characteristics, Applications, Benefits, Challenges. Major Cloud Vendors/Service Provider in the world.

UNIT II

Service and Deployment Models

Cloud Computing Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service, Cloud Computing Deployment Models: Private Cloud; Public Cloud, Community Cloud, Hybrid Cloud, Major Cloud Service providers.

UNIT III

Service Level Agreement (SLA) Management

Overview of SLA, Types of SLA, SLA Life Cycle, SLA Management Process.

UNIT IV

Virtualization Concepts

Overview of Virtualization, Types of Virtualization, Benefits of Virtualization, Hypervisors and its types.

UNIT V

Cloud Storage &Security

Storage as a Service, Benefits and Challenges, Storage Area Networks (SANs), Infrastructure Security, Network Level Security, Data Security & Privacy Issues, Legal Issues in Cloud Computing.

PRACTICAL EXERCISES

1. Introduction to Cloud Vendors: Amazon, Microsoft, IBM.
2. Setting up Virtualization using Virtualbox/VMWare Hypervisor
3. Introduction to OwnCloud and its features.
4. Installation and configuration of OwnCloud software for SaaS
5. Installing Open Source Cloud simulation software Cloud Sim.

RECOMMENDED BOOKS

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, " Cloud Computing: Principles and Paradigms, Wiley.
2. Barrie Sosinsky, " Cloud Computing Bible", Wiley, 2011.
3. Judith Hurwitz, Robin Bloor, Marcia Kaufman,Fern Halper, " Cloud Computing for Dummies", Wiley, 2010.

SUGGESTED WEBSITES

1. http://nptel.ac.in
2. https://ekumbh.aicte-india.org
3. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

Teacher should lay-emphasis on development of understanding amongst students about basic principles. This may be achieved by conducting quiz tests and by giving home assignments. The teachers should also conduct laboratories classes themselves encouraging each should to perform with his/her own hands and draw conclusions. 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. This subject contains five units of equal weight age.

6.4.3 MODELING, SIMULATION & ANALYSIS OF MANUFACTURING SYSTEMS

L	P
2	2

RATIONALE

Modeling & simulation technique helps in solving real-world problems safely and efficiently. Across industries and disciplines, modeling &simulation provide valuable solutions by giving clear insights into complex systems. This course will impart relevant knowledge and analytical skills to the students for modeling, simulation and analysis of manufacturing systems.

COURSE OUTCOMES

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

CO1: Understand the basic concepts and applications of continuous & discrete event simulation
CO2: Verify and validate simulation models using statistical techniques
CO3: Analyse and interpret simulation results
CO4: Build simulation models for applications in manufacturing

DETAILED CONTENTS

UNIT I

Introduction

Concept of System; Continuous and Discrete Systems; Types of Models; System Simulation; Simulation vs Analytical Methods; Steps in Simulation Study; Advantages and Limitations

Simulation of Continuous & Discrete Systems

Runge-Kutta method, Analog Simulation, Examples of Continuous System Simulation; Monte Carlo Techniques, Examples of Monte Carlo Method; Stochastic Simulation

UNIT II

Random Numbers

Random Number Tables, Generation of Random Numbers; Testing for Randomness, Uniformity Test, Chi-square Test; Testing for Autocorrelation, pseudorandom numbers, hash algorithm.

Statistical Considerations

Stochastic Activities; Discrete, Cumulative and Continuous Probability Functions; Measures of Probability Function; Binomial, Poisson, Normal and Exponential Distributions; Central Limit Theorem

UNIT III

Simulation of Queuing Systems

Components of a Waiting Line System; Stationary and Time-dependent Queues; Transient and Steady-State of System; Measure of System Performance; Examples of Time-oriented and Event-oriented Simulation.

Simulation of Inventory Systems

Classification, Inventory Costs, Single Item Constant Demand Inventory Model, Economic Order Quantity (EOQ) and terms related to EOQ.

UNIT IV

Simulation of PERT

Networks and Terms Used, Numbering of Events, Measure of Activity, Frequency Distribution Curve for PERT, Critical Path. Practical Applications of PERT.

Output Analysis

Simple Linear Regression, Method of Least Squares, Standard Error of Estimate, Coefficient of Co-relation, Analysis of Variance, skewness.

UNIT V

Simulation Languages & Software

Introduction to General Purpose Simulation System (GPSS), GPSS – Output Information, Block Diagram, Blocks Characteristics, Types of Blocks; Introduction to simulation software like Arena or FlexSim for production simulation

Applications of Simulation in Manufacturing

Modelling of Manufacturing Systems, Examples such as Simulation of Maintenance & Replacement Problem, Simulation of Capacity Planning Problem, Simulation of Inventory Problem, Simulation of a Manufacturing System, Maintenance jobs by queuing models

PRACTICAL EXERCISES

1. Use of a spreadsheet software like Microsoft Excel or equivalent, for entering data in rows and columns. Practice on using spreadsheet formulae for matrix operations, statistical functions, data analysis, What-if-analysis.

