NSQF ALIGNED CURRICULUM

DIPLOMA IN ELECTRICAL ENGINEERING

PUNJAB STATE BOARD OF TECHNICAL EDUCATION
&
INDUSTRIAL TRAINING

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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FOREWORD

An important issue generally debated amongst the planners and educators world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket of standard of life as that of the developed nations. The rapid industrialization and globalization has created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different cultures and environments together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the license-based closed economy to knowledge and market based open economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by the State Board of Technical Education, Punjab to revise the existing curricula of diploma programmes as per the needs of the industry and making them National Skill Qualification Framework (NSQF) compliant, are laudable.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon effective implementation of its curricula. Howsoever best the curriculum document is designed, if it is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected that the polytechnics carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and get the faculty members regularly trained and upskilled. So that it can infuse the much needed dynamism in the system. They are welcome to reach NITTTR Chandigarh whenever they want to train the faculty members and get the curricula revised.

Director
National Institute of Technical Teachers
Training & Research, Chandigarh

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i) Chairperson, Punjab State Board of Technical Education and Industrial Training, Chandigarh for entrusting this project of curriculum revision to NITTTR, Chandigarh.

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v) All the participants from industry/field organizations, universities, engineering colleges, polytechnics and other technical institutions for their professional inputs during curriculum workshops.

vi) Faculty from different departments of NITTTR, Chandigarh for content updation.

Coordinator

1. SALIENT FEATURES OF DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING

1)	Name of the Programme	:	Diploma Programme in Electrical Engineering
2)	Duration of the Programme	:	Three years (Six Semesters)
3)	Entry Qualification	:	Matriculation or equivalent NSQF Level as prescribed by State Board of Technical Education, Punjab
4)	Intake	:	40/60 (or as prescribed by the Board)
5)	Pattern of the Programme	:	Semester Pattern
6)	NSQF Level	:	Level - 5
7)	Ratio between theory and Practice	:	40 : 60

8) Industrial Training:

Six weeks of industrial training is included after IV semester during summer vacation

9) Ecology and Environment :

As per Govt. of India directives, a subject on Environmental Studies has been incorporated in the curriculum.

10) Energy Conservation:

An Energy Conservation Awareness Camp has been included in the curriculum to sensitize the students about significance and various aspects of energy conservation. Concepts of Energy Conservation have also been included in the subject of Environmental Studies.

11) Entrepreneurship Development:

An Entrepreneurial Awareness Camp and a full subject on Generic Skills and Entrepreneurship Development have been incorporated in the curriculum.

12) Camps on “Traffic Awareness and Road Safety” have been added in semester I & II under Student Centered Activities.

13) “Drugs Use and Abuse Awareness Camp” have been added in IIIrd Semester under Student Centered Activities.

14) Personality Development

A camp focusing on personality development of students has been incorporated in the curriculum.

15) Student Centred Activities:

A provision of 3-6 hrs per week has been made for organizing Student Centred Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities etc.

16) Project work

A project work has been included in the curriculum to enable the student get familiarize with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

2. EMPLOYMENT OPPORTUNITIES FOR DIPLOMA HOLDERS IN ELECTRICAL ENGINEERING

Keeping present scenario in view following employment opportunities are visualized in different sectors of employment for diploma holders in electrical engineering

a) Manufacturing Industry

The Electrical diploma holder will be able to execute following activities:

- Planning and execution for Electrical installation
- Electrical installations and Maintenance of DG Set
- Electrical Power Distribution and Maintenance
- Maintenance of Industrial Electrical System
- Repair and Maintenance of Electrical Machines and Equipment
- Quality Control for Electrical systems
- Energy Conservation
- Assistance in Research and Development
- Assistance in Planning, Designing and Detailing
- Shop-floor Management
- Electrical Safety Measures
- Estimate for Electrical Installations
- Inventory Management
- Marketing and Sales

b) Government Departments such as Electricity Board, MES, PWD, Railways, Air bases, Airports, Defence, Thermal, Hydro and Nuclear Power Stations and other Boards and Corporations

The Electrical diploma holder will be able to execute following type of activities in above mentioned Government Departments:

- Assistance in Planning and Design of Electrical generation, transmission, distribution and protection system including testing, quality control
- Estimating for electrical installation
- Construction, erection and commissioning of lines and Sub-stations
- Electrical Safety measures
- Operation and Maintenance of Lines and Sub-stations/underground cables
- Tariffs and Calculations of bills for consumption of electricity
- Inventory Management
- Repair and Maintenance of Electrical Machines/ Equipment
- Assist in Operation and maintenance of Generating and sub-stations

- Preventive maintenance and condition monitoring

c) Hospitals, Commercial Complexes, Service Sector Organizations like Hotels, Tourist-Resorts, high-rise buildings, Cinema/Theater Halls etc.

The diploma holder in electrical engineering will be involved in following type of activities in above mentioned Service Sector Organizations:

- Layout of wiring circuit, planning and execution for Electrical Installation
- Standby or captive Power Generation and its Distribution
- Maintenance of Electrical and Electronic Equipment
- Preventive maintenance of Electrical Systems of Lifts, Air-Conditioning Plants etc.
- Inventory Management
- Estimation for electrical repair and maintenance work

d) Self Employment

Following type of self employment opportunities are available to the diploma holder in electrical engineering:

- Trading of Electrical Goods
- Establishing Repair and Maintenance Unit/ Centre
- Free Lancer for Repair and Maintenance of House-hold Electrical and Electronic Gadgets such as: Washing Machines, Geysers, Air Conditioners, Coolers and electrical installations etc.
- Electrical contractor
- Motor Winding Unit
- Auto-electrical Work
- Service sector (AMC)

After first year, the NSQF Level – 3 pass out students have avenues to work as semi skilled employee. Similarly, after second year, the NSQF Level – 4 pass out students have wide scope to work as skilled employee in Electrical Engineering related industries.

3. LEARNING OUTCOMES OF DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING

After undergoing this programme, students will be able to:	
1.	Prepare and interpret drawings of engineering components
2.	Prepare simple jobs as per specifications
3.	Acquire knowledge and understand the elements of electricity and DC circuits.
4.	Acquire knowledge of AC circuits and their components
5.	Select proper conducting or insulating material for engineering application
6.	Detect and rectify various types of faults in house wiring, and contactor control circuits.
7.	Apply working principle of solar, thermal geothermal, tidal energy and photovoltaic energy conversion
8.	Operate and control D.C. Generators and D.C motors.
9.	Calculate efficiency and voltage regulation of three phase and single phase transformers
10.	Demonstrate working of bi-polar transistors as an amplifier
11.	Select/ develop and apply appropriate techniques and IT tools for the design and analysis of the system.
12.	Detect and rectify various types of faults in contactor control circuits
13.	Apply Boolean laws for simplification of logical expressions, and designing of combinational and sequential circuits
14.	Identify and connect starters for starting three phase and single phase induction motors
15.	Maintain and repair different indicating and recording instruments in electric circuits
16.	Control speed of D.C. shunt motor or universal motor.
17.	Draw schematic and wiring diagrams of simple electrical circuits and contactor control circuits.
18.	Draw orthographic projections of simple electrical parts and machine parts.
19.	Comprehend the principles of management including its functions in an organization

20.	Select suitable supporting structure, insulators, conductors and other accessories for power transmission and distribution lines.
21.	Interface microcontroller with hardware for given application
22.	Install various electrical equipment as per IER Act by adopting all safety measures.
23.	Understand the need of PLC for Industrial Automation
24.	Use and select protective relays and protective scheme
25.	Design lighting scheme for domestic, industrial and commercial installation.
26.	Analyze and compare cost estimates to determine the most economical solutions for electrical installations, including materials, labor and overhead costs.
27.	Use appropriate practices for conservation and prevention of environment pollution
28.	Communicate effectively in English in oral and written form with others
29.	Plan and execute given task/project as a team member or leader
30.	Prepare detailed project proposal and report.
31.	Use computer and IT tools for creating document, making spread sheet and making presentation
32.	Solve real life problems by application of acquired knowledge and skills
33.	Apply basic principles of mathematics and science to solve engineering problems
34.	Explore interest and passion in areas other than professional stream

4. DERIVING CURRICULUM AREAS FROM LEARNING OUTCOMES OF THE PROGRAMME

The following curriculum areas have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Prepare and interpret drawings of engineering components	– Engineering Drawing
2.	Prepare simple jobs as per specifications	– General Workshop Practice
3.	Acquire knowledge and understand the elements of electricity and DC circuits.	– Fundamentals of Electrical Engineering
4.	Acquire knowledge of AC circuits and their components	– Fundamentals of Electrical Engineering
5.	Select proper conducting or insulating material for engineering application	– Electrical Engineering Materials
6.	Detect and rectify various types of faults in house wiring, and contactor control circuits.	– Electrical Workshop Practice – I – Electrical Workshop Practice – II
7.	Apply working principle of solar, thermal geothermal, tidal energy and photovoltaic energy conversion	– Non-Conventional Energy Sources
8.	Operate and control D.C. Generators and D.C motors.	– Electrical Machines - I – Electrical Machines - II
9.	Calculate efficiency and voltage regulation of three phase and single phase transformers	– Electrical Machines - I
10.	Demonstrate working of bi-polar transistors as an amplifier	– Electronics Devices & Circuits
11.	Select/ develop and apply appropriate techniques and IT tools for the design and analysis of the system.	– Computer Programming Applications
12.	Detect and rectify various types of faults in contactor control circuits	– Electrical Workshop Practice – II

13.	Apply Boolean laws for simplification of logical expressions, and designing of combinational and sequential circuits	– Basics of Digital Electronics
14.	Identify and connect starters for starting three phase and single phase induction motors	– Electrical Machines - II
15.	Maintain and repair different indicating and recording instruments in electric circuits	– Electrical Measurement and Instrumentation
16.	Control speed of D.C. shunt motor or universal motor.	– Industrial Electronics and Control of Drives
17.	Draw schematic and wiring diagrams of simple electrical circuits and contactor control circuits.	– Electrical Engineering Design and Drawing
18.	Draw orthographic projections of simple electrical parts and machine parts.	– Electrical Engineering Design and Drawing
19.	Comprehend the principles of management including its functions in an organization	– Industrial Management
20.	Select suitable supporting structure, insulators, conductors and other accessories for power transmission and distribution lines.	– Electrical Power – I
21.	Interface microcontroller with hardware for given application	– Microcontroller and Applications
22.	Install various electrical equipment as per IER Act by adopting all safety measures.	– Installations and Maintenance of Electrical Equipment
23.	Understand the need of PLC for Industrial Automation	– PLC Based Industrial Automation
24.	Use and select protective relays and protective scheme	– Electrical Power – II
25.	Design lighting scheme for domestic, industrial and commercial installation.	– Utilization of Electrical Energy
26.	Analyze and compare cost estimates to determine the most economical solutions for electrical installations, including materials, labor and overhead costs.	– Electrical Estimating and Costing
27.	Use appropriate practices for conservation and prevention of environment pollution	– Environmental Studies

28.	Communicate effectively in English in oral and written form with others	– English and Communication Skills
29.	Plan and execute given task/project as a team member or leader	– Generic Skills and Entrepreneurship Development
30.	Prepare detailed project proposal and report.	– Generic Skills and Entrepreneurship Development
31.	Use computer and IT tools for creating document, making spread sheet and making presentation	– Basics of Information Technology
32.	Solve real life problems by application of acquired knowledge and skills	– Project Work – Industrial Training
33.	Apply basic principles of mathematics and science to solve engineering problems	– Applied Physics – Applied Chemistry – Applied Mathematics
34.	Explore interest and passion in areas other than professional stream	– Open Elective

5.	**ABSTRACT OF THE CURRICULUM AREAS**	
a)	**Humanities and Social Science Courses**	
	1.	English and Communication Skills
	2.	Generic Skills and Entrepreneurship Development
	3.	Industrial Management
	4.	Environmental Studies
b)	**Basic/Applied Science Courses**	
	5.	Applied Mathematics
	6.	Applied Physics
	7.	Applied Chemistry
c)	**Engineering Science Courses**	
	8.	Engineering Drawing
	9.	Basics of Information Technology
	10.	General Workshop Practice
	11.	Non-Conventional Energy Sources
	12.	Computer Programming Applications
d)	**Core Courses in Engineering/Technology**	
	13.	Electrical Engineering Materials
	14.	Fundamentals of Electrical Engineering
	15.	Electrical Machines
	16.	**ELECTRONICS DEVICES AND CIRCUITS**
	17.	Electrical Workshop Practice
	18.	Basics of Digital Electronics
	19.	Electrical Measurement and Instrumentation
	20.	Industrial Electronics and Control of Drives
	21.	Electronics Devices & Circuits
	22.	Electrical Engineering Design and Drawing
	23.	Industrial Management

24.	Electrical Power
25.	Microcontroller and Applications
26.	Installation and Maintenance of Electrical Equipment
27.	PLC based Industrial Automation
28.	Utilization of Electrical Energy
29.	Electrical Estimating and Costing
e) Electives	
30.	Program Electives
31.	Open Electives
f) Project Work, Seminar and Industrial Training	
31.	Project Work
32.	Industrial Training

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS

Sr. No.	Subjects	Distribution in Hours per week in Various Semesters					
		I	II	III	IV	V	VI
1.	English & Communication Skills	5	5	-	-	-	-
2.	Applied Mathematics	4	3	-	-	-	-
3.	Applied Physics	5	4	-	-	-	-
4.	Applied Chemistry	5	-	-	-	-	-
5.	Basics of Information Technology	2	-	-	-	-	-
6.	Engineering Drawing	6	-	-	-	-	-
7.	General Workshop Practice	6	-	-	-	-	-
8.	Fundamentals of Electrical Engineering	-	8	-	-	-	-
9.	Electrical Engineering Materials	-	3	-	-	-	-
10.	Environmental Studies	-	2	-	-	-	-
11.	Electrical Workshop Practice	-	6	6	-	-	-
12.	Non-Conventional Energy Sources	-	-	3	-	-	-
13.	Electrical Machines	-	-	7	7	-	-
14.	Electronics Devices & Circuits	-	-	7	-	-	-
15.	Computer Programing Applications	-	-	6	-	-	-
16.	Open Elective	-	-	2	-	-	-
17.	Generic Skills and Entrepreneurship Development	-	-	-	3	-	-
18.	Basics of Digital Electronics	-	-	-	4	-	-
19.	Electrical Measurement and Instrumentation	-	-	-	6	-	-
20.	Industrial Electronics and Control of Drives	-	-	-	7	-	-
21.	Electrical Engineering Design and Drawing	-	-	-	6	-	-
22.	Industrial Management	-	-	-	-	3	-
23.	Electrical Power	-	-	-	-	5	5
24.	Microcontroller and Applications	-	-	-	-	6	-
25.	Installation and Maintenance of Electrical Equipment	-	-	-	-	6	-
26.	Program Elective	-	-	-	-	3	-
27.	Minor Project Work	-	-	-	-	8	-

28.	PLC based Industrial Automation	-	-	-	-	-	4
29.	Utilization of Electrical Energy	-	-	-	-	-	5
30.	Electrical Estimating and Costing	-	-	-	-	-	3
31.	Major Project Work	-	-	-	-	-	16
32.	Student Centered Activities	2	4	4	2	4	2
Total		**35**	**35**	**35**	**35**	**35**	**35**

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING
FIRST SEMESTER

SR. NO.	SUBJECTS	STUDY SCHEME Hrs/Week			MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	*English and Communication Skills – I	3	2	4	20	10	30	50	3	20	3	70	100
1.2	*Applied Mathematics - I	4	-	4	50	-	50	50	3	-	-	50	100
1.3	*Applied Physics – I	3	2	4	20	10	30	50	3	20	3	70	100
1.4	*Applied Chemistry	3	2	4	20	10	30	50	3	20	3	70	100
1.5	* Basics of Information Technology	-	2	1	-	40	40	-	-	60	3	60	100
1.6	*Engineering Drawing – I	-	6	3	-	50	50	50	3	-	-	50	100
1.7	*General Workshop Practice – I		6	3	-	50	50	-	-	50	3	50	100
#Student Centred Activities including Traffic Awareness & Road Safety Camp(I)		-	2	-	-	-	-	-	-	-	-	-	-
Total		13	22	23	110	170	280	250	-	170	-	420	700

* Common course with other diploma programmes

\# SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

SECOND SEMESTER

SR. NO.	SUBJECTS	STUDY SCHEME Periods/Week			MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
2.1	*English and Communication Skills – II	3	2	4	20	10	30	50	3	20	3	70	100
2.2	*Applied Mathematics – II	3	-	3	50	-	50	50	3	-	-	50	100
2.3	* Applied Physics-II	2	2	3	20	10	30	50	3	20	3	70	100
2.4	Fundamentals of Electrical Engineering	4	4	6	20	10	30	50	3	20	3	70	100
2.5	Electrical Engineering Materials	3	-	3	50	-	50	50	3	-	-	50	100
2.6	* Environmental Studies	2	-	2	50	-	50	50	3	-	-	50	100
2.7	Electrical Workshop Practice – I	-	6	3	-	50	50	-	-	50	3	50	100
#Student Centred Activities including Traffic Awareness & Road Safety Camp(II)		-	4	-	-	-	-	-	-	-	-	-	-
Total		17	18	24	210	80	290	300	-	110	-	410	700

* Common Course with other diploma programmes

\# SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

THIRD SEMESTER

SR. NO.	SUBJECTS	STUDY SCHEME Hrs/Week			MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
3.1	Non-Conventional Energy Sources	3	-	3	50	-	50	50	3	-	-	50	100
3.2	Electrical Machines – I	3	4	5	20	10	30	50	3	20	3	70	100
3.3	Electronics Devices & Circuits	3	4	5	20	10	30	50	3	20	3	70	100
3.4	Computer Programing Applications	-	6	3	-	50	50	-	-	50	3	50	100
3.5	Electrical Workshop Practice–II	-	6	3	-	50	50	-	-	50	3	50	100
3.6	Open Elective (Offline/Online)	2	-	2	50	-	50	50	3	-	-	50	100
# Student Centred Activities (SCA) including Energy Conservation Awareness Camp ; Drug Use and Abuse Awareness Camp		-	4	-	-	-	-	-	-	-	-	-	-
Total		11	24	21	140	120	260	200	-	140	-	340	600

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

FOURTH SEMESTER

SR. No.	SUBJECTS	STUDY SCHEME Hrs/Week			MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	*Generic Skills and Entrepreneurship Development	3	-	3	50	-	50	50	3	-	-	50	100
4.2	Basics of Digital Electronics	2	2	3	20	10	30	50	3	20	3	70	100
4.3	Electrical Machines – II	3	4	5	20	10	30	50	3	20	3	70	100
4.4	Electrical Measurement and Instrumentation	2	4	4	20	10	30	50	3	20	3	70	100
4.5	Industrial Electronics and Control of Drives	3	4	5	20	10	30	50	3	20	3	70	100
4.6	Electrical Engineering Design and Drawing	-	6	3	-	50	50	-	-	50	3	50	100
# Student Centred Activities(SCA) including Entrepreneurial Awareness camp		-	2	-	-	-	-	-	-	-	-	-	-
Total		13	22	23	130	90	220	250	-	130	-	380	600

* Common Course with other diploma programmes

\# SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

Industrial Training - After examination of 4th Semester, the students shall go for training in a relevant industry/field organisation for a minimum period of 6 weeks and shall prepare a diary. It shall be evaluated during 5th semester by his/her teacher for 50 marks. The students shall also prepare a report at the end of training and shall present it in a seminar, which will be evaluated for another 50 marks. This evaluation will be done by HOD and lecturer in charge – training in the presence of one representative from training organisation.