2. Generate a sequence of 50 random numbers using random number tables. Determine whether the generated numbers are uniformly distributed or not? Repeat the exercise using a spreadsheet program and note the value of 10 random numbers, by

   i) repeating Same seed value

   ii) Changing seed value

3. Calculate area of a circle using Monte Carlo method and compare the result with analytical result. Calculate area of an irregular figure using Monte Carlo method. Repeat the exercise using a spreadsheet program.

4. Simulate a continuous system using pure pursuit algorithm.

5. Collect data ofa particular dimension of 100 component being manufactured in an industry and approximate a probability density function.

6. Observe the arrival of 50 components at a workstation for processing in an industry. Determine the mean and standard deviation for processing time. Simulate the observations as a queue.

7. Observe the manufacturing of a product (like gear or hand-tool) from raw material stage to finished product stage. Collect relevant data and apply PERT to determine the time required to manufacture ‘n’ number of pieces. Compare the calculated time with the actual production time.

8. Visit a manufacturing job shop and make a model in a simulation software for product job arrival, transportation, processing and departure.

9. Simulate manufacturing of a product (like gear or hand-tool) in an industry using a simulation software. Compare the simulation results with the actual production parameters like product throughput time, delay time and machine utilization.

RECOMMENDED BOOKS

1. D. S. Hira; System Simulation; S. Chand &Co,;New Delhi

2. Geoffery Gordon; System Simulation; Pearson Education; New Delhi
3. Deo Narsingh, System Simulation with Digital Computer, PHI Learning, New Delhi

SUGGESTED WEBSITES

1. https://www.rockwellautomation.com/en-us/products/software/arena-simulation/buying-options/download.html
2. https://www.flexsim.com/students/
3. https://gpss-world-student-version.software.informer.com/5.2/

INSTRUCTIONAL STRATEGY

Note: The students are be taken to an industry using statistical/simulation tools for higher productivity. This subject contains five units of equal weight age.

6.5 MAJOR PROJECT/ INDUSTRIAL TRAINING

L	P
-	16

RATIONALE

Major project/Industrial Training 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 Internship / Major project report effectively.

CO4: Present the Internship / 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
2. Practical
3. Minor & Major Project
4. Massive Open Online Courses (MOOCs)
5. Viva Voce
6. Industrial / In House Training
7. Professional Industrial Training

1. Theory Assessment

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 weight ages 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 skill achievements

3. Minor and Major Project 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 weight ages 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 and half of the examiners in the team should be invited from outside of the institute as expert for conducting the examination.

4. Massive Open Online Courses (MOOCs) Assessment

Open Elective and Multi-Disciplinary Elective may be covered through Massive Open Online Courses (MOOCs) to promote self learning. These 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 can get a certificate after registering and attending the classes and submitting the assignments/quizzes and qualifying nationwide conducted written exam.

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 the parent institution. 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 before the close of the even semester.

5. Viva Voce Assessment

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

6. Industrial / In-house Training Assessment

The two mandatory internships after First and Second Year of are to be assessed in 3rd and 5th semester subsequently. The trainng should be preferably done in the industry but can also be in house depending upon the stream and availability of resources in and around the institute. Faculty should be assigned each student and made responsible for the evaluation and assessment of the training. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weight ages on the basis of report submission / presentation followed by viva-voce of the relevant subject.

7. Professional Industrial Training Assessment

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 weight ages 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 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.

SGPA AND CGPA ASSESSMENT

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 behaviour 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 has a great role to play in its dissemination and percolation up to grass-root level.

3. Heads 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 practical's, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practical's 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 laid 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 an initiative in establishing liaison with industries and field organizations for imparting field experiences to the students.

11. 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.

12. 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.

13. 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.

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

15. Any relevant contents beyond the syllabus may be covered by the teacher or experts in extra time.

16. Minor project should be identified and allocated taking into consideration the inputs from industry stake-holders, and departmental faculty. The minor project work should be such

that it enhances the fundamental skill-sets of the students from industry perspective and subsequently helps them to handle major project.

17. For major project work, students may be given relevant and well thought out problems, which are purposeful and develop practical skills. This will help the students in developing creativity and confidence for their gainful employment.

18. A Project bank may be developed in consultation with related industry, research institutes and other relevant field organizations. It may be ensured that that the students take up some live problems being faced by industry as part of project work.