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Hrs/Week			MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
	Industrial Training during vacations after 4th Semester	-	-	2	-	50	50	-	-	50	3	50	100
5.1	Industrial Management	3	-	3	50	-	50	50	3	-	-	50	100
5.2	Electrical Power – I	3	2	4	20	10	30	50	3	20	3	70	100
5.3	Microcontroller and Applications	2	4	4	20	10	30	50	3	20	3	70	100
5.4	Installation and Maintenance of Electrical Equipment	2	4	4	20	10	30	50	3	20	3	70	100
5.5	Program Elective	3	-	3	50	-	50	50	3	-	-	50	100
5.6	Minor Project Work	-	8	3	-	50	50	-	-	50	3	50	100
# Student Centred Activities including Personality Development Camp		-	4	-	-	-	-	-	-	-	-	-	-
Total		13	22	23	160	130	290	250	-	160	-	410	700

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

Programme Elective To choose any one from the following: 5.5.1 Smart Grid 5.5.2 Electric Vehicles 5.5.3 Sensors & IoT

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Hrs/Week			MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	PLC based Industrial Automation	2	2	3	20	10	30	50	3	20	3	70	100
6.2	Electrical Power – II	3	2	4	20	10	30	50	3	20	3	70	100
6.3	Utilization of Electrical Energy	3	2	4	20	10	30	50	3	20	3	70	100
6.4	Electrical Estimating and Costing	3	-	3	50	-	50	50	3	-	-	50	100
6.5	Major Project Work	-	16	7	-	50	50	-	-	50	3	50	100
SCA		-	2	-	-	-	-	-	-	-	-	-	-
Total		11	24	21	110	80	190	200	-	110	-	310	500

***** Common with other Diploma Programmes

\# SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

1.1 ENGLISH AND COMMUNICATION SKILLS – I

L	P
3	2

RATIONALE

Communication skills play an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills.

LEARNING OUTCOMES

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

- Pronounce properly.
- Overcome communication barriers.
- Write legibly and effectively.
- Listen in proper prospective.
- Read various genres adopting different reading techniques.
- Converse logically.

DETAILED CONTENTS

1. Basics of Communication (12 hrs)

    1.1 Definition and process of communication
    1.2 Introduction to types of communication - formal and informal, oral and written, verbal and non-verbal
    1.3 Objectives of communication
    1.4 Essentials of communication
    1.5 Introduction to channels of communication - formal (upward, downward, diagonal, horizontal), informal (grapevine, consensus)
    1.6 Barriers to communication

2. Functional Grammar and Vocabulary (12 hrs)

    2.1 Parts of speech
    2.2 Article
    2.3 Tenses
    2.4 Subject verb agreement sentences
    2.5 Active and passive voice
    2.6 Synonyms and antonyms
    2.7 Pair of words
    2.8 Correction of incorrect sentences

3. Listening (04 hrs)

3.1 Meaning of listening
3.2 Listening and hearing
3.3 Importance of listening
3.4 Active listening – Meaning and strategies
3.5 Methods to improve listening skills

4. Speaking (03 hrs)

4.1 Importance
4.2 Methods to improve speaking

5. Reading (12 hrs)

5.1 Meaning
5.2 Techniques of reading: skimming, scanning, intensive and extensive reading
5.3 Comprehension, vocabulary enrichment and grammar exercises based on following readings:

Section - I

- My Struggle for an Education – Booker T. Washington
- Abraham Lincoln's letter to his son's headmaster – Abraham Lincoln
- Gateman's Gift – R.K Narayan
- The Selfish Giant - Oscar Wilde

Section - II

- Say Not, the Struggle Nought Availeth – A H Clough
- Stopping by Woods on a Snowy Evening – Robert Frost
- Where the Mind is Without Fear – Rabindranath Tagore

6. Writing (02 hrs)

6.1 Significance and effectiveness of writing
6.2 Paragraph writing – Word choice, sentence formation and construction of paragraph.

LIST OF PRACTICALS

1. Self and peer introduction
2. Newspaper reading
3. Just a Minute session – extempore
4. Situational conversation and role play
5. Language learning using open source software.

6. Greetings for different occasions
7. Improving pronunciation through tongue twisters.

INSTRUCTIONAL STRATEGY

Open source software should be used to help the students in developing listening skills. Student centred activities such as group discussions, role play should be used to ensure active participation of students in the classroom.

RECOMMENDED BOOKS

1. Revathi, Srinivas, "Communicating Effectively in English, Book-I", Abhishek Publications, Chandigarh.
2. Mohan, Krishna & Meera Banerji, "Developing Communication Skills (2nd Edition)", Published by Macmillan Publishers India Ltd; New Delhi.
3. Eastwood, John, "Oxford Practice Grammar", Oxford University Press, London
4. Chadha, R. K., "Communication Techniques and Skills", Dhanpat Rai Publications, New Delhi.
5. Wren & Martin, "High School English Grammar and Composition", S. Chand & Company Ltd., Delhi.
6. Kumar, Sanjay & Pushp Lata, "Communication Skills", Oxford University Press, New Delhi

WEBSITES FOR REFERENCE

1. http://www.mindtools.com/ page 8.html
2. http://www.letstalk.com.in
3. http://www.englishlearning.com
4. http://learnenglish.britishcouncil.org/en/

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	12	12
2	12	12
3	04	6
4	03	3
5	12	15
6	02	2
Total	**45**	**50**

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 binomial theorem, partial fractions, etc. for solving complex engineering problems with exact solutions in a way which involve less computational task. The analytical capabilities will enable the students to solve problems in engineering field.

LEARNING OUTCOMES

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

- Apply Complex Number and its representation for two dimensional designing and related calculations.
- Apply the basic concepts of permutation and combination to find out various ways or arrangements possible for a particular problem.
- Apply binomial theorem to find approximate value of certain expressions and extracting roots of certain expressions.
- Apply basics concepts of partial fractions to simplify the concept of rational expression.
- Solve engineering problems that are in matrix format by applying the basic understanding of matrices and their properties,
- Solve problems related to height, distance, elevation by making use of trigonometry.
- Write the equation of straight line and circle by using coordinate geometry.
- Optimize the utilization of resources by applying concepts of linear programming.

DETAILED CONTENTS

1. Algebra (20 hrs)

1.1 Complex Numbers: Complex number, representation, modulus and amplitude.

1.2 Partial fractions (linear factors, repeated linear factors, non-reducible quadratic factors excluding repeated factors).

1.3 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 without proof), first and second binomial approximation with applications to engineering problems.

1.4 Introduction to Matrices and Determinants – Addition, subtraction and multiplication (upto 3 * 3 matrices), Determinants, simple properties, Crammer Rule.

2. Trigonometry (15 hrs)

2.1 Introduction to T ratios, 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). T-Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2).

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

3. Co-ordinate Geometry (18 hrs)

3.1 Cartesian and Polar coordinates (two dimensional), conversion from Cartesian to Polar coordinates and vice-versa

3.2 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), inter section of two straight lines, concurrency of lines, angle between straight lines.

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

* Centre and radius
* Three points lying on it
* Coordinates of end points of a diameter

4. Operations Research (7 hrs)

4.1 Linear Programming Problems formulations.

4.2 Graphical Method

INSTRUCTIONAL STATREGY

Basic of algebra, trigonometry, coordinate geometry, operations research 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.

RECOMMENDED BOOKS

1. Grewal, BS, "Elementary Engineering Mathematics", Khanna Publishers, New Delhi
2. Sabharwal, SS & Dr Sunita Jain, "Applied Mathematics, Vol. I & II", Eagle Parkashan, Jalandhar
3. Sastry, SS, "Engineering Mathematics, Vol I & II", Prentice Hall of India Pvt. Ltd.,
4. Pal, Srimanta and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1.	20	16
2.	15	12
3.	18	16
4	7	06
Total	**60**	**50**

1.3 APPLIED PHYSICS – I

L	P
3	2

RATIONALE

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

Note: 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.

LEARNING OUTCOMES

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

- Select units of various physical quantities for use in engineering solutions.
- Represent physical quantities as scalar and vector.
- Use the concepts of force and motion to solve problems.
- Solve problems related to friction, work, power and energy,
- Comprehend properties of matter.
- Comprehend modes of heat transfer.
- Make measurements with accuracy.

DETAILED CONTENTS

1. Units and Dimensions (9 hrs)

    1.1 Physical quantities Units - fundamental and derived units, systems of units (FPS, CGS and SI units)
    1.2 Dimensions and dimensional formulae of physical quantities (area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, surface tension, stress, strain)
    1.3 Principle of homogeneity of dimensions
    1.4 Dimensional equations and their applications, conversion of units from one system to another for density, force, pressure, work, power, velocity and acceleration. Checking of dimensional equations
    1.5 Limitations of dimensional analysis

2. Force and Motion (10 hrs)

2.1 Scalar and vector quantities – examples, representation of vector, types of vectors
2.2 Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product.
2.3 Resolution of Vectors
2.4 Force, Momentum, Statement of Conservation of linear momentum, its applications
2.5 Impulse and its Applications
2.6 Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period.
2.7 Relation between linear and angular velocity, linear acceleration and angular acceleration (Only Formula), Angular momentum and torque (definition only)
2.8 Concept of centripetal and centrifugal forces and their applications with examples such as banking of roads

3. Work, Power and Energy (8 hrs)

3.1 Work: and its units, examples of zero work, positive work and negative work
3.2 Friction: concept, types, laws of limiting friction
3.3 Energy and its units: Kinetic energy and gravitational potential energy with examples and their derivation
3.4 Principle of conservation of mechanical energy for freely falling bodies, examples of transformation of energy.
3.5 Power and its units, calculation of power in numerical problems

4. Properties of Matter (9 hrs)

4.1 Elasticity: definition of stress and strain, Modulii of elasticity (Only definition, No derivation) , Hooke's law, significance of stress strain curve
4.2 Pressure: definition, its units, atmospheric pressure, gauge pressure, absolute pressure
4.3 Surface tension: concept, its units, angle of contact, applications of surface tension, effect of temperature on surface tension
4.4 Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law

5. Thermometry (9 hrs)

5.1 Difference between heat and temperature
5.2 Modes of transfer of heat (Conduction, convection and radiation with examples)
5.3 Different scales of temperature and their relationship
5.4 Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them
5.5 Concept of Co-efficient of thermal conductivity

LIST OF PRACTICALS (to perform minimum 8 experiments)

1. To find volume of solid sphere using a vernier caliper.
2. To find internal diameter and depth of a beaker using a vernier caliper and hence find its volume.
3. To find the diameter of wire using a screw gauge
4. To determine the thickness of glass strip using a spherometer
5. To verify parallelogram law of forces
6. To study conservation of energy of a ball or cylinder rolling down an inclined plane.
7. To determine the atmospheric pressure at a place using Fortin's Barometer
8. To determine the viscosity of glycerin by Stoke's method
9. To determine the coefficient of linear expansion of a metal rod
10. To determine force constant of spring using Hooks law

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. The teacher should explain about field applications before teaching the basics. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XI (Part-I, Part-II)", N.C.E.R.T., Delhi
2. "Applied Physics, Vol. I and Vol. II", TTTI Publications, Tata McGraw Hill, Delhi
3. Verma, HC, "Concepts in Physics Vol. I & II", Bharti Bhawan Ltd. New Delhi
4. "Comprehensive Practical Physics, Vol, I & II", JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
5. Naik, PV, "Engineering Physics", Pearson Education Pvt. Ltd, New Delhi
6. Banwait, RA & R, Dogra, "Applied Physics I & II", Eagle Parkashan, Jalandhar
7. Bhhatacharya, DK & Poonam Tandan, "Engineering Physics", Oxford University Press, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1.	9	10
2.	10	12
3.	8	8
4.	9	10
5.	9	10
Total	**45**	**50**

1.4 APPLIED CHEMISTRY

L	P
3	2

RATIONALE

The use of various chemicals and chemical products in diverse technical and engineering fields have repeatedly proved the importance of Applied Chemistry, which enhances its role to a new peak. On the other hand, ever increasing use of such materials will compel engineers, technocrats to acquire essential applied chemistry knowledge in order to select engineering materials, which not only suit them but also provide more environmental compatibility. This situation demands principles of Applied Chemistry in diploma-engineering courses. Principles of Applied Chemistry will enable budding diploma holders to develop scientific temper and appreciate importance of chemistry. Hence the subject of Applied Chemistry.

LEARNING OUTCOMES

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

- Interpret both qualitative and quantitative aspects of simple chemical substances.
- Substantiate the laws and principles on which structure of atom is established.
- Understand types of bonds in chemical substance and their influence on the properties of chemical substances.
- Prepare solution of required concentrations.
- Understand qualitatively and quantitatively pH and buffer solutions.
- Significance of pH and buffer solutions and their industrial applications (in the process such as electrolysis, electrochemical machining of materials etc).
- Explain cause and factors adversely affecting natural water quality and remedial measures available for water purification to achieve water quality standards required for domestic, agricultural and industrial applications.
- Appreciate and practice the water conservation techniques.
- Identify and classify the substance based on the electric behavior.
- Realize the laws/principles efficiently used in development of electrochemical cells towards the greener energy.
- Identify most efficient fuel for the engine and engineering applications.
- Understand the elementary idea of polymers and plastics
- Distinguish different type of plastics and their applications.

DETAILED CONTENTS

1. Basic Concept of Chemistry (2 hrs)
   - 1.1 Symbols of elements and valency, writing of chemical formulae of simple compounds.
   - 1.2 Calculation of molecular masses of $CaCO_3$, NaCl, $CuSO_4$, NaOH, $Ca(OH)_2$, H_2SO_4, $C_2H_2O_4$. (Atomic mass of elements should be provided)

2. Atomic Structure and Chemical Bonding (8 hrs)
   - 2.1 Bohr's model of atom (qualitative treatment only).
   - 2.2 Atomic number, atomic mass number isotopes and isobars.
   - 2.3 Definition of orbit and orbitals, shapes of s and p orbitals only, quantum numbers and their significance,
   - 2.4 Aufbau's principle, Pauli's exclusion principle and Hund's rule electronic configuration of elements with atomic number (Z) = 30 only. (Electronic configurations of elements with atomic number greater than 30 are excluded).
   - 2.5 Chemical bonding and cause of bonding and types of chemical bonding; Ionic bond (example NaCl) and Covalent bond (sigma (σ) and pi (π) bonds) with examples of H_2, O_2, N_2 and CH_4 Metallic bonding.

3. Solutions (05 hrs)
   - 3.1 Definition of solution, solute and solvent with examples
   - 3.2 Methods to express the concentration of solution- molarity (*M*) and molality (m), mass percentage, volume percentage and mole fraction and related simple numericals.
   - 3.3 Arrhenius concept of acids and bases. pH of solution, simple numericals on pH and industrial applications of pH.
   - 3.4 Definition of buffer solution and types of buffer solutions with examples and industrial applications of buffers solutions.

4. Water (10 hrs)
   - 4.1 Classification of water – soft water and hard water, action of soap on hard water, types of hardness, causes of hardness, units of hardness – mg per liter (mgL^{-1}) and part per million (ppm) and simple numericals.
   - 4.2 Disadvantages caused by the use of hard water in domestic industry and boiler feed water.
   - 4.3 Removal of hardness -Permutit process and Ion-exchange process.
   - 4.4 Drinking water and characteristics of drinking water.
   - 4.5 Natural water sterilization by chlorine and UV radiation and reverse osmosis (elementary idea).

5. Electro Chemistry (6 hrs)

5.1 Electronic concept of oxidation, reduction and redox reactions
5.2 Definition of terms: electrolytes, non-electrolytes with suitable examples
5.3 Faradays laws of electrolysis and simple numerical problems.
5.4 Industrial Application of Electrolysis – Electroplating.
5.5 Application of redox reactions in electrochemical cells (qualitative idea only excluding reactions) - commercial dry cell (Primary) and elementary idea of secondary cell (Only lead storage battery)

6. Chemistry of Fuels and Lubricants (12 hrs)

6.1. Definition of fuel, classification of fuels (primary and secondary), characteristics of good fuel.
6.2 Calorific value-higher calorific value, lower calorific value, determination of calorific value of solid or liquid fuel using Bomb calorimeter and numerical examples.
6.3 Coal - proximate analysis of coal
6.4 Fuel rating – Octane number and Cetane number, fuel-structural influence on Octane and Cetane numbers
6.5 Gaseous fuels – chemical composition, calorific value and applications of natural gas (CNG), LPG, producer gas, water gas and biogas. (preparation/manufacture excluded)
6.6 Definition of Lubricant and characteristics of good lubricant
6.7 Classification of lubricants –liquid lubricants, solid lubricants, semi-solid lubricants with examples
6.8 Properties of lubricant: Physical properties –viscosity and viscosity index, cloud point and pour point, flash point and fire point, oiliness. Chemical properties- Total Acid Value or Number (TAV or TAN), carbon residue, saponification value.

7. Polymers and Plastics (02 hrs)

7.1 Definition of polymer, monomer and degree of polymerization
7.2 Brief introduction of plastics - thermo plastics and thermo setting plastics with suitable examples (PVC, PS, PTFE, Nylon 6, Nylon 66, bakelite) distinction between thermo and thermo setting plastics
7.3 Applications of polymers in industry and daily life
7.4 Introduction to nano materials and nano technology

LIST OF PRACTICALS

1. Preparation of standard solution of oxalic acid.
2. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.

3. To determine TDS in given sample of water.
4. To prepare Mohr's salt from ferrous sulfate and ammonium sulfate.
5. Determination of pH of given solution using pH meter.
6. Estimation of total alkalinity of given water sample by titrating it against standard sulfuric acid solution.
7. Gravimetric estimation of moisture in the given coal sample (proximate analysis).
8. Gravimetric estimation of ash content in the given coal sample (proximate analysis).
9. Determination of viscosity of given liquid using Redwood viscometers
10. To construct simple Daniel cell and measure its e.m.f. using voltmeter.
11. To estimate hardness of water using EDTA method.

INSTRUCTIONAL STRATEGY

Teachers may take help of various models and charts while imparting instructions to make the concept clear. More emphasis should be laid on discussing and explaining practical applications of various chemical process and reactions.In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career.

RECOMMENDED BOOKS

1. Kuricose, J.C. and J. Rajaram, "Chemistry in Engineering", Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Jain, P.C. & Monika Jain, "Engineering Chemistry", Dhanapat Rai Publishing Company, New Delhi.
3. Ahuja, S. C. and G. H. Hugar, "Eagle's Applied Chemistry (I and II)", Eagle Prakashan, Jalandhar.
4. Rao, C N R, "Understanding Chemistry", Universities Press (India) Pvt Ltd., 2011
5. Chopra, H. K. & A. Parmar, "Engineering Chemistry – A Text Book", Narosa Publishing House, New Delhi.
6. Pandey, Dr. Himanshu, "Engineering Chemistry", Goel Publishing House, Meerut, India.

SUGGESTED DISTRIBUTION OF MARKS

Topics	Time Allotted (hrs)	Marks Allotted (Out of 50)
1.	02	03
2.	08	08
3.	05	06
4.	10	12
5.	06	06
6.	12	12
7.	02	03
Total	**45**	**50**

1.5 BASICS OF INFORMATION TECHNOLOGY

L	P
-	2

RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. The subject introduces the fundamentals of computer system for using various hardware and software components. 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 concept of information technology and its scope; operating a computer; use of various office automation tools using MS Office/Open Office/Libre Office, and internet concepts. This exposure will enable the students to enter their professions with confidence.

LEARNING OUTCOMES

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

- Identify computer hardware components, network components and peripherals.
- Install application and utility software.
- Use word processing software to prepare document.
- Use spreadsheet software to create workbook and automate calculation.
- Use presentation software to create interactive presentation.
- Browse information on the Web.

Note: Explanation of Introductory part should be demonstrated with practical work. Following topics may be explained in the laboratory along with the practical exercises. There will not be any theory examination.

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Basic Concepts of IT and Its Application

   Information Technology concept and scope, applications of IT.

2. Computer Hardware:

   Block diagram of a computer, components of computer system, CPU, Memory, Input devices; keyboard, Scanner, mouse etc; Output devices; VDU, LCD, Printers etc. Primary and Secondary Memory: RAM, ROM, tracks and sectors, optical disk (CD , DVD & Blue Ray Disk.), USB/Flash Drive, HDD, SSD

3. Software Concepts and Programming:

   System software, Application software, Virtualization software and Utility software, Introduction of Operating System, Installation of Application software, Features of OPEN OFFICE/MS OFFICE(MS word, Excel, PowerPoint).
   Flow chart using algorithm development, Input Output statement, Control structures

4. Internet Concepts:

   Basics of Networking – LAN, WAN, PAN, MAN, and sharing of printers and other resources, Concept of IP addresses, introduction of internet, applications of internet like: e-mail and browsing, concept of search engine and safe searching. Various browsers like Internet explorer/Microsoft Edge, Mozilla Firefox, WWW (World Wide Web), hyperlinks, introduction to Anti-virus.

LIST OF PRACTICAL EXERCISES

1. Given a PC, identify its basic hardware components, network components and peripherals. List their functions .

2. Installation of various application software and utility software.

3 Installation of I/O devices like scanner, printer and plotter.

4. Practice on various features/functions of Windows Operating System..

Word Processing (MS Word/Open Office Writer/Libre Office Writer)

5. Creating/opening, saving and printing a document
6. Editing and formatting a document
7. Setting paragraph and page margins.
8. Adding header, footer and page numbering
9. Creating, inserting and formatting a table.
10. Spell checker, inserting date, time, special symbols, importing graphic images, drawing tools.

Spread Sheet Processing (MS Excel/Open Office Calc/Libre Office Calc)

11 Creating/opening, saving and printing a worksheet.
12 Editing and formatting of worksheets including changing colour, size, font, alignment of text and cell formatting.
13 Using statistical functions like sum, avg, min, max, if, count and countif, lookup.
14 Creating and formatting a chart, Using charts to analyse data. Use of filters.

Presentation Software (MS Power Point/Open Office Impress/Libre Office Impress)

15. Creating, saving, opening and printing a presentation.
16. Different views of a slide.
17. Using slide layout and template.
18. Editing and formatting slides by adding titles, subtitles, text, background, watermark, table, charts, images and sound.
19. Viewing the slide show with slide transition, animation effect, timing and order.

Programming

20. Printing of name 100 times using loop statement.

Internet and its Applications

21. Creating an e mail account. Sending and receiving e-mail.
22. Browsing and down loading of information from internet.
23. Surfing different websites like institute website, State Board PSBTE website, DTE website, NITTTR, Chandigarh website, AICTE website, various search engines like google, bing etc.

INSTRUCTIONAL STRATEGY

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computer parts, peripherals, connections and proficient in making use of MS Office/Open Office in addition to working on internet. The student should be made capable of working on computers independently.

RECOMMENDED BOOKS

1. Arora, Vipan, "Computer Fundamentals and Information Technology", Eagle Parkashan, Jalandhar
2. Sinha, PK, "Computer Fundamentals", BPB Publication, New Delhi
3. Rajaraman V, "Fundamentals of Computer", Prentice Hall of India Pvt. Ltd., New Delhi
4. Saxena, Sanjay, "MS Office for Everyone", Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. Leon and Leon, "Fundamentals of Information Technology", Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi

1.6 ENGINEERING DRAWING - I

L	P
-	6

RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawing 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.

Note:

i) First angle projection is to be followed.
ii) Minimum of 16 sheets to be prepared and at least 3 sheets on AutoCAD.
iii) Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students.

LEARNING OUTCOMES

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

- Identify and use of different grades of pencils and other drafting instruments which are used in engineering field
- Draw free hand sketches of various kinds of objects.
- Utilize various types of lines used in engineering drawing.
- Read and apply different dimensioning methods on drawing of objects.
- Use different types of scales and their utilization in reading and reproducing drawings of objects and maps.
- Draw 2 - dimensional view of different objects viewed from different angles (orthographic views)
- Draw and interpret complete inner hidden details of an object which are otherwise not visible in normal view
- Generate isometric (3D) drawing from different 2D (orthographic) views/sketches
- Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances
- Use basic commands of AutoCAD.

DETAILED CONTENTS-CUM- PRACTICAL EXERCISES

1. Introduction to Engineering Drawing (03 sheets)

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

   1.2 Different types of lines in Engineering drawing as per BIS specifications

   1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.

   1.4 Free hand and instrumental lettering (Alphabet and numerals) – upper case (Capital Letter), single stroke, vertical and inclined at 75 degree, series of 5,8,12 mm of free hand and instrumental lettering of height 25 to 35 mm in the ratio of 7:4

2. Dimensioning Technique (01 sheet)

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

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

3. Scales (02 sheets)

   3.1 Scales –their needs and importance (theoretical instructions), type of scales, definition of R.F. and length of scale

   3.2 Drawing of plain and diagonal scales

4. Orthographic Projections (06 sheets)

   4.1 Theory of orthographic projections (Elaborate theoretical instructions)

   4.2 Projection of Points in different quadrant

   4.3 Projection of Straight Line (1^{st} and 3^{rd} angle)
   - 4.3.1. Line parallel to both the planes
   - 4.3.2. Line perpendicular to any one of the reference plane
   - 4.3.3. Line inclined to any one of the reference plane.

4.4 Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1st angle only

4.5 Three views of orthographic projection of different objects. (At least one sheet in 3rd angle)

4.6 Identification of surfaces

5. Sections (02 sheets)

5.1 Importance and salient features

5.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.

5.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections

5.4 Orthographic sectional views of different objects.

6. Isometric Views (02 sheets)

6.1 Fundamentals of isometric projections and isometric scale.

6.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.

7. Common Symbols and Conventions used in Engineering (02 sheets)

7.1 Civil Engineering sanitary fitting symbols

7.2 Electrical fitting symbols for domestic interior installations

*8. Introduction to Computer Aided Drafting (03 sheets)

Basic introduction and operational instructions of various commands in Computer Aided Drafting. At least three 2 D drawings using Computer Aided Drafting of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.

*** Computer aided drawing will be evaluated internally by sessional marks and not by final theory paper.**

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. The institute should procure AutoCAD or other engineering graphics software for practice in engineering drawings. Teachers should undergo training in AutoCAD/Engineering Graphic. Separate labs for practice on AutoCAD should be established.

RECOMMENDED BOOKS

1. Singh, Surjit, “A Text Book of Engineering Drawing”, Dhanpat Rai & Co., Delhi
2. Gill, PS, “Engineering Drawing”, SK Kataria & Sons, New Delhi
3. Bhatt, ND, “Elementary Engineering Drawing in First Angle Projection”, Charotar Publishing House Pvt. Ltd., Anand
4. Layall, JS, “Engineering Drawing I & II”, Eagle Parkashan, Jalandhar
5. Goel, DK, “Engineering Drawing I”, GBD Publication.

1.7 GENERAL WORKSHOP PRACTICE – I

L	P
-	6

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practical. General workshop practical included in the curriculum in order to provide hands-on practical knowledge of different tools and basic manufacturing processes. Basic knowledge of workshop technology and practical in various workshops develop the attitude of team working, safety awareness and development of right attitude. This subject provides miniature industrial environment in the educational institute.

LEARNING OUTCOMES

After completing the course the students will be able to:

- Identify shop wise tools and equipment, their types, specifications and use with proficiency.
- Identify different types of materials, their uses and to maintain tools, equipment etc.
- Use and take measurements with the help of basic measuring tools/instrument.
- Select proper tools for a particular operation and use hand tools in different workshops with predefined outcome.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same according to drawing.
- Operate various tools and equipment in different workshops with predefined outcome, performance, standards.
- Follow the safety procedures and precautionary measures in different workshop with zero accidents.

DETAILED CONTENTS-CUM- PRACTICAL EXERCISES

Note: The students are supposed to come in proper workshop uniform 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 workshops will be explained for conduct of practical. The students should prepare sketches of various tools/jobs sequence of operations etc. in their practical notebook.

The following shops are included in the syllabus:

1. Welding Shop – I
2. Fitting Shop – I
3. Sheet Metal Shop – I
4. Electric Shop-I
5. Carpentry Shop – I
6. Smithy Shop – I or Additive Manufacturing Shop- I

1. WELDING SHOP – I

a. Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction and importance of welding as compared to other material joining processes. Classification of welding processes. Specifications and type of welding machines, welding parameters, welding methods, welding joints and welding positions. Classification and coding of electrodes and functions of electrode coating ingredients.

b. Demonstration of hand tools, arc welding machines, equipment and materials to be welded.

1.3 Jobs to be prepared:

Job I	Practice of striking arc (Minimum 4 beads on 100 mm long M.S. flat) and Practice of depositing beads at different current levels. (Minimum 4 beads on M.S. flat at four different setting of current level).
Job II	Making a lap joint using arc welding (SMAW) on MS Flat.
Job III	Making a butt joint using arc welding (SMAW) on MS Flat. (100 mm long).
Job IV	Making a T shape Joint using arc welding (SMAW) on M.S. Flat (100mm x 6 mm).

2. FITTING SHOP – I

2.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction, functions, classification, specification and use of various types of holding, cutting, marking and measuring tools used in fitting shop like-Bench vice, V block, C clamp, Ball peen hammer, scriber, punches, files, hacksaw, surface plate, try square, calipers, steel rule, Vernier calliper, Micrometre and Vernier height gauge etc. Identification of materials like-Iron, Copper, Stainless Steel, Aluminium etc.), Identification of various steel sections like-flat, angle, channel, bar etc.). Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing).

2.2 Demonstration of various types of holding, cutting, marking and measuring tools used in fitting shop.

2.3 Jobs to be prepared:

Job I To make a rectangular job by performing the operations: Sawing, Marking, filing on MS work piece (75 x 50 x 6 mm) by making sides at 90 degree and surface flatness at 180 degrees and to maintain dimensions within an accuracy of ± 0.25 mm.

Job II To make a job by performing the operations: Sawing, Marking, corner circular/radius filing on MS work piece (75 x 50 x 6 mm) by measuring dimensions with the help of Vernier Calipers within the tolerance of ± 0 1mm.

Job III To Make 'V' type cut-out profile from a square piece of MS flat using hand hacksaw, filing, marking and measuring operations.

3. SHEET METAL SHOP – I

3.1. Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction and functions of various types of tools used in sheet metal shop: - snips, hand shearing, measuring tools, marking tools, striking tools and bending tools including types of stakes. Introduction and importance to different types of joints and fasteners used in sheet metal work. Introduction and purpose of different metals used in sheet-metal work-black iron, galvanized iron, aluminium and stainless steel. Introduction of different types of Rivets, types of riveted joints, advantages, disadvantages and applications.

3.2 Demonstration of various types of holding, cutting, marking and bending tools used in fitting shop. demonstration of various raw materials used in sheet metal shop e.g. black-iron sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.

3.3 Jobs to be prepared:

Job I Shearing and bending practice on a sheet using hand shears/snips and stakes.

Job II To fabricate different types of sheet metal joint such as lap joint-single seam/double seam.

Job III To fabricate riveted lap joint (chain or zig zag type).

Job IV To fabricate single cover plate chain type, zig-zag type and single rivetted butt Joint.

4. ELECTRIC SHOP - I

4.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction, functions and specifications of different

types of tools, wires, cables, switches, fuses, cleats, clamps, allied items, and accessories used in Electric shop. Introduction to battery charger and its functioning. Introduction to common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc. Introduction to lead acid battery and nickel cadmium battery.

4.2 Demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, fuses, cleats, clamps and allied items, tools and accessories. Demonstration of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc. Demonstration of lead acid battery and nickel cadmium battery.

4.3 Job Practice:

Job I Identification of phase, neutral, earth wires for connection to domestic electrical appliances and their connections to three pin plugs.

Job II Practice in making series and parallel circuit. Make one lamp control by one switch circuit.

Job III Practice on house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping, conduit and concealed wiring.

Job IV Installation of battery and connecting two or three batteries in series and parallel.

Job V Charging a battery and testing with hydrometer and cell tester

5. CARPENTRY SHOP – I

5.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to wood, timber their properties, uses & defects and their joints. Seasoning of wood and its advantages. Introduction, specifications and function of various types of tools used in carpentry (such as different types of Saws, C-Clamp, Chisels, Carpenter's vice, Mallets, Marking gauges, Scriber, Try-square, Steel tape, Wooden plane, Metallic Jack plane, Rulers) by segregating as cutting tools, supporting tools, holding tools, measuring tools etc. Types of wooden joints. Techniques/method of sharpening of jack plane cutter/blade.

5.2 Demonstration of wood/timber, seasoning, various types of tools used in carpentry shop. Types of wooden joints.

5.3 Jobs to be Prepared :

Job 1 To make a rectangular wooden piece involving operations like-planing, marking, sawing and measuring.

Job II Iron jack plane blade/cutter sharpening and Chisel sharpening practice.

Job III To make a Half Lap Joint (cross, L or T shape – any one)
Job IV To make a Mortise and Tenon joint (T- shape Joint)

6. SMITHY SHOP – I

6.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to Smithy shop, different types of Hearths, its purpose, specifications, uses, types of various tools and equipment used in hand forging by segregating as cutting tools, supporting tools, holding tools, measuring tools etc. Types of fuel used and maximum temperature obtained, types of raw materials used in Smithy Shop , uses of Fire Bricks and Clays in Forging workshop.

6.3 Demonstration of different fuels used and maximum temperature obtained. Use of fire brick and clay in forging/ smithy shop. Practice of firing of hearth/Furnace, Temperature Control of Fire. Demonstration of different basic Smithy/Forging operations such as Cutting, Upsetting, Drawing down, Setting down, Necking, Bending, Fullering, Swaging, Punching and Drifting. Demonstration of Simple Heat treatment processes like Tempering, Normalizing Hardening etc

6.3 Jobs to be prepared:
Job I Making a job of square shape from a M.S. rod by forging method.

Job II Making a square shape L hook from M.S. rod.

Job III Making a ring from MS rod by cold or hot forging process

Job IV Making a job using drawing down operation on round or flat section.

6. ADDITIVE MANUFACTURING SHOP - I

6.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to digital design, Computer Aided Drafting (2D drawing) and Computer Aided Design (3D modelling), various CAD packages, basic 2D and 3D commands, basic geometrical shapes (both regular and irregular) etc. Introduction to Additive Manufacturing, identification of different types of materials used, applications and advantages. Identification of different types of geometrical shapes: regular shapes like sphere, prisms, pyramids, solids of revolution, irregular shapes like I section, L section, C section and T section etc.

6.2 Demonstration of 3D CAD package including software interphase, basic commands for drawing, editing, modelling etc., fabrication of 3D models, saving in .PRT file, conversion to .STL file, error identification and its rectification, working of 3D printer, 3D printing of simple components.

6.3 Jobs to be performed

Job I: 3D modelling of basic right regular geometrical shapes:

Prisms: Triangular, square. Rectangular, pentagonal and hexagonal

Pyramids: Triangular, square. Rectangular, pentagonal and hexagonal

Job II: 3D modelling of solids of revolution: Sphere, cylinder, cone and torus

Job III: 3D modelling of special shapes like I section, L section, C section and T section

Job IV: 3D modelling of machined parts using various 3D commands.

Note :

1. Workshop instructors will guide and help the students throughout the practical class in order to explain and complete the job according to syllabus and for providing necessary facilities to the students during performance of practical by observing the safety precautions

2. The Workshop Superintendent or Foreman Instructor or Foreman will demonstrate and deliver the theoretical instructions with regard to introduction, functions, classification and specification of tools, instruments, equipment, apparatus etc. of all the topics covered in the syllabus.

3. The Workshop Superintendent or Foreman Instructor will also conduct the mid-term test and final practical exam of this subject.

RECOMMENDED BOOKS

1. Singh, Swaran, “Workshop Practice”, S. K. Kataria and Sons, New Delhi.
2. Bawa, H.S., “Workshop Practice”, Tata McGraw Hill Publishers, New Delhi.
3. Hajra, SK, “Workshop Technology I, II, III”, Choudhary and AK Choudhary Media Promoters and Publishers Pvt. Ltd. Mumbai.
4. Manchanda, “Workshop Technology Vol. I, II, III”, India Publishing House, Jalandhar.
5. Raghuwanshi, B.S., “ Workshop Technology”, Dhanpat Rai and Co., New Delhi

TRAFFIC AWARENESS & ROAD SAFETY CAMP (I)

A diploma holder must have knowledge of various types of traffic rules and regulations. Road safety education is vital for people of all ages. As a responsible citizen, you should be aware of each and every road safety rules. Observation is the key skill you need in ensuring road safety By obeying safety rules and regulations, you can save yourself and others on the road. This camp covers the basic concepts of traffic rules and safety. Lectures will be delivered on following broad topics with the coordination of Distt. Traffic police. There will be no exam for this camp.

1. Road safety Scenario
2. School bus and traffic management
3. Awareness of Traffic Signs
4. Speeding Limit
5. Always Wear your Shields
6. Overtaking
7. Awareness through Hoardings
8. Walking & Safe cycling

2.1 ENGLISH AND COMMUNICATION SKILLS - II

L	P
3	2

RATIONALE

Communication skills play an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills.

LEARNING OUTCOMES

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

- Make proper oral presentations.
- Speak confidently.
- Debate properly.
- Write accurate official/business letters.
- Respond to telephone calls effectively.
- Overcome communication barriers.

DETAILED CONTENTS

1. Functional Grammar and Vocabulary (12 hrs)

Theory and Practical exercises on following:

1.1 One word substitution
1.2 Functional Grammar and Vocabulary
1.3 Prefixes and Suffixes
1.4 Punctuation
1.5 Narration
1.6 Idioms and Phrases

2. Reading (9 hrs)

Comprehension, Vocabulary enrichment and grammar exercises based on the following readings:

Section-I

- The Last Leaf - O' Henry
- Sparrows - K A Abbas
- The Postmaster - Rabindra Nath Tagore

Section-II

- Night of the Scorpion - Nissim Ezekiel
- All the World is a Stage - William Shakespeare
- Success – Emily Dickenson
- Daffodils – William Wordsworth

3. Writing (24 hrs)

3.1 Writing Resume and Cover letter
3.2 Correspondence: Business and Official
3.3 Report Writing – Introduction and features of good report.
3.4 Press Release
3.5 Memos and Circulars
3.6 Notices (lost, found, and auction)
3.7 Agenda and Minutes of Meetings
3.8 Filling-up different forms such as bank form and on-line form for placement etc.
3.9 Precis Writing
3.10 E mail writing

LIST OF PRACTICALS

1. Group discussion on some current topic of interest.
2. Small speech using voice modulation.
3. Debate
4. Manners and Etiquette
5. Power point presentation
6. Telephonic conversation: General etiquette for making and receiving calls.
7. Mock interviews

INSTRUCTIONAL STRATEGY

Open source software should be used to help the students in developing listening skills. Student centred activities such as group discussions, role play should be used to ensure active participation of students in the classroom.

RECOMMENDED BOOKS

1. Revathi, Srinivas, "Communicating Effectively in English, Book-I", Abhishek Publications, Chandigarh.
2. Mohan, Krishna & Meera Banerji, "Developing Communication Skills (2nd Edition)", Published by Macmillan Publishers India Ltd; New Delhi.
3. Eastwood, John, "Oxford Practice Grammar", Oxford University Press, London

4. Chadha, R. K., “Communication Techniques and Skills”, Dhanpat Rai Publications, New Delhi.
5. Wren & Martin, “High School English Grammar and Composition”, S. Chand & Company Ltd., Delhi.
6. Kumar, Sanjay & Pushp Lata, “Communication Skills”, Oxford University Press, New Delhi

WEBSITES FOR REFERENCE

1. http://www.mindtools.com/ page 8.html
2. http://www.letstalk.com.in
3. http://www.englishlearning.com
4. http://learnenglish.britishcouncil.org/en/

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	12	12
2	9	12
3	24	26
Total	**45**	**50**

2.2 APPLIED MATHEMATICS – II

L	P
3	-

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.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Apply differential calculus to solve max/min and related rate measure problems.
- Apply concepts of definite integrals to calculate the area of a curve bounded by axes.
- Evaluate complex integrals in a simpler way by applying definite integral.
- Solve engineering problems by making use of ordinary differential equations.