26. LIST OF EXPERTS

1. Controller of Examination, Haryana State Board of Technical Education, Panchkula.
2. Controller of Administration & 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, Academic, Haryana State Board of Technical Education, Panchkula.
7. Assistant Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
8. Mr. KP Sharma, Electronics Sector Skills Council, Okhla Industrial Estate, New Delhi-110020.
9. Mr. Virender Dhiman, Regional Manager, Department of Business, Electronics Sector Skills Council, Okhla Industrial Estate, New Delhi- 110020.
10. Mr. Pankaj Jain, Manager, Department of Human Resource, Napino Auto & Electronics Pvt. Ltd., Plot No-7, Sector 3, Manesar, Gurugram.
11. Ms. Jahida, Senior Executive, Human Resource, Communication Test Design India Pvt. Ltd., Mansesar.
12. Mr. Varun Bhatia, Head Standards, Electronic Sector Skills Council of India. Bhikaji Cama Place, Rama Krishna Puram, New Delhi.
13. Mr. Azhar Ansari, Technical Manager, Encomsystem Robotics & Automation, Gurgaon.
14. Mr. Ajay Kumar Godara, Director, Enovation Lab. Sector 26, Chandigarh.
15. Dr. Ajay Dagar, Vice Principal, World College of Technology Management, Farukhnagar, Gurgaon.

16. Mr. MS Gautam, HOD, Department of Mechanical Engineering, World College of Technology Management, Farukhnagar, Gurgaon

17. Dr. Rajesh Garg, Lecturer, Department of Electronics & Communication Engineering, Seth Jai Parkash Polytechnic, Damla.

18. Mr. Sanjay Puri, Lecturer, Department of Electronics & Communication Engineering, Seth Jai Parkash Polytechnic, Damla.

19. Sh. Rajiv Sharma, Lecturer, Department of Electrical Engineering, Seth Jai Prakash Polytechnic, Dhamla.

20. Mr. Inderjeet Singh Dhindhsa, Lecturer, Department of Electronics & Communication Engineering, Government Polytechnic, Ambala.

21. Mr. Ravinder Singh Punia, Lecturer, Department of Electronics & Communication Engineering, Government Polytecnic, Ambala.

22. Mr. Vipin Kumar, Lecturer, Department of Electronics & Communication Engineering, Seth Jai Parkash Polytechnic, Damla.

23. Er. Yogindra Kaushik, Assistant General Manager, Hartron, Gurgaon.

24. Dr. Amandeep Singh, Assistant Professor, Department of Electronics & Communication Engineering, National Institute of Technology, Srinagar.

25. Mr. Munish Gupta, HOD, Department of Computer Engineering, Government Polytechnic, Ambala.

26. Mr. Jagjit Singh Narang, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Ambala.

27. Dr. Bhajan Lal, Lecturer, Applied Science Department, Government Polytechnic for Women, Sirsa, Haryana.

28. Sh. Anil Nain, Lecturer, Applied Science Department, Government Polytechnic, Hisar, Haryana.

29. Dr. Sarita Mann, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.

30. Smt. Bindu Verma, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

31. Smt. Pushpa Rani, Senior Lecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.

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44. Mr. Subhash Chandra Bhoria, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Hisar.

45. Mr. Pardeep Kumar, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri.

46. Dr. SS Dhami, Professor & Head, Mechanical Engineering Department, NITTTR, Chandigarh.

47. Mr. KG Srinivasa, Professor CSE, IIIT-Naya Raipur.

48. Dr. Pankaj Sharma, Professor, Applied Science Department, NITTTR, Chandigarh.

49. Dr. Ritula Thakur, Associate Professor, Electrical Engineering, NITTTR, Chandigarh.

50. Dr. Balwinder Raj, Associate Professor, NIT Jalandhar.

51. Dr. Ashok Kumar, Associate Professor, Applied Science Department, NITTTR, Chandigarh.

52. Dr. KC Lachhwani, Assistant Professor, Applied Science, NITTTR, Chandigarh

53. Dr. P.S. Rao, Assistant Professor, Department of Mechanical Engineering, NITTTR, Chandigarh.

54. Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.