DETAILED CONTENTS

1. Differential Calculus (18 hrs)

1.1 Definition of function; Introduction to limit and continuity (definition only).

1.2 Standard differentiation of algebraic, trigonometric, inverse trigonometric functions, logarithmic function and exponential function.

1.3 Differentiation of sum, product and quotient of functions, Differentiation of function of a function, differentiation of implicit functions and parametric functions.

1.4 Logarithmic differentiation and successive differentiation (excluding nth order).

1.5 Application of differential calculus in:

(a) Rate Measures

(b) Maxima and minima (single variable functions) using second order derivative only

(c) Equation of tangent and normal to a curve (for explicit functions only)

2. Integral Calculus (22 hrs)

2.1 Indefinite integrals, Integration as inverse operation of differentiation with simple examples.

2.2 Standard integrals and related simple problems

2.3 Simple integration by substitution, by parts and by partial fractions (for linear factors only)

2.4 Evaluation of definite integrals (simple problems)

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).

2.5 Applications of integration for evaluation of area bounded by a curve and axes (Simple problems).

3. Differential Equations (5 hrs)

3.1 Definition, order, degree of ordinary differential equations.

3.2 Formation of differential equation (up to 2^{nd} order). Solution of Differential equations with Variable separation and Linear Differential equations.

INSTRUCTIONAL STATREGY

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.

RECOMMENDED BOOKS

1. Grewal, BS, "Elementary Engineering Mathematics", Khanna Publishers, New Delhi

2. Engineering Mathematics by Vol. I & II by S Kohli, IPH, Jalandhar

3. Sabharwal, SS & Dr Sunita Jain, "Applied Mathematics, Vol. I & II", Eagle Parkashan, Jalandhar

4. Engineering Mathematics, Vol I, II & III by V Sundaram et al, Vikas Publishing House (P) Ltd., New Delhi

5. Sastry, SS, "Engineering Mathematics, Vol I & II", Prentice Hall of India Pvt. Ltd.,

6. Pal, Srimanta and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	18	20
2	22	25
3	5	05
Total	**45**	**50**

2.3 APPLIED PHYSICS – II

L	P
2	2

RATIONALE

Applied physics includes the study of a large number of diverse topics related to things that go in the world around us. It aims to give an understanding of this world both by observation and prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology

LEARNING OUTCOMES

After undergoing this subject, the student will be able to;

- Apply the concept of wave motion
- Illustrate laws of reflection and refraction of light.
- Comprehend the phenomenon related to electrostatics
- Comprehend the terms and laws related to electricity and magnetism.
- Make use of laser for engineering applications.

DETAILED CONTENTS

1. Wave motion and its Applications (6 hrs)

   1.1 Wave motion, transverse and longitudinal wave motion with examples, sound and light waves, relationship among wave velocity, frequency and wave length and its application
   1.2 Free, forced and resonant vibrations with examples
   1.3 Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications
   1.4 Ultrasonics – Introduction and applications.

2. Optics (6 hrs)

   2.1 Laws of reflection and refraction, refractive index, lens formula for thin lenses, power of lens, magnification
   2.2 Total internal reflection and its applications, Critical angle and conditions for total internal reflection
   2.3 Simple and compound microscope, astronomical telescope in normal adjustment, magnifying power (Only formula).

3. Electrostatics (6 hrs)

3.1 Coulombs law, unit of charge,
3.2 Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference
3.3 Capacitor and its working principle, Capacitance and its units. Capacitance of parallel plate capacitor (No derivation), Series and parallel combination of capacitors (numericals)
3.4 Dielectric and its effect on capacitance, dielectric break down

4. Electricity and Magnetism (9 hrs)

4.1 Electric Current and its Unit, Direct and alternating current,
4.2 Resistance and its Units, Specific Resistance, Conductance, Specific Conductance, Series and Parallel combination of Resistances. Factors affecting Resistance, Superconductivity (concept only)
4.3 Ohm's law and its verification
4.4 Kirchhoff's laws, Wheatstone bridge principle
4.5 Heating effect of current, Electric power, Electric energy and its units (related numerical problems)
4.6 Introduction to magnetism, Types of magnetic materials. Dia, para and ferromagnetic materials with their properties,
4.7 Magnetic field and its units, magnetic lines of force, magnetic flux and their units
4.8 Concept of electromagnetic induction, Faraday's Laws and Lenz's law, Galvanometer and its use.

5. Modern Physics (3 hrs)

5.1 Lasers: its characteristics, spontaneous and stimulated emission, population inversion; Principle, construction and working of Ruby laser, engineering applications of lasers.

LIST OF PRACTICALS (To perform minimum 8 experiments)

1. To find the time period of a simple pendulum
2. To determine and verify the time period of cantilever
3. To verify laws of reflection from a plane mirror.
4. To find the focal length of convex lens by parallax method.
5. To determine the magnifying power of an astronomical telescope
6. To verify ohm's laws by drawing a graph between voltage and current.
7. To verify laws of resistances in series and parallel combination.
8. To find resistance of galvanometer by half deflection method
9. To measure very low resistance and very high resistances using Slide Wire bridge
10. Use of CRO in plotting AC and DC waveforms.
11. To find wave length of the laser beam.

INSTRUCTIONAL STATREGY

Teacher may use various instructional media like models, charts and graphs while imparting instructions. The field application should be made clear before teaching the basics to develop proper understanding of the physical phenomenon**.** Use of demonstration can make the subject interesting and develop scientific temper in the students.

RECOMMENDED BOOKS

1. Text Book of Physics (Part-I, Part-II); N.C.E.R.T., Delhi
2. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
3. Practical Physics by C. L. Arora, S Chand Publications
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (hrs)	Marks Allotted (Out of 50)
1	06	10
2	06	10
3	06	10
4	09	15
5	03	05
Total	**30**	**50**

2.4 FUNDAMENTALS OF ELECTRICAL ENGINEERING

L	P
4	4

RATIONALE

For a diploma holder in electrical engineering, it becomes imperative to know the fundamentals of the subject in order to grasp the knowledge of the field. This subject will provide acquaintance with various terms knowledge of fundamental concepts of electricity, magnetism and various principles related to it.

LEARNING OUTCOMES

After completing the course the student should be able to:

- Acquire knowledge and understand the elements of electricity and DC circuits.
- Acquire knowledge of AC circuits and their components
- Illustrate the single phase and poly phase connections
- Measure power and power factor in a single phase circuits
- Measure power and power factor in a poly phase 23circuits
- Explain the various batteries as storage devices and be aware of safe disposal of batteries.

DETAILED CONTENTS

1. Electrostatics (14 hrs)

1.1 Introduction to Electricity, Charge, free electrons, Electric potential and potential difference, Electric current, Electrical Energy, Electrical power and their unit. SI units of work, power and energy and meters used to measure the electrical quantities, Concepts of Electrostatics, Coulomb's law.

1.2 Advantages and application of Electrical Energy, Rating and the connections of various Electrical appliances.

1.3 Concept of resistance, conductivity and resistivity, Laws of resistance, Effect of temperature on resistance, Temperature coefficient of resistance, Color coding of resistance.

1.4 Introduction to Capacitors, capacitance, Variable capacitor, Factors affecting capacitance of a capacitor, Introduction to Inductors, Inductance

1.5 Concept of voltage source & current source, connections and their conversions.

1.6 Applications of series, parallel, and series-parallel connections of resistance, inducatnce and capacitance

2. DC Circuits (6 hrs)

2.1 Applications of Ohm's law with practical implementation.

2.2 DC circuit, types of DC circuits: series circuit, parallel circuit, series-parallel circuit.

2.3 Applications of Kirchhoff's Laws-KVL and KCL.

2.4 Definitions of Nodes, Branches and loops.

2.5 Working Principle of Wheatstone bridge.

2.6 Voltage division in series resistors. Current division in parallel resistors

3. AC Fundamentals (14 hrs)

3.1 Concept of alternating current and voltage.

3.2 Difference between A.C and D.C

3.3 Equation of sinusoidal waveform for an alternating quantity

3.4 Concept of cycle, frequency, time period, amplitude.

3.5 Concept of instantaneous value, RMS value, maximum value and average value.

3.6 Concept of form factor, peak factor and power factor.

3.7 Concept of phasor and phase difference

3.8 Representation of alternating sinusoidal quantities by vectors

3.9 Phasor algebra (addition, subtraction)

4 AC Circuits (14 hrs)

4.1 Effect of alternating voltage applied to a pure resistance, pure inductance and pure capacitance.

4.2 Concept of inductive and capacitive reactance.

4.3 Alternating voltage applied to RL, RC and RLC series circuits

4.4 Power and power factor in pure resistance, inductance, capacitance, RL, RC, RLC circuits.
4.5 Active and reactive power and their significance
4.6 Definition and significance of Power factor.
4.7 Definition of susceptance, conductance, admittance, impedance and their units.

5. Poly Phase System (6 hrs)

5.1 Introduction of Three Phase system, Comparison between single and poly phase systems
5.2 Interconnection of three phases
5.3 Star or Y connection
5.4 Delta or mesh connection

6. Batteries (6 hrs)

6.1 Basic idea about primary and secondary cells
6.2 Concept of Cell: definition, emf of cell, internal resistance of cell, terminal potential of cell, types of cell (primary and secondary cell), grouping of cell (series grouping, parallel grouping, series-parallel grouping).
6.3 Working principle, construction and applications of Lead acid, Nickel Cadmium and Silver Oxide Cells, Lithium ion batteries, Button Cells
6.4 Charging, care, maintenance and Disposal of batteries

LIST OF PRACTICALS

1. Familiarization of meters: Use of analog and digital mutimeter for measurement of voltage, current (A.C/D.C) and resistance.
2. (a) To verify that Rt = R1+R2+…. where R1, R2 etc. are resistances connected in series (b) To verify 1 1 1 1 -- = -- + -- + - - - - - - + -- Rt R1 R2 Rm Where R1, R2 etc. are resistances connected in parallel.
3. Measure the current drawn by the lamp at different voltages from zero to 220 volts and the resistance of lamp at different voltages, plot a graph between current and voltage
4. Verify KVL and KCL in different circuits
5. To generate an electric current using a magnetic field.

6. To calculate the self-inductance for a solenoid.
7. To calculate the mutual inductance of two adjacent inductive coils.
8. To find the value of inductors connected in series and parallel.
9. Measurement of power and power factor of a single phase RLC circuit.
10. To construct an RL and RC circuit and to measure
    a) Total impedance
    b) Phase angle between voltage and current
    c) Construct impedance triangle
11. To construct an RLC series circuit and to measure

a) Total impedance
b) Phase angle between voltage and current
c) Construct impedance triangle

12. To determine the impedance of a capacitor and inductor in an AC circuit.
13. Power measurement in single phase systems
14. Power measurement three phase systems
15. Demonstration of parts of a battery and find the specific gravity of battery.
16. Testing a battery for its charged condition and to charge it.
17. Demonstration of charging and discharging of Battery and measure the terminal voltage during charging and discharging condition.
18. Charging and testing of a lead - acid storage battery.

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.

1. Teachers may take help of various models and charts, you-tubes video's, e-learning resources while studying the contents of the subject to the students so that the concepts should be clear. More emphasis should be laid on discussing and explaining practical applications.
2. Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles.
3. Preparing students to apply the technological method of problem solving to a real life problems. This quality is buildup in the students when students practice the numerical problems of the subject. Teachers should motivate students to solve the numerical problems of subject.

4. Teachers must ask 30% of numerals problems in sessional test and final semester exam of this subject.
5. Teachers should expose to different learning tools used in respective labs, Operational safety and Procedure to be followed in the laboratory. Students may ask to make micro projects by using the idea as learning in the subject.
6. Demonstrate/practice approach may be followed throughout the courses so that learning may be skill and employ-ability based.
7. Teachers should take assignments, seminar, quiz, viva-voce etc. to enhance the learning ability of the students.
8. Students must have to perform at least 12 experiment in the laboratory.

RECOMMENDED BOOKS

1. Theraja, B. L. and A. K. Theraja, "ABC of Electrical Engineering", S Chand Publishers, New Delhi.
2. Bhattacharya, S. K., "Basic Electrical and Electronics Engineering", Pearson Education India.
3. Kothari, DP, and Nagrath, "Basic Electric Engineering", Tata McGraw Hill.
4. Mittle, V., and Arvind Mittle, "Basic Electrical Engineering", Mc Graw Hill Companies.
5. Mehta, V. K., & Rohit Mehta, "Basic Electrical Engineering", S. Chand & Co.
6. Bhattacharya, SK, and KM Rastogi, "Experiments in Basic Electrical Engineering", New Age International (P) Ltd. Publishers, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1.	14	12
2.	6	5
3.	14	12
4.	14	12
5	6	5
6	6	4
Total	**60**	**50**

2.5 ELECTRICAL ENGINEERING MATERIALS

L	P
3	-

RATIONALE

A diploma holder in Electrical Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Identify various electrical engineering materials
- Select proper conducting or insulating material for engineering application
- Comprehend the properties of various materials
- Identify alternate materials for various engineering applications

DETAILED CONTENTS

1. Classification (4 hrs)

    1.1 Classification of materials: Conductor, semi-conductor and insulators
    1.2 Brief reference to their atomic structure and energy bands
    1.3 Criteria for selection of material for particular application

2. Conducting Materials (12 hrs)

    2.1 Introduction
    2.2 Resistance and factors affecting it such as alloying and temperature etc.
    2.3 Classification of conducting material as low resistivity and high resistivity materials, low resistance materials. Copper - General properties as conductor: Resistivity, temperature coefficient, density, mechanical

properties of hard-drawn and annealed copper, corrosion, contact resistance. Application in the field of Electrical Engineering. Aluminum - General properties as conductor: resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminum, solderability, contact resistance. Applications in the field of electrical engineering. Steel- Mechanical properties of steel, applications in the field of electrical engineering. Introduction to bundle conductors and its applications. Low resistivity copper alloys- Brass and Bronze their practical applications with reasons for the same

2.4 Applications of special metals e.g. Silver, Gold, and Platinum etc.

2.5 High resistivity materials and their applications e.g., Manganin, Constantan, Nichrome, Mercury, Platinum, Carbon and Tungsten

2.6 Superconductors and their applications

3. Properties of Insulators (10 hrs)

3.1 Electrical Properties: Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage)

3.2 Physical Properties: Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness

3.3 Thermal Properties: Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, Thermal conductivity

3.4 Chemical Properties: Solubility, chemical resistance, weatherability

3.5 Mechanical properties: mechanical structure, tensile structure

4. Insulating Materials (12 hrs)

4.1 Plastics: Definition and classification, Thermosetting materials: Phenol-formaldehyde resins (i.e. Bakelite) amino resins (Urea Formaldehyde and Melamine-formaldehyde), Epoxy resins - their important properties and applications. Thermo-plastic materials: Polyvinyl chloride (PVC), Polyethylene, Silicons, their important properties and applications.

4.2 Natural insulating materials, properties and the applications of Mica, Asbestos, Ceramic materials (porcelain and steatite), Glass, Cotton, Silk, Jute, Paper (dry and impregnated), Rubber, Bitumen, Mineral and insulating oil for transformers switchgear capacitors, high voltage

insulated cables, insulating varnishes for coating and impregnation, Enamels for winding wires, Glass fibre sleeves.

4.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF4 their properties and applications

5. Magnetic Materials (7 hrs)

5.1 Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect.

5.2 Soft Magnetic Materials: Alloyed steels with silicon, High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines. Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine

5.3 Hard magnetic materials: Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

INSTRUCTIONAL STRATEGY

The teacher should bring different materials and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be given exercises on identification of materials used in various electrical gadgets etc. and be encouraged to do practical work independently and confidently.

RECOMMENDED BOOKS

1. Bhattacharya, SK, “Electrical and Electronic Engineering Materials”, Khanna Publishers, New Delhi.
2. Sahdev, “Electrical Engineering Materials”, Uneek International Publications, Jalandhar.
3. Kapoor, PL, “Electrical Engineering Materials”, Khanna Publishers, New Delhi.
4. Sharma, BR, and Others, “Electrical and Electronics Engineering Materials”, Satya Parkashan, New Delhi.
5. Dogra, Rakesh, “Electrical Engineering Materials”, SK Kataria and Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1.	4	6
2.	12	14
3.	10	10
4.	12	12
5.	7	8
Total	**45**	**50**

2.6 ENVIRONMENTAL STUDIES

L	P
2	-

RATIONALE

Engineering activities require the use of natural resources which results in wide-ranging adverse effects on the environment. Natural replenishment of these recourses is practically impossible. This necessities that all technicians should know about the basics of ecology, environment and its functions, environmental pollution and management and environmental legislation which will enable them to accomplish their professional work with environmental compatibility. Hence this subject.

LEARNING OUTCOMES

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

- Comprehend the importance of ecosystem and environment.
- Demonstrate interdisciplinary nature of environmental issues.
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abetment of environmental pollutions.
- Compute the impact of human activities on the environment.
- Understand purpose of environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.

DETAILED CONTENTS

1. Introduction: (4 hrs)
   Basics of ecology, eco system and environment. Review of carbon, nitrogen, sulphur and water cycle)

2. Conservation of land reforms: (3 hrs)
   Desertification, Causes, effects and prevention. rain water harvesting, maintenance of ground water, deforestation – its effects and control measures

3. Environmental Pollution: (10 hrs)
   Sources of pollution - natural and man made, causes, effects and control measures of pollution (air, water, noise, soil and radioactive). Concept of BOD, COD and AQI, Prevention of Pollution- Introduction to Cleaner Production Technologies, Waste Minimization Techniques, Concept of Zero Discharge, Impact of Energy

Usage on Environment: Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain.

4. Solid Waste management (3 hrs)
Classification of refuse material, sources, effects and control measures. Introduction to E-waste Management

5. Environmental Legislation (4 hrs)
Introduction to Water (prevention and control of pollution) Act, Air (Prevention and Control of Pollution) Act and Environmental Protection Act, Role and Function of State Pollution Control Board, Introduction to Energy Conservation Act & its importance, Concept of Environmental Impact Assessment (EIA)

6. Energy Conservation and Sustainable Development (6 hrs)
Introduction to Energy Management, Energy Conservation, Energy efficiency and its need. Role of Non-conventional Energy Resources (Solar Energy, Wind Energy, Bio mass energy, hydro energy) in environmental protection. Sustainable development, Concept of Green building and eco friendly materials.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits etc. may also be organized.

RECOMMENDED BOOKS

1. Sharma, BR, "Environmental and Pollution Awareness", Satya Prakashan, New Delhi.
2. Khitoliya, Dr. RK, "Environmental Pollution", S Chand Publishing, New Delhi.
3. Deswal and Deswal, "Environmental Science", Dhanpat Rai and Co. (P) Ltd. Delhi.
4. Bharucha, Erach, "Environmental Studies", University Press (India) Private Ltd., Hyderabad.
5. Dhamija, Suresh K, "Environmental Engineering and Management", SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	4	06
2	3	05
3	10	16
4	3	05
5	4	06
6	6	12
Total	**30**	**50**

2.7 ELECTRICAL WORKSHOP PRACTICE - I

L	P
-	6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers working under him. In addition, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, fault finding, wiring in electrical appliances and installations.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:
Illustrate types of tools/equipment required for

- Repair various domestic appliances
- Detect and rectify various types of faults in house wiring, and contactor control circuits.
- Perform wiring, testing and fault finding of the control circuits process
- Identify electrical hazards and its safety measures
- Assemble distribution and extension boards
- Install electrical wiring and test it using meggar

PRACTICAL EXERCISES

1. Electrical Safety Measures and Identification of Common Electrical Tools

    1.1 Study safety measures while working or handing the electrical equipment.
    1.2 Use of fire extinguisher during electric fire.
    1.3 Study the methods to take restoration of person suffering from electric shock.
    1.4 Identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, 1-pole, 2-pole and 3-pole

MCB, RCCB & ELCB, fuses, cleats, clamps and allied items, tools and accessories.

1.5 Identification ,use and connections of 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.

1.6 Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs.

1.7 Identification and familiarization of following electrical wiring tools with respect to their usage: Screw drivers (different sizes), Insulated Pliers, Cutter, Sniper, Screw Driver (Star Screw Driver), L- Keys, Soldering Iron, soldering wire, flux, Drilling machines and Drilling Bits, Voltage/line tester, Insulation remover, Standard Wire Gauge .

2. Wiring System

2.1 Types of joints: Straight married Joint, Western union joint, Britania joint, Twist sleeve joint and Bolted type joint

2.2 Types of wiring and to make different light control circuits in the following types of wiring:

i. Casing and capping (PVC) wiring.

ii. Conduit wiring (surface/concealed), Filling and crimping of thimbles

2.3 Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection)

2.4 Fault detection and its repair in wiring system

2.5 Construction/assembly of Distribution Board and Extension Board with following specifications:

i. Two 5A sockets and one I5A Socket controlled by their respective switches, a fuse and indicator with series test lamp provision.

ii. Board panel using MCB, main switch, change over switch and ELCB/RCCB.

iii. Main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection)

2.6 Fault detection and repair of domestic electric installation

3. Household Appliances

3.1 Winding/re-winding of a fan (ceiling and table)/ motor and BLDC

3.2 Repair and maintenance of domestic electric appliances, Electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace etc.

3.3 Dismantling and assembly of voltage stabilizers

3.4 Assembly and interchange wiring of fluorescent tube light, CFL lamp etc.

3.5 Earth resistance measurement and earthing processes.

3.6 To carry out pipe/plate earthing for a small house and 3-phase induction motor. Testing the earthing using earth tester for the following

i. One lamp controlled by two switches (staircase circuit)

ii. Two lamps controlled by three switches (double staircase circuit)

iii. Two ordinary bells (for day and night) used at a distant residence

iv. Traffic light control system for two roads crossing

v. Wiring of a switch board containing at least two switches, one fan regulator and one 5/15A socket controlled by their respective switches using piano type switches and matching socket

3.7 Wiring of a series test lamp board and to use it for finding out simple faults

3.8 Testing of domestic wiring installation using Meggar

4. Power Supply Connection

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

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

4.3 Connecting Generator and 3 phase wiring through Change over Switch.

4.4 Power cable jointing using epoxy based jointing kits.

4.5 Demonstration of laying of underground cables at worksite.

4.6 Assembly of distribution board/ panel using MCB, main switch, changeover switch and ELCB etc.

RECOMMENDED BOOKS

1. Bhattacharya, SK, “Electrical and Electronic Engineering Materials”, Khanna Publishers, New Delhi.
2. Grover, and Jamwal, “Electronic Components and Materials”, Dhanpat Rai and Co., New Delhi.
3. Sahdev, “Electrical Engineering Materials”, Uneek International Publications, Jalandhar.
4. Dhir, SM, “Electronic Components and Materials”, Tata Mc Graw Hill, New Delhi.
5. Kapoor, PL, “Electrical Engineering Materials”, Khanna Publishers, New Delhi.
6. Sharma, BR, and Others, “Electrical and Electronics Engineering Materials”, Satya Parkashan, New Delhi.

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students. All the experiments are to be performed by the students. There are five units of equal weightage. The teacher should also engage the students in various Hands on Practice/Training of Students

TRAFFIC AWARENESS & ROAD SAFETY CAMP (II)

A diploma holder must have knowledge of various types of traffic rules and regulations. Road safety education is vital for people of all ages. As a responsible citizen, you should be aware of each and every road safety rules. Observation is the key skill you need in ensuring road safety By obeying safety rules and regulations, you can save yourself and others on the road. This camp covers the basic concepts of traffic rules and safety. Lectures will be delivered on following broad topics with the coordination of Distt. Traffic police. There will be no exam for this camp.

1. Time management
2. Traffic light signals
3. Speed limits of vehicles
4. Schedule of offences
5. Dividing lines
6. Proper road Maintenance and Warnings
7. Test yourself

3.1 NON-CONVENTIONAL ENERGY SOURCES

L	P
3	-

RATIONALE

Energy is a crucial input in the process of economic, social and industrial development. High-energy consumption has traditionally been associated with higher quality of life. Since the conventional energy resources are under strain of depletion, it is high time to tap the non-conventional energy sources. The electrical diploma holder will have to face this challenge. Therefore, this subject is introduced in the curriculum to familiarize the diploma students with non-conventional engineering sources, so that they may secure the energy supply for future.

LEARNING OUTCOMES

After completing the course the student will be able to:

- Comprehend the need and significance of non-conventional energy sources.
- Apply working principle of solar, thermal and photovoltaic energy conversion
- Implement bio-mass energy conversion methods.
- Apply working principle of wind conversion technologies with respect to mechanical and electrical energy generation.
- Apply working principle of geothermal and tidal energy conversion.

DETAILED CONTENTS

1. Introduction (05 Hrs)

    1.1 Overview of energy management and need for energy conservation
    1.2 Environmental Aspects
    1.3 Alternative sources of energy and their importance
    1.4 Energy efficiency- its significance
    1.5 National Scenario of Non-conventional sources of energy

2. Solar Energy (09 Hrs)

2.1 Principle of conversion of solar radiation into heat
2.2 Photovoltaic energy, photo electric effect, formation of photo-voltaic cell,
2.3 Solar cell efficiency and photovoltaic system for power generation.
2.4 Applications of solar energy: solar cookers, solar water heaters, solar furnace.
2.5 PV pumping- types, components, block diagram, principle of working and their advantages

3. Hydro Energy (05 Hrs)

3.1 Components of hydro-electric Power Plants
3.2 Design considerations of Mini and Micro hydro-electric power generation,
3.3 Advantages and limitations of small hydroelectric power plant

4. Bio-energy (08 Hrs)

4.1 Bio-mass constituents, advantages and disadvantages of biomass.
4.2 Thermo chemical conversion : Direct combustion, pyrolysis, gasification and liquefaction
4.3 Biochemical conversion of biomass: Alcoholic fermentation, Anaerobic digestion and bio electrolysis
4.4 Power generation by biomass

5. Wind Energy (03 Hrs)

5.1 Basic components of Wind Energy Conversion system
5.2 Site selection for WECS
5.3 Advantages, disadvantages and applications of wind energy

6. Geo-thermal and Tidal Energy: (10 Hrs)

6.1 Elements of Geo-thermal system
6.2 Geothermal energy conversion principle
6.3 Advantages and disadvantages of geothermal energy
6.4 Parts, working, advantages and disadvantages of tidal plants
6.5 Working principle of Ocean thermal electric conversion, open cycle, closed cycles and hybrid cycles.

7. Novel Sources of Power Generation (05 hrs)

7.1 Basic principle of Thermoelectric generators
7.2 Magnet Hydro Dynamics
7.3 Fuel cell
7.4 Concept of Smart Grid
7.5 Concept of Micro Grid

INSTRUCTIONAL STRATEGY

The teacher should make the students aware about the depletion of energy sources and the availability of alternate sources of energy, their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. Teacher must give practical application of these energy sources in nearby surrounding areas.

RECOMMENDED BOOKS

1. Rai, G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi.
2. Khan, B.H., "Non-Conventional Energy Resources", McGraw Hill, 2nd Edition.
3. Chauhan, D.S. and S.K. Srivastava, "Non-Conventional Energy", New Age International Publisher.
4. Sukhatme, S.P., "Solar Energy", Tata Mc Graw Hill Education Pvt. Ltd, 3rd Edition.
5. Bansal, N.K., "Non-Conventional Energy Sources", Vikas Publishing House Pvt Ltd, Noida.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	5	04
2	9	12
3	5	04
4	8	10
5	3	04
6	10	12
7	5	04
Total	**45**	**50**

3.2 ELECTRICAL MACHINES - I

L	P
3	4

RATIONALE

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

LEARNING OUTCOMES

After completing the course the student will be able to:

- Demonstrate the development of Torque in D.C Motors
- Operate and control D.C. Generators and D.C motors.
- Operate and control three phase and single phase transformers
- Calculate efficiency and voltage regulation of three phase and single phase transformers
- Check polarity of windings of a three phase transformer and connect windings in various configurations

DETAILED CONTENTS

1. Introduction to Electrical Machines (05 Hrs)

    1.1 Definition of motor and generator and their comparison.
    1.2 Torque development due to alignment of two fields and the concept of torque angle.
    1.3 Electro-magnetically induced e.m.f.
    1.4 Elementary concept of an electrical machine.

2. DC Machines (18 Hrs)

    2.1 Main constructional features, Types of armature winding.
    2.2 Function of the commutator for motoring and generation action.

2.3 Factors determining induced e.m.f.
2.4 Factors determining the electromagnetic torque.
2.5 Types of DC machines.
2.6 Significance of back e.m.f., the relation between back emf and Terminal voltage.
2.7 Methods to improve commutation.
2.8 Performance and characteristics of different types of DC Machines.
2.9 Losses in a DC machine
2.10 Speed control of dc shunt/series motors.
2.11 Need of starter, three point dc shunt motor starter and 4 point starter.
2.12 Applications of DC Machines.

3. Transformers (16 Hrs)

3.1 Significance of transformers in electrical engineering.
3.2 Constructional features of a transformer and parts of transformer.
3.3 Working principle of a transformer, EMF equation.
3.4 Transformer on no-load and load (Resistive, Inductive and Capacitive) alongwith phasor diagram.
3.5 Equivalent circuit of single phase transformer.
3.6 Relationship between induced e.m.f. and terminal voltage, Voltage regulation of transformer (No derivation.)
3.7 Losses in a transformer.
3.8 Determination of efficiency, condition for maximum efficiency.
3.9 Auto transformer construction, working and applications.

4. Three phase Transformers (06 Hrs)

4.1 Construction of three phase transformer.
4.2 Types of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star
4.3 Star delta connections (relationship between phase and line voltage, and current).
4.4 Conditions for parallel operation (only conditions are to be studied).
4.5 On load tap changer
4.6 Difference between power and distribution transformer.
4.7 Cooling of transformer.

LIST OF PRACTICALS

1 Demonstrate and study of different parts of D.C. Machine.
2. Measurement of induced e.m.f. of a separately excited D.C Generator as a function of field current.
3. Measurement of terminal voltage of a separately excited D.C. Generator as a function of the load current.
4. Measurement of the terminal voltage of a D.C. Shunt Generator as function of load current.
5. Speed control of DC shunt motor by
   (i) Armature control method and
   (ii) Field control method
6. Plot OCC of a D.C. Shunt Generator at constant speed and determine the critical resistance from the graph of OCC.
7. Study of DC series motor with starter (to operate the motor on no load for a moment)
8. Determine efficiency of DC motor by Swinburne's Test at
   (i) Rated capacity
   (ii) Half full load
9. Checking the polarity of the windings of a three phase transformer.
10. To find the voltage and current relationships of primary and secondary of a three phase transformer under balanced load in various configurations conditions such as
    (a) Star-star
    (b) Star-delta
    (c) Delta-star
    (d) Delta – Delta
11. Make maintenance schedule of transformers
12. To find transformation ratio of single phase transformer
13. To perform open circuit and short circuit test for determining
    (i) Equivalent circuit and
    (ii) Voltage Regulation
14. To find the efficiency of single phase transformer by actually loading it
15. Usage of instrument transformers to measure high voltage and high current

INSTRUCTIONAL STRATEGY

Electrical machines being a core subject of electrical diploma curriculum, where a student will deal with various types of electrical machines which are employed in industry, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Special care has to be taken on conceptual

understanding of concepts and principles in the subject. For this purpose exposure to industry, work places, and utilization of various types of electrical machine for different applications may be emphasized. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

RECOMMENDED BOOKS

1. Bhattacharya, SK, "Electrical Machines" Tata Mc Graw Hill, Education Pvt Ltd., New Delhi.
2. Sahdev, SK, "Electrical Machines", Uneek Publications, Jalandhar.
3. Gupta, JB, "Electrical Machines", SK Kataria and Sons, New Delhi.
4. Arora, D R, "Electrical Machines I", Ishan Publications, Ambala City.
5. Bimbra, P.S., "Electrical Machines, Khanna Publishers.
6. Nagrath, I.J., & D.P. Kothari, "Electric Machines", Tata Mc Graw –Hill Publishers.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	5	7
2	18	20
3	16	15
4	6	8
Total	**45**	**50**

3.3 ELECTRONICS DEVICES & CIRCUITS

L	P
3	4

RATIONALE

At present, electronic gadgets are being extensively used in various manufacturing processes in industries, power system operations, communication systems, computers etc. Even for an electrical diploma holder, it is absolutely necessary to have a basic understanding of electronic components, their functions and applications. This understanding should facilitate the operation and maintenance of equipment, which is electronically controlled.

LEARNING OUTCOMES

After completing the course the student will be able to:

- Illustrate p-n junction as a rectifier
- Illustrate Zener diode as voltage stabilizer
- Demonstrate working of bi-polar transistors as an amplifier
- Analyze JFET and MOSFET working principle, their construction and applications

DETAILED CONTENTS

1. Semiconductor Diodes (15 Hrs)

    1.1 Electronics devices and their applications
    1.2 Types of semiconductors: Intrinsic and Extrinsic (N type and P type)
    1.3 PN Junction, mechanism of current flow in PN junction, drift and diffusion currents, depletion layer, potential barrier, effect of forward and reverse biasing in a PN junction.
    1.4 Ideal diode and practical semiconductor diode characteristics
    1.5 Working and application of diode as half wave and full wave rectifiers (centre tapped and bridge type)
    1.6 Concept of ripples, filter circuits – shunt capacitor, series inductor, and π-filters and their applications.
    1.7 Breakdown mechanism, Various types of diodes such as Zener diode
    1.8 Zener and Avalanche diode and its characteristics
    1.9 Use of Zener diode for voltage stabilization

2 Bi-polar Transistors and Transistor Biasing (12 Hrs)

2.1 Concept of junction transistor: PNP and NPN transistors, their symbols and working principle

2.2 Transistor configurations: common base (CB), common emitter (CE) and current relation and their input/output characteristics; comparison of the three configurations

2.3 Brief introduction of the common collector (CC) transistor configuration

2.4 Concept of DC and AC load line

2.5 Need of transistor biasing, operating point and need of stabilization of operating point.

3 Transistor Amplifiers (10 Hrs)

3.1 Single stage transistor amplifier circuit in CE configuration, function ofeach component

3.2 Working of single stage transistor amplifier

3.3 Frequency response of a single-stage transistor amplifiers

3.4 Need of multi-stage transistor amplifiers – different types of couplings,their purpose and applications.

4 Field Effect Transistor (FET) (8 Hrs)

4.1 Construction, operation, characteristics and applications of a N channel JEET and P channel JFET

4.2 Types, construction, operation, characteristics and applications of a MOSFET

4.3 C- MOS Power MOSFET

4.4 Comparison between BJT, JFET and MOSFET

LIST OF PRACTICALS

1. Identification and testing of electronic components such as a resistor, inductor, capacitor, diode, transistor and different types of switches used in Electronic circuits
2. Measurement of resistances using a multimeter and their comparison with color code values
3. To plot V-I characteristics of a semiconductor diode and calculate its static and dynamic resistance
4. To read and understand diode rating/specifications
5. Draw input and output wave shapes of a half-wave rectifier

6. Draw and Observe of input and output wave shapes of a full wave rectifier (center tapped and bridge type)
7. Draw and Observe input and output wave shapes of a half wave rectifier with (i) shunt capacitor (ii) series inductor Π (iii) filter circuits
8. Draw and Observe input and output wave shapes of a full wave rectifier with (i) shunt capacitor) (ii) series inductor Π (iii) filter circuits
9. To plot V-I characteristics of a Zener diode and find its reverse breakdown voltage
10. To Use data book to know the parameters of a given transistor
11. Plotting input and output characteristics of a transistor in CB configuration
12. Plotting input and output characteristics of a transistor in CE configuration
13. Measurement of operating point in case of (i) fixed biased circuit (ii) potential divider biasing circuit and to observe the effect of temperature variation on the operating point.
14. Use of transistor as a switch
15. To study the FET characteristics
16. Study characteristics and experimental verification of MOSFET.

INSTRUCTIONAL STRATEGY

This subject gives the knowledge of fundamental concepts of basic electronics. The teacher should give emphasis on understanding of concepts and various term used in the subject. The students be made familiar with diodes, transistors, resistors, capacitors, inductors etc. and electrical measuring instruments etc. Practical exercises will reinforce various concepts. Application of Semiconductor Diodes, Transistors, Field Effect Transistors etc must be told to students.

RECOMMENDED BOOKS

1. Bhargava, NN, Kulshreshta, and SC Gupta, “Basic Electronics and Linear Circuit” Tata McGraw Hill Education Pvt Ltd, New Delhi.
2. Mehta, VK, “Principles of Electrical and Electronics Engineering” S Chand and Co., New Delhi.
3. Dhir, SM, “Electronic Components and Materials”, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi.
4. Millman and Halkias, “Electronics Devices and Circuits”, McGraw Hill.
5. Malvino, Albert Paul, “Principles of Electronics”, Tata McGraw Hill Education Pvt Ltd, New Delhi.
6. Gupta, JB, “Basic Electronics”, SK Kataria and Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	15	16
2	12	14
3	10	11
4	8	9
Total	**45**	**50**

3.4 COMPUTER PROGRAMMING APPLICATIONS

L	P
-	6

RATIONALE

Computer plays a very vital role in present day life also in the professional life of Diploma engineers in order to enable the students to use computers effectively in problem solving. To impart students with high technical knowledge to make them globally adept to the new technologies. Also to disseminate and integrate knowledge of engineering, science and technology that expands the electrical engineering knowledge base towards research. It provides the students with a platform for developing new products and systems that can help industry and society as a whole.

LEARNING OUTCOMES

After completing the course the student will be able to:

- Apply the knowledge of fundamental engineering concepts in solving engineering problems through software.
- Select/ develop and apply appropriate techniques and IT tools for the design and analysis of the system.
- Apply MATLAB tools for solving relevant problems of Electrical Engineering
- Analyze and comprehend the electrical engineering circuits through PSPICE
- Use AUTOCAD for designing of various parts of machines.

DETAILED CONTENTS CUM PRACTICE EXERCISES

1. Software Applications

   Computer application in Electrical Engineering through software PSIM, PSPICE

2. MATLAB

   Introduction to MATLAB, MATLAB Programming – input/output, types of graphs, functions, loops, structures, MATLAB Simulink.

3. AutoCAD

   Introduction to Auto CAD electrical, designing of various electrical machines and parts.

LIST OF PRACTICALS

1. Study of various Computer applications (softwares) for electrical engineering.
2. Design of Circuits with PSPICE
3. Verification of Network Theorems using PSPICE
   i) Superposition theorem.
   ii) Thevenin's theorem.
   iii) Maximum power transfer theorem
4. Simulation of half wave uncontrolled rectifier
5. Simulation of full wave controlled rectifier.
6. Design of Common base, Common emitter Transistors
7. (a) Learn about Matlab software, basic features, tool box and different functions.
   (b) To learn, arithmetic, relational and logical operator.
8. Matrix formation and its manipulation.
9. Vector manipulation.
10. To get familiar with plotting commands used in MATLAB.
11. To plot a sine and cosine wave.
12. To study of mirror, offset and array command.
13. To use copy, move, scale, and rotate commands
14. Introduction to computer aided drafting.
15. Basic Diagram (To draw and modify simple geometrical figure with CAD tools.)
16. Pin Insulater(To draw the half sectional elevation of pin insulator
17. DoL Starter (To draw the line diagram of DOL starter)
18. Star Delta Starter (To draw the line diagram of STAR DELTA starter.)