55. Dr. AB Gupta, Professor and Head, Education & Educational Management Department, NITTTR, Chandigarh.

56. Sh. PK Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
57. Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
58. Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

27. APPENDIX

Sr. No.	LIST OF EQUIPMENT
1.	DC regulated low voltage variable power supply
2.	DC regulated multiple output power supply
3.	Audio oscillator
4.	Wide band RC Oscillator
5.	RF Signal Generator
6.	Pulse Generator
7.	Function Generator
8.	Dual trace CRO with accessories
9.	Electronic Multimeter DC and AC with different ranges
10.	Electronics digital Multimeter three and a half digit
11.	Digital LCR- Q meter
12.	Audio output power meter
13.	Mains Voltage stabilizer(3 KVA)
14.	AC Millivoltmeters
15.	DC Millivoltmeters
16.	Voltmeter
17.	DC Ammeter
18.	Battery of different voltage and Ampere hour
19.	Single Phase variac
20.	Rheostat of different wattage and resistance
21.	Servo stabilizer power supply
22.	IC Bread Boards
23.	Distortion factor meter
24.	Decade resistance, capacitance and inductance
25.	Transducers: Pressure type, thermocouple, LVDT, opto Pick-up, electromagnetic pick-up, ultrasonic pick-up and potentiometer etc
26.	Thyristor control experimental kits Instrumentation/Transducer experimental kit. Basic electronic experiment kit
27.	Digital thermometer
28.	Digital load indicator with load Cells
29.	Digital Lux meter
30.	Function Generators Audio Frequency
31.	Multimeter (Digital)
32.	Rectifier Kits

33.	Filter Circuit Kit
34.	Transistor Kits (a) CB (b) CE
35.	FETs
36.	DSO
37.	Gravesend apparatus
38.	Bell crank lever
39.	Screw jack
40.	Worm wheel
41.	Soldering Set`
42.	Hand Drill
43.	PCB Etching Machine
44.	Silk Screen Printing
45.	Drafting Equipment
46.	PCB Drilling Machine
47.	Sheet metal folding and binding machine
48.	Sheet metal cutting machine
49.	Centre Lathe
50.	Grinder
51.	Circular saw
52.	DC regulated low voltage variable power supply
53.	Soldering stations temperature controlled
54.	Solder suckers with accessories
55.	Digital IC power supply
56.	Universal Counter timer
57.	Pulse Generator
58.	Logic probes (TTL and CMOS)
59.	Digital logic trainer (TTL)
60.	Logic Trainer Boards
61.	TTL and CMOS ICs
62.	8051 Microcontroller Trainer Kits with peripherals
63.	Arduino Microcontroller
64.	PIC18F458 Microcontroller Trainer Kits with peripherals
65.	ESp8266
66.	Raspberry pi

67.	Sensors
68.	Actuators
69.	Tinker CAD Open source software
70.	Digital IC Tester
71.	Universal Programmer
72.	EPROM Eraser
73.	Ink jet Printers
74.	Laser Printers
75.	Scanners
76.	Light Measurement (Photocells) Kit
77.	LVDT Kit
78.	Pressure Measurement Kit
79.	Strain Measurement Kit
80.	Water Level Measurement Kit
81.	Velocity Measurement Kit
82.	RPM Measurement Kit
83.	Temperature Measurement Kit
84.	Maxwell's Bridge Kit
85.	Wein's Bridge Kit
86.	Anderson Bridge Kit
87.	Flux Meter (Digital) Kit
88.	Q. Meter (Digital) Kit
89.	Flow Meter
90.	Ammeter, Voltmeter, Wattmeter and Energy Meters (3- phase and 1- phase)
91.	3-Phase Resistive load
92.	LCR/Q Bridge
93.	Tong tester
94.	Transformer (single phase)
95.	Watt meter, Volt meter, Ammeter,
96.	DC Shunt Motor,2 hp with loading arrangement
97.	Induction Motor (Single phase)
98.	Induction Motor (Three phase)
99.	Slipring Induction Motor 3 HP with loading facility
100.	Alternator and Load for Alternators
101.	DC generator with prime-mover motor
102.	DC Regulated Power Supply

103.	Starters (DOL and Star Delta)
104.	Rheostats
105.	Tacho meters (digital)
106.	Maggar (Insulation Tester)
107.	Earth Tester
108.	Digital Multi-meter
109.	Rectifier, Inverter Set
110.	Series Inverter
111.	Parallel Inverter
112.	Speed Control of dc motor (Thyristorized)
113.	Gate Triggering Characteristics of SCR
114.	AC Phase Control Trainer Kit
115.	UJT Characteristics and its Application as Relaxation Oscillator
116.	Diac and Triac characteristics trainer kits
117.	Solar Cell Characteristics trainer kit
118.	PLCs with Digital and Analog Input and output along with programming software
119.	PCB Software licensed or Open sources
120.	Matlab or Scilab
121.	MS or Open source Office
122.	Python
123.	SMPS
124.	UPS
125.	Auto CAD Software
126.	3D Printing Software
127.	Hydraulic power pack
128.	Hydraulic fluid power system
129.	Pneumatic fluid power system
130.	CATIA IDEAS SOLID WORKS
131.	CAPP programming software
132.	Milling machine
133.	Electro-Chemical Machine
134.	CNC Lathe machine

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