RECOMMENDED BOOKS

1. Dennis Fitzpatrick, "Analog Design and Simulation Using OrCAD Capture and PSpice" Elseveir Ltd.
2. Pratap, Rudra, "MATLAB 7"y, Oxford University Press.
3. Chapman, Stephen J., "MATLAB Programming for Engineers".
4. Bansal, R.K., and A.K. Goel, "MATLAB and Its Applications In Engineering".
5. Tickoo, Prof. Sham, "AutoCAD Electrical 2021 for Engineers and Designers".
6. Venugopal, K., "Engineering Drawing + Autocad".

WEBSITES FOR REFERENCE

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

3.5 ELECTRICAL WORKSHOP PRACTICE – II

L	P
-	6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers or artisans working under him. In addition to these persons, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, faultfinding, wiring in electrical appliances and installations.

LEARNING OUTCOMES

After completing the course the student will be able to:

- Provide connection to 3 phase motors through various starters
- Detect and rectify various types of faults in contactor control circuits
- Rewind a single phase motor or choke coil
- Make cable joints and lay underground cables at the work site
- Make connections of star-delta starter and D.O.L starter
- Repair and maintain electrical wiring and appliances
- Preparer a small PCB for small electrical circuit

DETAILED CONTENTS CUM PRACTICAL EXERCISES

1. Earthing in Electrical Installations

    1.1 Earth Resistance measurement and earthing processes.
    1.2 To carry out pipe/plate earthing for a small house and 3 phase induction motor. Testing the earthing using earth tester.

2. Dismantling/Assembly/Maintenance of Electric Appliances.

    2.1 Dismantling and assembly of voltage stabilizers
    2.2 Dismantling/assembly of star-delta and DOL starter
    2.3 Winding/re-winding of a fan (ceiling and table)motor, BLDC fan and choke
    2.4 Dismantling/assembly/maintenance of motor operated appliances such as

mixer, blender, drill machine etc.

2. 5 Prepare a Printed Circuit Board (PCB) for voltage regulator using zener diode.

3. Underground Cables

3.1 Demonstration of laying of underground cables at worksite.

3.2 Power cable jointing using epoxy based jointing kits.

4 Power Supply Connections and Fault Findings

4.1 Connections of single phase and 3-phase motors, through an appropriate starter and to change their direction of rotation.

4.2 Wiring, testing and fault finding of the Remote control circuits, Time delay circuits, Inter locking circuits and Sequential operation control circuits operating on 3-phase supply.

Note: Students may be taken to a practical site to study control circuit of a passenger lift, automatic milling machine, etc. using relays

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students. All the experiments are to be performed by the students. The teacher should engage the students in various Hands on Practice/Training of Students during Educational Tour, Seminar/ Assignment Event, Students Quiz.

RECOMMENDED BOOKS

1. Bhattacharya, SK, "Electrical and Electronic Engineering Materials", Khanna Publishers, New Delhi.
2. Grover, and Jamwal, "Electronic Components and Materials", Dhanpat Rai and Co., New Delhi.
3. Sahdev, "Electrical Engineering Materials", Uneek International Publications, Jalandhar.
4. Dhir, SM, "Electronic Components and Materials", Tata McGraw Hill, New Delhi.
5. Sharma, BR, and Others, "Electrical and Electronics Engineering Materials", Satya Parkashan, New Delhi.
6. Singh, Surjit, “Electrical Engineering Drawing”, SK Kataria and Sons, New Delhi.

3.6 OPEN ELECTIVE

L	P
2	-

RATIONALE

Open Elective refers to a course that students can opt for in addition to their primary area of study. The open electives is from an unrelated discipline with the intention to provide exposure in that discipline. It provides the students the opportunity to select and learn a subject related to his/her interest, thus allowing them to explore their passion..

LIST OF SUGGESTED OPEN ELECTIVES

The student can opt one course out of the following:

1 Foreign Language
2 NCC
3 Yoga
4 First Aid
5 Creative Writing
6 Sketching, Drawing and Colour Studies
7 Gardening
8 Photography
9 Legal Studies
10 Event Management
11 Diet and Nutrition

Open elective can be offered online or offline.

3.6.1 FOREIGN LANGUAGE
(French, Japanese, German, Spanish)

L	P
2	-

RATIONALE

This course is an introduction to the specific language. Learning to understand and articulate oneself in day to day real life situations, and to begin to make sense of the language as a cultural space are the overall objectives of the course. The student should be able to grasp the basic sentence structure and build a good foundational vocabulary through this course.

LEARNING OUTCOMES

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

- Enhance the level of vocabulary in specific language.
- Manage situational communication in specific language.

DETAILED CONTENTS

1. Introduction (06 hrs)

   Self introduction, Numbers, Days, Months, Date, Time, and Counting

2. Vocabulary (06 hrs)

   My home, My family, My friend, Daily routine, Hobbies, Food, Greeting and Thanking

3. Grammar (12 hrs)

   Verb and Verb forms, Articles, Possessive pronouns, Auxiliary verbs, Questions, Present and Past tense

4. Theme (06 hrs)

   Means of transport, Basic directions, Food, Drink, Family, Groceries and Meals

RECOMMENDED BOOKS

1. Annie Berthet, Hugot et al, “Alter Ego - Méthode de Français”, Hachette.
2. 3 A Corporation, “Minna no Nihongo”, Goyal Publishers, New Delhi.
3. Stefanie Dengler, “NETZWERK Deutsch als Fremdsprache A1”, Goyal Publishers, New Delhi.
4. Jaime Corpas et.al, “Aula International 1”, Difusión, Madrid.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	06	10
2	06	10
3	12	20
4	06	10
Total	**30**	**50**

3.6.2 NATIONAL CADET CORPS (NCC)

L	P
2	-

RATIONALE

This course is structured to instil in the students qualities like nationalism, patriotism, discipline, team spirit, esprit-de-corps, leadership, self-confidence, national integration and improve their personality. The objective of the course is to expose the students to a regimental way of life, which is essential to inculcate in them the values of discipline, duty, punctuality, orderliness, smartness, and respect for authority, correct work ethos and self-confidence. In addition, it will inculcate defence services work ethos, which is characterized by hard work, sincerity of purpose, honesty, ideals of selfless service, dignity of labour, secular outlook, comradeship, spirit of adventure and sportsmanship.

LEARNING OUTCOMES

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

- Explain aims and objectives of NCC.
- Understand the importance of national integration.
- Assist Civil Administration in performance of selective duties during disasters.
- Perform drill without arms.
- Contribute towards nation building.
- Provide voluntary social service.

DETAILED CONTENTS

1. Introduction (08 hrs)

   Aims and objectives of NCC, Organisation structure and training, NCC Song, National Integration and awareness, Religions, Culture, Traditions and Customs of India, National Integration: Importance and Necessity. Freedom Struggle and Nationalist Movement in India, Problems/ Challenges of national integration, Unity in diversity, Famous leaders of India, Images/ Slogans for national integration, Contribution of youth to nation building

2. Civil Affairs (04 hrs)

Civil Defence Organization and its duties/ NDMA, Types of emergencies/ Natural Hazards, Role of NCC during Natural Hazards/ Calamities

3. Drill Without Arms (08 hrs)

General and Words of Command, Attention, Stand at Ease and Stand Easy, turning and inclining at the halt, Sizing, forming up in three ranks and numbering, open and close order march and Dressing, Saluting at the halt, Getting on parade, dismissing and falling out, Marching, length of pace and time of marching in quick time and halt, slow march and halt, Turning on the march and wheeling, Saluting on the March Individual word of command

4. Personality Development and Leadership (04 hrs)

Personality development, self-awareness, Leadership, life/soft skills, time management
and character building.

5. Social Service (06 hrs)

Basics of Social service, and its needs, Social/ Rural Development Projects: MNREGA, SGSY, NSAP; Literacy enhancement and poverty alleviation, Social evils, Contribution of youth towards social welfare.

RECOMMENDED BOOKS

1 "Cadet Hand Book (Common Subjects)", published by DG, NCC.
2 "Grooming Tomorrow's Leaders", published by DG, NCC.
3 "Youth in Action", published by DG, NCC.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	08	14
2	04	06
3	08	14
4	04	06
5	06	10
Total	**30**	**50**

3.6.3 YOGA

L	P
2	-

RATIONALE

Yoga is a practice that connects the body, breath, and mind. It uses physical postures, breathing exercises, and meditation to improve overall health. It not only improves physical health but also mental and spiritual well-being, which are the foundations of life. The course is aimed at developing skills in yoga for strength, flexibility and relaxation.

LEARNING OUTCOMES

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

- Explain the importance of yoga and its effect on health
- Perform yoga in various forms and combinations
- Understand the philosophy of heartfulness meditation.
- Promote positive health and holistic wellness through yoga and meditation.

DETAILED CONTENTS

1. Yoga (4 hrs)

   Concept, need and importance, Yogic principles, Rules and precautions to be followed by yoga practitioners, Introduction to Ashtanga yoga and Yoga sutra

2. Asanas and Mudras (14 hrs)

   Basic asanas, Asanas in different postures - Sukshma Vayayam, Pawan Muktasan, Surya Namaskar, Hasta Utthanasana, Padahastasana, Tadasana, Vrikshasana,Tirayak Tadasana, Natarajasana, Vajrasana, Padmasana, Bhujangasana.
   Mudras - Concept, Important mudras - Prana Mudra, Varuna Mudra, Prithvi Mudra, Aakash Mudra, Gyana Mudra.

3. Pranayama (6 hrs)

   Kapalbhati Pranayama, Nadi Shodhan Pranayama (Anulom Vilom), Bhastrika Pranayama, Ujjayi Pranayama.

4. Meditation (3 hrs)

Heartfulness meditation, Practice on meditation

5. Health Benefits of Yoga and Meditation (3 hrs)

Benefits and effect of Asanas, Mudras and Pranayama on various systems and organs of human body. Relaxation and wellness through meditation

RECOMMENDED BOOKS

1. Saraswati, Swami Satyananda, "Asana, Pranayama, Mudra and Bandha", Yoga Publication Trust, Bihar.
2. BKS Iyengar, "Light on Yoga", George Allen and Unwin.
3. Mudras by Heartfulness; Heartfulness Education Trust.
4. Kamlesh D Patel, "The Way of the Heart", Spiritual Hierarchy Publication Trust
5. Goel, Aruna, "Yoga Education: Philosophy and Practice", Deep & Deep Publications, New Delhi.
6. Nagendra, H R, and R Nagarathna, "Yoga for Promotion of Positive Health". Swami Vivekananda Yoga Prakashan.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	06
2	14	24
3	06	10
4	03	05
5	03	05
Total	**30**	**50**

3.6.4 FIRST AID

L	P
2	-

RATIONALE

First aid is a valuable and life-saving course. The objective of this course is to impart knowledge and skills to the students necessary in an emergency to help sustain life, reduce pain, and minimize the consequences of injury or sudden illness until professional medical help arrives.

LEARNING OUTCOMES

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

- Administer basic life support skills including cardiopulmonary resuscitation
- Provide first aid of simple and multiple system trauma.

DETAILED CONTENTS

1. Basics of First Aid (4 hrs)

   First aid, importance of first aid, first aider, laws of first aid, contents of an ideal first aid kit, dealing with an emergency.

2. Emergency Response (10 hrs)

   CPR, steps for performing CPR,CPR for newborns and infants, recovery position, first aid in drowning, fractures of bones, causes and types of fractures, dislocation.

3. First Aid in Burns (4 hrs)

   Types of burns, danger of burns, first aid in dry burns and scalds, electrical burns, chemical burns, sunburn, heatstroke.

4. First Aid in Wounds and Injuries (6 hrs)

   Types of wounds- small cuts and abrasions, Head injury- nose bleed, bleeding gums, bleeding from varicose veins, Shocks- causes of shock and its first aid.

5. First Aid in Poisoning (3 hrs)

Poisoning by swallowing, gases, injections, skin absorption, Animal bites, snake bites and insect stings.

6. First Aid in Foreign Objects Entering the Sense Organs: (3 hrs)

Foreign body in the eye, ear, nose, skin, swallowing of foreign objects.

Note : Persons from Civil Defence/ National Disaster Response Force (NDRF) etc. can be invited for conduct of first aid classes and demonstration of first aid practices.

RECOMMENDED BOOKS

1. Gauri Goyal, Dr. Kumkum Rajput, Dr. Manjul Mungali,, "First Aid and Health", SBPD Publishing House
2. Williamson, Swapna Naskar and Goswami Mala, "First Aid and Emergency Care", Kumar Publishing House, New Delhi.
3. Mahopatra, R., "First Aid for You and Me", Academic Publishers, New Delhi.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	04	06
2	10	18
3	04	06
4	06	10
5	03	05
6	03	05
Total	**30**	**50**

3.6.5 CREATIVE WRITING

L	P
2	-

RATIONALE

Creative writing is a written art form that uses the imagination to tell stories and compose essays, poetry, screenplays, novels, lyrics, and more. The objective of this course is to acquaint the students with ideas related to creative writing including art, craft and basic skills required for a creative writer.

LEARNING OUTCOMES

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

- Distinguish between literary genres.
- Practice various forms of creative writing.
- Write for various media.

DETAILED CONTENTS

1. Fundamentals of Creative Writing (06 hrs)

   Meaning and significance of creative writing, Genres of creative writing: poetry, fiction, Non-fiction, Drama and other forms, Research for creative writing

2. Elements of Creative Writing (10 hrs)

   Plot, Setting, Character, Dialogue, Point of view, Literary devices and figurative language, Elements of style, Grammar and the structure of language, Proof reading and editing

3. Traditional Forms of Creative Writing (10 hrs)

   Fiction: short story, novella and novel, Poetry, Drama, Essay, Fable, Biography, Memoire and autobiography, Travelogues, Diaries, Self-narrative writing

4. Writing for Media (04 hrs)

   Print media, Broadcast media, Internet - Web content writing and blog writing, Advertising

RECOMMENDED BOOKS

1. Anjana Neira Dev. Anuradha Marwah, Swati Pal, “Creative Writing: A Beginner’s Manual”, Pearson Longman, Delhi.
2. Robert Scholes, Nancy R. Comley, Carl H. Klaus, Michael Silverman, “Elements of Literature: Essay, Fiction, Poetry, Drama, Film”, Delhi.
3. Bell, Julia and Magrs, Paul, “The Creative Writing Course-Book”, Macmillan, London.
4. Gardner, John, “The Art of Fiction”, Vintage, New York.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	6	10
2	10	16
3	10	16
4	4	08
Total	**30**	**50**

3.6.6 SKETCHING, DRAWING AND COLOUR STUDIES

L	P
2	-

RATIONALE

This course is aimed to develop aesthetic sense of students. It also encompasses training in sketching, drawing and colouring to develop their mental faculties of observation, imagination and creation.

LEARNING OUTCOMES

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

- Sketch common objects and various geometrical and non-geometrical forms found in life and nature.
- Use different medium and materials.
- Use colour judiciously in creation of visual work.
- Prepare collage using various paper and materials.

DETAILED CONTENTS

1. Sketching of Objects and Nature (8 hrs)

   Sketching of objects at home like cup, plate, glass, book, pencil box etc.
   Sketching of tree, mountain, hills, vegetables flower etc. for Nature study using Pencil, colour Pencil

2. Drawing of Human and Animal Figures (10 hrs)

   Drawing of Human and animal form with the help of Basic Geometrical shapes

3. Collage Making (4 hrs)

   Creating Collage with the help of coloured cut out papers, picture from a magazine or any easily available materials

4. Colours (8 hrs)

Water colour, Poster colour, Colour theory – Colour system, Colour wheel, Colour dimensions, Drawing with oil pastel colour and dry pastel.

RECOMMENDED BOOKS

1. Betty Edwards, "Color: A Course in Mastering the Art of Mixing Colors", Penguin Group Inc., New York.
2. Feisner, E., "Colour Studies", Fairchild Publications, USA.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	08	14
2	10	16
3	04	06
4	08	14
Total	**30**	**50**

3.6.7 GARDENING

L	P
2	-

RATIONALE

Gardening activities are fantastic for helping students engage in a way that is more difficult in the classroom. Watching plants grow is a fun and educational experience for them. Their enormous curiosity and excitement over anything new makes them natural for gardening. Growing plant seeds teaches them how nature works and adds to their interest in environmental sustainability.

LEARNING OUTCOMES

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

- Explain various techniques of gardening, cultivation, multiplication, raising of seedlings of garden
- Discuss new and modern techniques of plant propagation.
- Develop interest in nature and plant life.

DETAILED CONTENTS

1. Gardening (6 hrs)

   Definition, objectives and scope. Different types of gardening - landscape and home/ terrace gardening, parks and its components. Plant materials and design.

2. Gardening Operations (14 hrs)

   Soil laying, manuring, watering, management of pests and diseases and harvesting.

3. Sowing/Raising of Seeds and Seedlings (10 hrs)

   Structure and types - Seed dormancy; causes and methods of breaking dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology. Seed testing and certification. Transplanting of seedlings.

RECOMMENDED BOOKS

1. Bose T.K., Mukherjee, D., "Gardening in India", Oxford & IBH Publishing Co. New Delhi.
2. Kumar, N., "Introduction to Horticulture", Rajalakshmi Publications. Nagercoil, Tamil Nadu.
3. Sandhu, M.K., "Plant Propagation", New Age International Publishers.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	10
2	14	24
3	10	16
Total	**30**	**50**

3.6.8 PHOTOGRAPHY

L	P
2	-

RATIONALE

Photography is a unique and creative medium of self-expression that requires aesthetic sense as well as technical expertise. Students who are highly passionate about learning the workings of cameras and different technologies based on them can pursue this course. The objective of this course is to enable the candidates to understand the utility of different camera parts and the art of taking candid shots.

LEARNING OUTCOMES

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

- Explain the principles of photography.
- Handle various cameras for taking photographs.
- Apply aesthetics of photography.

DETAILED CONTENTS

1. Basic Photography (04 hrs)

   Meaning and definition of photography, Basic principle in the film and digital photography, History of photography.

2. Camera Function and Accessories (04 hrs)

   Basic camera, Different parts of camera and their basic functions, Camera Accessories

3. Main Controls of Camera (10 hrs)

   Parts of Camera, Types of lenses, Shutter, Diaphragm, Exposure, Film and digital image sensor, Depth of field, Lighting, Photography with flash, Filters in photography.

4. Digital Camera (05 hrs)

Process of digital imaging, Types of digital cameras, Menu operationsof digital cameras, Introduction to colors.

5. Aesthetics of Photography (07 hrs)

Definition of lighting, Principles of lighting, Reflection, Light characteristics, Color, Direct light and indirect light, Light and subject, Light as subject, Shadow as subject, Light sources, Natural light and artificial light, Principles of visualization, Composition guidelines

RECOMMENDED BOOKS

1. Dilwali, Ashok, “All about Photography”, National Book Trust, New Delhi.
2. Sharma, O.P., “Practical Photography”, Hind Pocket Books.
3. Freeman, “The Photographer's Guide to Light”, John Collins & Brown

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	06
2	04	08
3	10	16
4	05	08
5	07	12
Total	**30**	**50**

3.6.9 LEGAL STUDIES

L	P
2	-

RATIONALE

The course introduces the students to Indian legal system, contracts management, and legal documentation. Further, the course familiarizes students with basic knowledge of labour laws that would be useful.

LEARNING OUTCOMES

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

- Understand the Indian Legal System.
- Discuss Indian Contract Act.
- Explore labour laws and laws related to women.

DETAIL CONTENTS

1. Introduction to Indian Legal System (4 hrs)

   Constitution of India, Sources of Law and Judicial system.

2. The Indian Contract Act (6 hrs)

   Contract – meaning and kinds. Essentials of a valid contract, Discharge of a contract, Contract of Agency

3. Legal Documentation (10 hrs)

   Drafting of legal documents including Non-Disclosure Agreements (NDA), Request for Proposal (RFP), collaboration agreements, joint venture agreements, tendering and subcontracting

4. Labour Laws (6 hrs)

   Provident Fund, ESIC, Gratuity and Bonus

5. Legislation Related to Women (4 hrs)

Sexual harassment at Work place (Prevention, Prohibition and Redressal), Protection of Women from Domestic Violence Act, Criminal Law (Amendment) Act, The Indecent Representation of Women (Prohibition) Act.

RECOMMENDED BOOKS

1. Joseph Minattur, "Indian Legal System", Indian Law Institute, New Delhi.
2. Srivastava, S.C., "Industrial Relations and Labour Laws", Vikas Publishing House Pvt. Ltd.
3. Aggarwal, S K, "Business Law", Galgotia Publishers, Delhi.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	04	07
2	06	10
3	10	16
4	06	10
5	04	07
Total	**30**	**50**

3.6.10 EVENT MANAGEMENT

L	P
2	-

RATIONALE

Event Management is a course which deals with the planning, coordinating, and organising of events for people and communities. It is a part of the mass communication course which is offered by many prestigious colleges in India. Event management course aims to imbibe knowledge on analysing, marketing, planning and strategies in business administration to its students.

LEARNING OUTCOMES

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

- Explain the purpose of special events in an organization.
- Use techniques and strategies required to plan successful special events.
- Promote and conduct special events.
- Assess the quality and success of special events.

DETAILED CONTENTS

1. Principles of Event Management (04 hrs)

   Introduction to event management, size & type of event, event team, code of ethics, principles of event management, role of event manager – planning, organising, leading and controlling an event

2. Event Planning (08 hrs)

   Objective of event, use of planning tools, protocols, dress codes, staging, staffing.

3. Event Marketing (04 hrs)

   Advertising, publicity, event marketing process, even hospitality

4. Event Leadership (06 hrs)

Teambuilding & work distribution, managing team, managing meetings, written & verbal communication.

5. Event Safety and Security (04 hrs)

Role of Security, Safety, Crowd management, Risk management.

6. Event Accounting (04 hrs)

Budget, Cash flow analysis, Profit & loss statement, Balance sheet.

RECOMMENDED BOOKS

1. Singla, Sita Ram, "Event Management", ATH Publishers, New Delhi.
2. Sharma, Divakar, "Event Planning and Management", Deep & Deep Publication.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	4	06
2	8	12
3	4	08
4	6	10
5	4	08
6	4	06
Total	**30**	**50**

3.6.11 DIET AND NUTRITION

L	P
2	-

RATIONALE

The objective of this course is to help the students to understand the concept of diet and nutrients and provide knowledge about causes and symptoms of Nutrition-related disorders.

LEARNING OUTCOMES

On completion of this course, the students will be able to:

- Comprehend the nutritional value of different food items.
- Explain the need of nutrition during the normal stages of life.
- Calculate normal dietary requirements and balanced diet.

DETAILED CONTENTS

1. Introduction (04 hrs)

   Basic concepts of health, Nutrition, Nutrients, Nutrition requirement, Balanced diet. Relationship between health & nutrition, Assessment of nutritional status.

2. Nutrients (16 hrs)

   Nutrients & their classification. Macro Nutrients –Sources, Functions and Effects on the Body; Micro nutrients - sources, Functions and effects on the Body; Fat soluble nutrients - sources, Functions and effects on the body, Water soluble nutrients - Sources, Functions and effects on the body, Digestion, Absorption of carbohydrates, Lipids, Proteins and energy.

3. Energy and Nutrition-related Disorders (06 hrs)

   Basic concepts, Definition and components of energy requirement, Protein malnutrition, Iodine deficiency disorders, Disease and disorder caused by imbalance of nutrients, Food allergies.

4. Nutritional Needs (04 hrs)

Nutritional need during normal stages of life - Infancy, Childhood, Adolescence, Pregnancy, Lactation and Old age, Disease management with diet.

RECOMMENDED BOOKS

1. Antia, F.P., "Clinical Dietetics and Nutrition", Oxford University Press.
2. Swaminathan, "Essentials of Food and Nutrition", Ganesh and Co., Madras.
3. Subhangini Joshi, "Nutrition and Dietetics", McGraw Hill Publishers.
4. B.S. Narsinga Rao et al, "Nutritive Value of Indian Foods", National Institute of Nutrition, Hyderabad.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	04	06
2	16	28
3	06	10
4	04	06
Total	**30**	**50**

ENERGY CONSERVATION AWARENESS CAMP

A diploma holder must have knowledge of various tips of energy conservation. Energy conservation has attained priority as it is regarded as additional energy resource. Energy saved is energy produced. This camp covers the basic concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in household appliances and star rating. Lectures will be delivered on following broad topics. There will be no exam for this camp.

1. Classification of energy- primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy with special reference to solar energy

2. Introduction to energy management, energy conservation, energy efficiency and its need

3. Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance

4. Standards and Labeling

   - Concept of star rating and its importance
   - Types of product available for star rating

5. Salient Features of Punjab Energy Conservation Building Code (ECBC)

6. General Energy Saving Tips in:

   - Lighting System
   - Room Air Conditioners
   - Refrigerators
   - Water Heater
   - Computers
   - Fans, Heaters, Blowers and Washing Machines
   - Colour Television
   - Water Pumps
   - Kitchens
   - Transport

DRUGS USE AND ABUSE AWARENESS CAMP

This is to be organized at a stretch for two to three days during third semester. Lectures will be delivered on the following broad topics. There will be no examination for this subject.

1. Drugs Use and Abuse in Society
   b. Concept and overview
   c. Extent of the problem
   d. Drug use as a social problem
   e. Causes of Drug Use: Biological, Socio-cultural, psychological

2. Types of Dugs and identification of Abuse

   a. Familiar drugs: Tabacco, Caffeine, over the counter drugs
   b. Restricted Drugs: Opiates, Hallucinogens, Marijuana
   c. Reformance enhancing drugs
   d. Uppers and Downers: Stimulants and Depressants

3. Impact of Drug Abuse

   a. Individual level biological and psychological
   b. Family social, National

4. Management and Prevention of Drug Abuse

   a. Medical and psychological
   b. Role of family School , Media and Legislation

4.1 GENERIC SKILLS AND ENTREPRENEURSHIP DEVELOPMENT

L	P
3	-

RATIONALE

Generic Skills and Entrepreneurship Development is one of the courses from "Human Science" subject area. Generic skills have emerged as an important component of employability skills, which enable an individual to become and remain employable over lifetime and to lead happy and prosperous life. Entrepreneurship development aims at developing conceptual understanding for setting-up one's own business venture/enterprise. This aspect of Human Resource Development has become equally important in the era, when wage employment prospects have become meager. Both the subject areas are supplementary to each other and soft skills are required to be developed in diploma pass-outs for enhancing their employability and self-confidence.

LEARNING OUTCOMES

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

- Explain the importance of generic skills
- Manage himself/herself physically, intellectually and psychologically
- Work effectively as a team member
- Manage tasks effectively
- Develop an entrepreneurial mindset.
- Identify entrepreneurial support system for new ventures and small businesses.
- Recognize a business opportunity.
- Conduct market survey and prepare project report.

DETAILED CONTENTS

1. Introduction to Generic Skills (04 hrs)

   1.1 Importance of Generic Skill Development

   1.2 Life Long Learning and associated importance of Generic Skill Development

2. Managing Self (07 hrs)

   2.1 Knowing Self for Self Development
   - Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc.

   2.2 Managing Self - Physical
   Personal grooming, Health, Hygiene, Time Management

   2.3 Managing Self – Intellectual development
   - Information Search: Sources of information
   - Communication: Official & business correspondence, Job application covering letter and resume

   2.4 Managing Self – Psychological
   - Stress, Emotions, Anxiety-concepts and significance
   - Techniques to manage stress

3. Managing in Team (06 hrs)

   3.1 Team - definition, team dynamics

   3.2 Team related skills- sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background

4 Task Management (03 hrs)

4.1 Task Initiation, planning, execution, close out

4.2 Exercises/case studies on task planning towards development of skills for task management

5. Problem Solving (05 hrs)

5.1 Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving

5.2 Different approaches for problem solving.

5.3 Steps followed in problem solving.

5.4 Exercises/case studies on problem solving.

6. Entrepreneurship (20 hrs)

6.1 Introduction

- Concept/Meaning and its need
- Qualities of an entrepreneur
- Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level.

6.2 Obtaining financial assistance through various government schemes like Prime Minister Employment Generation Program (PMEGP) Pradhan Mantri Mudra Yojana (PMMY) , Make in India, Start up India, Stand up India, National Urban Livelihood Mission (NULM); Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

6.3 Market Survey and Opportunity Identification (Business Planning)

- How to start a small scale unit/ industry

- Procedures for registration of small-scale unit /industry
- Assessment of demand and supply in potential areas of growth.
- Understanding business opportunity
- Considerations in product selection

6.4 Project Report Preparation

- Preliminary Project Report
- Techno-Economic Feasibility Report
- Exercises on preparation of Detailed Project Report

INSTRUCTIONAL STRATEGY

This subject will require a blend of different teaching and learning methods beginning with lecture method. Some of the topics may be taught using question answer, assignment, case studies or seminar. In addition, expert lectures may be arranged from within the institution or from management organizations. Conceptual understanding of Entrepreneurship, inputs by teachers and outside experts will expose the students so as to facilitate in starting ones own business venture/enterprise. The teacher will discuss success stories and case studies with students, which in turn, will develop managerial qualities in the students. There may be guest lectures by successful diploma holding entrepreneurs and field visits also. The students may also be provided relevant text material and handouts.

RECOMMENDED BOOKS

1. Balasubramanian, S., "Soft Skills for Interpersonal Communication", Orient Black Swan, New Delhi**.**
2. **"**Lifelong learning", Policy Brief (www.oecd.orf).
3. Rathore, BS, and Dr JS Saini, "A Handbook of Entrepreneurship", Aapga Publications, Panchkula (Haryana).
4. Gupta, CB, and P Srinivasan, "Entrepreneurship Development", Sultan Chand and Sons, New Delhi.
5. "Entrepreneurship Development", Tata McGraw Hill Publishing Company Ltd., New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1.	04	06
2.	07	08
3.	06	06
4.	03	04
5.	05	06
6.	20	20
Total	**45**	**50**

4.2 BASICS OF DIGITAL ELECTRONICS

L	P
2	2

RATIONALE

Digital Electronics has made extremely rapid advances in the last five decades. It has important applications in communication, entertainment, instrumentation, control, automation etc. So, it is important to give knowledge of digital electronics to electrical students.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Implement various number system
- Apply Boolean laws for simplification of logical expressions
- Apply the K-Map technique for simplification
- Design various combinational and sequential circuits
- Analyze functioning of multiplexer, de-multiplexer, encoder and decoders.

DETAILED CONTENTS

1. Number System (4 Hrs)

    1.1 Decimal, Binary, octal and hexadecimal number system and their inter-conversion
    1.2 Binary and Hexadecimal addition, subtraction and multiplication
    1.3 1's and 2's complement method of addition/subtraction

2. Logic Gates (4 Hrs)

    2.1 Definition, symbols and truth tables of NOT, AND, OR, XOR, X-NOR gates
    2.2 Universal gates NAND and NOR and the implementation of basic gates with Universal gates

3. Boolean Algebra (6 Hrs)

3.1 Boolean relations and their applications
3.2 Verification of De Morgan's Theorems
3.3 Implementation of Boolean (logic) equation with gates
3.4 Karnaugh (K) map (upto 4 variables) and simple application in developing combinational logic circuits

4. Combinational Circuits (8 Hrs)

4.1 Half adder and Full adder circuit, design and implementation.
4.2 Half and Full subtractor circuit, design and implementation.
4.3 2-bit comparator
4.4 Basic functions and block diagram of Encoders and decoders.
4.5 Basic functions and block diagram of Multiplexers and De-Multiplexers.
4.6 Display devices (LED, LCD, 7-Segment Display)

5. Sequential Circuits (8 Hrs)

5.1 Operation using waveforms and truth tables of R-S, T, D, J-K flip flops.
5.2 Applications of flip flops
5.3 Shift registers and counters: Introduction and types
5.4 A/D and D/A converters: Introduction

LIST OF PRACTICALS

1. Verification and interpretation of truth tables for AND, OR, NOT, NAND, NOR and XOR gates
2. Realisation of logic functions with the help of NAND or NOR gates
3. Design of a NOR gate latch and verification of its operation
4. Construction of half adder using gates
5. Construction of full adder using gates
6. To verify the truth table of R-S flip flop
7. To verify the truth table of J-K flip flop
8. To verify the truth table of T and D type flip flop

9. Design problem using Flip flops
10. Verification of truth table for encoder and decoder ICs,
11. Verification of truth table for Mux and DeMux ICs
12. Design problem using MUX and DE MUX
13. Construction of Shift registers and their functioning

Note: All experiments preferably be performed on breadboard

RECOMMENDED BOOKS

1. Leach, Malvino, "Digital Electronics and Applications", Tata McGraw Hill Education Pvt Ltd, New Delhi.
2. Mano, Morris, "Digital Logic Designs", Prentice Hall of India, New Delhi.
3. Mandal, Soumitra Kumar, "Digital Electronics", Tata McGraw Hill Education Pvt Ltd.
4. Jain, RP, "Digital Electronics", Tata McGraw Hill Education Pvt Ltd, New Delhi.
5. Gupta, BR, "Digital Electronics", Dhanpat Rai & Co., New Delhi.
6. Rajaraman, V., "Digital Electronics", Prentice Hall of India, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	4	8
2	4	8
3	6	10
4	8	12
5	8	12
Total	**30**	**50**

4.3 ELECTRICAL MACHINES - II

L	P
3	4

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Operate and control three phase synchronous generator and motor
- Operate the synchronous motor as synchronous condenser
- Operate and control speed of three phase squirrel cage and three phase slip ring induction motor.
- Identify and connect starters for starting three phase and single phase induction motors
- Operate and control speed of single phase induction motors

DETAILED CONTENTS

1. Synchronous Machines (18 hrs)

    1.1 Main constructional features of synchronous machine including commutator
    1.2 Generation of three phase emf
    1.3 Production of rotating magnetic field in a three phase winding
    1.4 E.M.F. Equation, Concept of distribution factor and coil span factor
    1.5 Operation of single synchronous machine independently supplying a load, voltage regulation by synchronous impedance method

1.6 Need and necessary conditions of parallel operation of alternators, synchronizing an alternator (Synchroscope method) with the bus bars
1.7 Operation of synchronous machine as motor, Starting methods of Synchronous Motor
1.8 Concept and Cause of hunting and its prevention
1.9 Specification of Synchronous Machine
1.10 Cooling of synchronous machines
1.11 Application of synchronous machines (as a synchronous condenser)

2. Induction Motors (16 hrs)

2.1 Salient constructional features of 3 phase squirrel cage and slip ring induction motors
2.2 Principle of operation, slip and its significance
2.3 Locking of rotor and stator fields
2.4 Rotor resistance, inductance, e.m.f. and current
2.5 Relationship between copper loss and the motor slip
2.6 Power flow diagram of an induction motor
2.7 Factors determining the torque
2.8 Torque-slip curve, stable and unstable zones
2.9 Effect of rotor resistance upon the torque slip relationship
2.10 Starting of 3-phase induction motors by DOL, star-delta and auto transformer starter
2.11 Causes of low power factor of induction motors
2.12 Speed control of induction motor
2.13 Cogging and Crawling in Induction Motors.

3. Single Phase Induction Motors (06 hrs)

3.1 Single phase induction motors; Construction characteristics and applications
3.2 Nature of field produced in single phase induction motor
3.3 Split phase induction motor: Capacitors start and run motor, Shaded pole motor and Reluctance start motor
3.4 Alternating current series motor and universal motors

4. Special Purpose Machines (05 hrs)

4.1 Working principle of Linear induction motor, Stepper motor and Servomotor

4.2 Introduction to Energy efficient Motors.

LIST OF PRACTICALS

1. To Plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed.
2. Determination of the relationship between the terminal voltage and load current of an alternator, keeping excitation and speed constant.
3. Determination of the efficiency of alternator from the open circuit and short circuit test.
4. Parallel operation of three phase alternators.
5. Study of ISI/BIS code for 3-phase induction motors.
6. Perform at least two tests on a 3-phase induction motor as per BIS code.
7. To reverse the direction of rotation of three phase induction motor.
8. To control speed of three phase induction motor.
9. Determination of efficiency of three phase induction motor by
   (a) No load test and blocked rotor test.
   (b) Direct loading (refer BIS code).
10. Determination of effect of rotor resistance on torque speed curve of an induction motor.
11. To Plot Torque-Slip Characteristics of three phase induction Motor.
12. Study of performance of a ceiling fan with and without capacitor.
13. Study the effect of change in capacitor on the performance of single phase induction motor.
14. To reverse the direction of rotation of single phase induction motor.

INSTRUCTIONAL STRATEGY

Teacher should lay-emphasis on development of understanding amongst students about basic principles of operation and control of electrical machines. 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.

RECOMMENDED BOOKS

1. Bhattacharya, SK, “Electrical Machines”, Tata Mc Graw Hill, Education Pvt Ltd. New Delhi.
2. Sahdev, SK, “Electrical Machines”, Uneek Publications, Jalandhar.
3. Gupta, JB, “Electrical Machines”, SK Kataria and Sons, New Delhi.
4. Marwaha, G L, “Electrical Machines”, Eagles Publication, Jalandhar.
5. Arora, D R, “Electrical Machines I”, Ishan Publications, Ambala City.
6. Bimbra, P.S., “Electrical Machines”, Khanna Publishers.
7. Nagrath, I.J., & D.P. Kothari, “Electric Machines”, Tata Mc Graw –Hill Publishers.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (Out of 50)**
1	18	19
2	16	17
3	6	8
4	5	6
Total	**45**	**50**

4.4 ELECTRICAL MEASUREMENT AND INSTRUMENTATION

L	P
2	4

RATIONALE

Diploma holders in Electrical Engineering have to work on various jobs in the field as well as in testing laboratories and on control panels, where they perform the duties of installation, operation, maintenance and testing by measuring instruments. They will come across the use of various types of instruments and have to take measurements. Instruments used to read and observe the general electrical quantities like current, voltage, power, energy, frequency, resistance etc and their wave shapes, have been incorporated in this subject. So the technician will know the construction and use of various types of electrical instruments.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Comprehend how different types of meters work and their construction
- Maintain and repair different indicating and recording instruments in electric circuits
- Measure different electrical quantities like current, voltage, power, energy, power factor, frequency etc.
- Monitor, analyze and control any electrical system
- Design and create novel products and solutions for real life problems.

DETAILED CONTENTS

1. Electrical Measuring Instruments (6 hrs)

    1.1 Concept of measurement and instruments
    1.2 Concept of measurement of electrical quantities and instruments for their measurements
    1.3 Types of electrical measuring instruments–indicating, integrating and recording type instruments
    1.4 Essentials of indicating instruments–deflecting, controlling and damping

torque

1.5 Methods of providing deflecting, controlling and damping torque

2. Moving coil and moving iron type measuring Instruments (4 Hrs)

2.1 Concept of ammeters and voltmeters and difference between them

2.2 Construction and working principles of moving Iron and moving coil instruments

2.3 Merits and demerits, sources of error and application of these instruments

3. Power & Energy Measurement (7 Hrs)

3.1 Construction, working principle, merits and demerits of dynamometer type wattmeter, sources of error

3.2 Induction Type Energy Meter: Construction, working principle, merits and demerits of single Phase and Three phase energy meters, Errors and their compensation, Simple numerical problems

3.3 Construction and working principle of maximum demand indicators

3.4 Block diagram of Digital Energy meter

4. Other Measuring Instruments: (7 Hrs)

4.1 Construction, working principle and application of Meggar, Earth tester, Multimeter (Analog), Frequency meter (Dynamometer type), Single phase Power Factor Meter (Electrodynamo meter type), Phase sequence indicator

4.2 Instrument Transformers: Construction, working and applications of Current Transformer (CT) and Potential transformer (PT).

5. Transducers (6 Hrs)

5.1 Introduction and advantages

5.2 Classification of transducer: Primary & Secondary transducers, Active & Passive transducer, Analog & Digital transducer

5.3 Principle of strain gauge and displacement transducer

5.4 Construction, working and applications of Capacitive Transducers, Inductive

Transducers, LVDT, Photoelectric Transducer, Piezoelectric Transducers.

5.5 Construction, working and applications of Temperature Transducers: Thermistors, Thermocouple and Resistance Thermometer.

LIST OF PRACTICALS

1. Use of analog multimeter for measurement of voltage, current and resistance.
2. Study the front panel of digital multimeter, draw its block diagram and measure voltage, current (A.C/D.C) and resistance.
3. Measure current using tong tester (Clamp-on meter)
4. To measure power, power factor in a single-phase circuit, using wattmeter and power factor meter and to verify results with calculations.
5. Measurement of power in a 3 phase circuit using CT, PT and 3-phase wattmeter
6. To measure Energy at different Loads using Single Phase Digital Energy meter
7. To measure the value of earth resistance using earth tester.
8. Study the front panel of CRO and draw its block diagram.
9. Measurement of voltage and frequency of a sinusoidal signal using CRO and draw wave shape of signal.
10. Study the front panel of analog LCR meter, draw its block diagram and measure inductance, capacitance and resistance.
11. Study the front panel of Digital LCRmeter, draw its block diagram and measure inductance, capacitance and resistance.
12. Measurement of temperature by using Thermistor, Thermocouple and RTD
13. Measurement of pressure by using LVDT
14. To record all electrical quantities from the meters installed in the institution premises

INSTRUCTIONAL STRATEGY

After making the students familiar with measuring instruments, they should be made conceptually clear about the constructional features and connections of various measuring instruments. Teacher should demonstrate the application of each measuring instrument in laboratory and encourage students to use them independently in various circuits.

RECOMMENDED BOOKS

1. Golding, & Widdis, “Electrical Measurements and Measuring Instruments”, Wheeler Publishers.
2. Prasad, Dr. R., “Electrical Measurements and Measuring Instruments”, Khanna Publishers.
3. Sahdev, S.K., Electrical Measurements and Measuring Instruments, Uneek International Publications, Jalandhar.
4. Sawhney, A.K., “A Course in Electrical and electronic Measurement and Instrumentation”, Dhanpat Rai and Co., New Delhi.
5. Kalsi, H.S., “Electronics Instrumentation and Measurement”, MacGraw-Hill.
6. Gupta, J.B., “Electrical Measurement and Measuring Instruments”, SK Kataria and Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1	6	10
2	4	6
3	7	12
4	7	12
5	6	10
Total	**30**	**50**

4.5 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

L	P
3	4

RATIONALE

Industrial electronics plays 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. The old magnetic and electrical control schemes have all become obsolete. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance of the subject this has been incorporated in the curriculum.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Illustrate the use of Diode for Alternating Current (DIAC) and Triode for Alternating Current (TRIAC).
- Detail the various controlled Rectifiers.
- Control various Electrical Drives.
- Maintenance of Uninterrupted Power Supply (UPS) and storage batteries.
- Comprehend the applications of choppers, cyclo convertors and dual convertors

DETAILED CONTENTS

1. Introduction to Silicon Controlled Rectifier (SCR) (15 hrs)

    1.1. Introduction to Power Transistors
    1.2 Symbols and V-I characteristics of DIAC, TRIAC and Quadriac
    1.3. Basic idea about the selection of heat sinks.
    1.4 Construction and working principles of an SCR, two transistor analogy and characteristics
    1.5. Methods of triggering a Thyristor
    1.6. Commutation of Thyristors
    1.7. Series and parallel operation of Thyristors
    1.8. Snubber Circuit.

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

1.10 UJT, its Construction, working principles and V-I characteristics, UJT as relaxation oscillator

2. Controlled Rectifiers (8 hrs)

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

2.2 Single phase half controlled full wave rectifier

2.3 Single phase fully controlled full wave Rectifier Bridge.

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

3. Inverter, Chopper and Cycloconverter (9 hrs)

3.1 Inverter-introduction, working principles, series and parallel inverters and applications, Basic Idea of Reduction of Harmonics in Inverter Output Voltage.

3.2 Choppers-introduction, types and their working principle and applications

3.3 Dual converters-introduction, working principle and applications

3.4 Cyclo-converters- introduction, types, working principle and applications

3.5 Basic Layout of HVDC Transmission system

4. Control of Electric Drives (10 hrs)

4.1 Basic concept of DC drives control

4.2 Half wave drives

4.3 Dual Converter Drives (Four Quadrant D.C. Drive)

4.4 Speed control of DC motor using Chopper.

4.5 Basic concept of AC drives control)

4.6 Voltage Source Inverter (VSI)

4.7 Current Source inverter (CSI)

4.8 Cyclo convertors controlled AC drives

4.9 Slip control AC drives

5. UPS (Uninterruptible Power Supply) (3 hrs)

5.1 Block Diagram and working principle of Online UPS and off line UPS

5.2 Use of Industrial Electronics in Industrial Automation

LIST OF PRACTICALS

1. To draw V-I characteristics of a DIAC and TRIAC.
2. To study SCR specifications and rating.
3. To draw V-I characteristics of an SCR
4. To study and design SCR using Two Transistors.
5. Observe the wave shape across SCR and load of an illumination control circuit.
6. Fan speed regulator using TRIAC Quadriac (fabrication of this circuit)
7. Study of Light Intensity control circuit.
8. To draw uni-junction transistor characteristics.
9. Observe the output wave of an UJT as relaxation oscillator.
10. To observe the output wave shape on CRO Single phase full controlled rectifier and effect of change in firing angle.
11. To observe the output wave shape on CRO Three phase full wave fully controlled bridge rectifier and effect of change in firing angle.
12. Speed-control of a DC shunt motor or universal motor
13. Characteristics of online and offline UPS.
14. Installation of UPS and Maintenance of batteries.
15. Study of choppers, dual convertors and cylco-convertors.

RECOMMENDED BOOKS

1. Rashid, Mohammad H., “Power Electronics, Circuits Devices and Applications”.
2. Sen, PC, “Power Electronics”, Tata McGraw-Hill.
3. Bhimbra, PS, “Power Electronics by, Khanna Publishers”, New Delhi.
4. Bhattacharya, SK, & S Chatterji, “Industrial Electronics & Control”, New Age international Publications(P) Ltd, New Delhi.
5. Sehdev, SK, “Power Electronics”, Uneek Publication, Jalandhar.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	15	14
2	8	8
3	9	10
4	10	12
5	3	6
Total	**45**	**50**

4.6 ELECTRICAL ENGINEERING DESIGN AND DRAWING

L	P
-	6

RATIONALE

A student of electrical engineering is supposed to have ability to read, understand and interpret engineering drawings. He has to Communicate and co-relate through sketches and drawings while preparing estimates of electrical engineering projects. Preparing working drawings of panels and distribution boards is another important task to be performed by an electrical engineering diploma holder. The contents of this subject have been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Recognize various electrical devices and their symbols
- Design and draw the panels/ distribution boards.
- Draw orthographic projections of simple electrical parts and machine parts.
- Draw schematic and wiring diagrams of simple electrical circuits and contactor control circuits.
- Read and interpret electrical installation plan.
- Communicate about circuits and devices through sketches and drawings.

DETAILED CONTENTS CUM PRACTICAL EXERCISES

1. Symbols, Signs Conventions and Panels/Distribution Boards (3 Sheets)

    1.1 Various Electrical Symbols used in Domestic, Industrial Installations and Power System as per BIS Code.

    1.2 Design and Drawing of panels/Distribution board using MCB, ELCB, Main switch and change over switches for domestic installation, industrial and commercial installation.

2. Orthographic projections of Simple Electrical Parts (3 Sheets)

    2.1 Bus bar post/ Kit Kat.

2.2 Pin type and shackle type insulator
2.3 Bobbins of a small transformer / choke
2.4 Stay insulators/Suspension type insulators

3. Orthographic Projection of Machine Parts (3 Sheets)

3.1 Rotor of a squirrel cage induction motor
3.2 Motor body (induction motor) as per IS Specifications (using outside dimensions)
3.3 Slip rings of 3-phase induction Motor.
3.4 End cover of 3 phase Induction motor (Sectional View)

4. Contactor Control Circuits: Schematic and wiring diagram (4 Sheets)

4.1 DOL Starter of 3-phase induction Motor.
4.2 Forwarding/reversing of 3-phase induction motor
4.3 Limit switch control of a 3-phase induction motor
4.4 Sequence operation of two 3-phase induction Motor using T.D.R.
4.5 Two speed 3-phase induction motor control.
4.6 Remote control of 3-phase induction motor.
4.7 Automatic star-delta starter for 3-phase induction motor.

5. AutoCAD in Electrical Design (2 Sheets)

5.1 To draw electrical and electronic symbols.
5.2 To draw DOL starter for 3 Phase Induction motor.
5.3 To draw star delta starter for 3 Phase Induction motor.

INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

RECOMMENDED BOOKS

1. Singh, Surjeet, “Electrical Engineering Design and Drawings”, Dhanpat Rai and Co. New Delhi.

2. Bhattacharya, SK, “Electrical Engineering Design and Drawings”, SK Kataria and Sons, New Delhi
3. Ubhi, & Marwaha, “Electrical Engineering Design and Drawings”, IPH, New Delhi.
4. Sahdev, SK, “Electrical Design and Drawing”, Uneek Publications, Jalandhar.
5. Singh, Surjit, “Electrical Engineering Drawing”, SK Kataria and Sons, New Delhi.

ENTREPRENEURIAL AWARENESS CAMP

This is to be organized at a stretch for two to three days during fourth semester. Lectures will be delivered on the following broad topics. There will be no examination for this subject.

1. Who is an entrepreneur?

2. Need for entrepreneurship, entrepreneurial career and wage employment

3. Scenario of development of small scale industries in India

4. Entrepreneurial history in India, Indian values and entrepreneurship

5. Assistance from District Industries Centres, Commercial Banks. State Financial Corporations, Small industries Service Institutes, Research and Development Laboratories and other financial and development corporations

6. Considerations for product selection

7. Opportunities for business, service and industrial ventures

8. Learning from Indian experiences in entrepreneurship (Interaction with successful entrepreneurs)

9. Legal aspects of small business

10. Managerial aspects of small business

11. Preparation of Project Report

INDUSTRIAL TRAINING OF STUDENTS

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of a minimum of 6 weeks duration to be organised during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 50 and external assessment of 50 marks have been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4th semester for further details.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%

5.1 INDUSTRIAL MANAGEMENT

L	P
3	-

RATIONALE

The diploma holders are generally expected to take up middle level managerial positions, their exposure to basic management principles is very essential. This includes necessary information about Structure of Organization, Leadership, Motivation, Ethics and Values; Marketing Management, Financial Management, Customer Relationship Management (CRM) & Total Quality Management (TQM), resume making, etc.

LEARNING OUTCOMES

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

- Comprehend the principles of management Marketing and Sales.
- Apply insight into HRM and Material Management.
- Apply management skills for Plant Maintenance.
- Handle social issues and issues related to environment.

DETAILED CONTENTS

1. Principles of Management (10 hrs)

    1.1. Introduction, importance and general functions of management.
    1.2. Concept and Types of an organization - Sole trading, partnership, companies, corporation, PSU's and Co-operative societies.
    1.3. Structure of an organization - a) Line organization b) Staff organization c) Functional organization d) Line and staff organization
    1.4. Hierarchical Management Structure - Top, middle and lower level management
    1.5. Departmentalization – Introduction, need and its advantages.

2 Human Resource Management (HRM) and its functions (05 hrs)

    2.1 Manpower Planning
    2.2 Recruitment and selection

2.3 Training and development of work force

2.4 Performance appraisal - Wages, salary and incentive schemes

3 Marketing and Sales (06 hrs)

3.1 Marketing - Introduction, importance and its functions - Marketing mix for industries and service sector - Basic Marketing strategies

3.2 Sales - Difference between marketing and selling

3.3 Advertisement- print media and electronic media - Market-Survey and Sales promotion.

4. Material Management (10 hrs)

4.1 Purchase - Objectives, different methods of purchasing

4.2 Purchase procedure-Comparative statement, purchase order, Tender, Types of tender

4.3 Storekeeping- classification of stores, duties of store keeper,

4. Store management Bin Card - Material Issue Requisition- Material Returned Note

4.6 Store ledgers - Material Requirement Planning (MRP)-concept and need

5. Plant Maintenance and Industrial Safety (08 Hrs)

5.1 Plant maintenance-Definition -Types of maintenance

5.2 Preventive maintenance and Break down maintenance-Advantages and disadvantages

5.3 Industrial safety –Meaning, Accidents, Causes for accident, Direct and indirect losses due to an accident

5.4 Personal protective devices for preventions of accidents

5.5 Safety department- role of safety officer

5.6 Fire prevention and Protection, Principles of fire extinguishing and Types of fire extinguishers

6. Social Issues and the Environment (06 Hrs)

6.1 Definition and scope of Solid waste management

6.2 Causes, effects and control measures of municipal solid wastes (hospital wastes, hazardous wastes and e-wastes)

6.3 Water conservation and rain water harvesting.
Climate change: global warming, acid rain, ozone layer depletion.

RECOMMENDED BOOKS

1. Khanna, P., "Industrial Engineering and Management", Dhanpatrai Publications Ltd, New Delhi.
2. Jhamb, L.C., and Savitri Jhamb, "Industrial Management – I", Everest Publishing House.
3. Banga, T.R., and S C Sharma, "Industrial Organization and Engineering Economics", Khanna Publishers.
4. Khanna, O.P., "Industrial Management and Engineering Economics", Khanna Publishers.
5. Aswathappa, Dr. K., and Dr. Sreedhar, "Production and Operations Management", Himalaya Publishers.
6. Krishnan, "Safety Management in Industry". N V Jaico Publishing House, Bombay.
7. Singh, Dr. A.K., "Industrial Engineering and Management Book", Satya Parkashan, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allocation (Out of 50)**
1	10	10
2	5	06
3	6	06
4	10	12
5	8	10
6	6	06
Total	**45**	**50**

5.2 ELECTRICAL POWER – I

L	P
3	2

RATIONALE

Diploma students working in State Electricity Boards/Corporations/Organisations/ Power industries and plants have to perform various activities in the field of Generation, Transmission and Distribution of Electrical power and Protection of Electrical power networks and systems. The range of these activities vary from simple operation and maintenance of equipments/lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, in addition to administrative jobs including public relations. They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards along with modern techniques in Transmission and Distribution of Electrical Power.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Distinguish and select suitable resource of energy for a particular area and environment.
- Apply power factor economies to calculate effective cost generation.
- Select suitable supporting structure, insulators, conductors and other accessories for power transmission and distribution lines.
- Prepare layout plan for HT and LT lines/distribution system and their estimates.
- Operate and maintain indoor and outdoor substations.

DETAILED CONTENTS

1. Power Generation (10 hrs)

    1.1 Historical development, growth and present scenario of Electric Power Generation in India, Future Energy Demand and supply in India.

    1.2 Plan Layout of Power System showing Generation, Transmission and Distribution.

1.3 Thermal Power Generation: Energy conversion process of thermal power station, Plant layout, Site selection criteria, Block Diagram, Major equipment's and auxiliaries, Construction and working.

1.4 Block diagram, Construction and working of Hydro, Gas, Diesel and Nuclear Power stations.

2. Economics of Generation (08 hrs)

2.1 Fixed and Running cost, load estimation, load curves, demand factor, load factor, diversity factor, capacity factor, utilisation factor and its effect on cost of generation.

2.2 Base load and peak load power stations, inter-connection of power stations and its advantages and disadvantages, concept of regional and national grid.

2.3 Hydro - thermal co-ordination.

2.4 Power factor Economics: Importance of improving Power factor in the field of power engineering, most economical power factor. Methods of improving power factor by making use of static capacitor, synchronous condenser and phase advancer with their advantages, disadvantages and applications.

3. Transmission Systems (12 hrs)

3.1 Selection of voltage for transmission of electrical power, advantages and disadvantages of Transmission of Electrical Power at high voltage, Need of High Voltage AC (HVAC) and High Voltage DC (HVDC) Transmission lines.

3.2 Comparison of different systems of power transmission: AC versus DC on the basis of Conductor material, types and selection of size of conductor from standard tables.

3.3 Constructional features of transmission lines: Types of supports/ insulators/conductors/earth wire and other accessories, Transposition of conductors and string efficiency of suspension type insulators, Bundle Conductors.

3.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice related issues

3.5 Electrical features of line: Calculation of resistance, inductance and capacitance (without derivation) in a.c. transmission line, voltage regulation, and concept of corona. Effects of corona and remedial measures

3.6 Transmission Line Losses

3.7 Introduction of Flexible AC Transmission Systems (FACTS).

4. Distribution System (09 hrs)

4.1 Concept and Constructional features of feeders, distribution lines and service mains and their erection.

4.2. Types of Distribution Systems i.e. Radial, Ring or Loop: their advantages and disadvantages.

4.3 Constructional features of LT, HT and EHT underground cables, advantages and disadvantages of underground system, Comparison between overhead and underground system.

4.4 Handling and Laying of underground cables.

4.5 Calculation of losses in Power Distribution system.

5. Substations (06 hrs)

5.1 Types of substations; Outdoor grid sub-station 220/132 kV, 66/33 kV, Pole mounted substations and indoor substations. Comparison of outdoor and indoor substations.

5.2 Layout of 33kV/11kV/400V distribution substation and various auxiliaries and equipments associated with it.

LIST OF PRACTICALS

1. Visit to a power generation plant to study its major parts, working and prepare detailed report.
2. Visit to a 400kV/220kV/132kV transmission line to study various parts such as supports, conductors, insulators and other accessories and prepare detailed report.
3. Visit to a 66kV/33kV/11kV/415V/230V distribution line to study various parts such as supports, conductors, insulators and other accessories and preparing detailed report.
4. Measure power factor of three phase and single phase electrical circuit in a distribution board.
5. Study of Indian Electricity rules related to clearance of overhead transmission and distribution lines.
6. Study of Indian Electricity rules regarding general conditions related to supply and use of energy.
7. Study of data related to conductors of different sizes/types for overhead lines as per IS 398.

8. Visit to study constructional features of LT, HT and EHT underground cables and preparing detailed report.
9. Visit to a distribution substation to study layout of major components and types of Feeders, Distributors and Service Mains and prepare detailed report.

RECOMMENDED BOOKS

1. Sahdev, S.K., "Electrical Power – I", Uneek Publication Jalandhar.
2. Marwah, G.L., "Electrical Power –I", Eagle Prakashan (Regd.) Old Road Jalandhar.
3. Gupta, B.R., "Power System Analysis and Design", Wheeler Publishing, New Delhi.
4. Sivanagaraju, S., and S. Satyanarayana, "Electric Power Transmission and Distribution", Dorling Kindersley (India) Pvt. Ltd. Pearson Education, Noida UP.
5. Raina, K.B., S.K. Bhattacharya, and Y.K. Anand, "Transmission and Distribution of Electrical Power", Tata McGraw-Hill Publishing Ltd., New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allocation (Out of 50)**
1	10	11
2	8	9
3	12	13
4	9	10
5	6	7
Total	**45**	**50**

5.3 MICROCONTROLLER AND APPLICATIONS

L	P
2	4

RATIONALE

Microcontroller is the sole of all embedded electronic equipments and is used in most of the areas of electronics. They include product ranges from tiny consumer electronic products to complex industrial process controllers. A diploma engineer needs to maintain such systems. Programming practices will further help the students to develop indigenous microcontroller based applications. Hence this course is designed to achieve the above.

LEARNING OUTCOMES

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

- Comprehend the architecture and organization of 8085 Microprocessor
- Illustrate architectural features of 8051 microcontroller
- Interface microcontroller with hardware for given application
- Write and execute assembly language programs for given application
- Develop small microcontroller based applications.

DETAILED CONTENTS

1. Fundamentals of Microprocessors (05 Hrs)

    1.1 Overview of microcomputer systems and their building blocks
    1.2 8085 microprocessor: Functional block diagram and operation
    1.3 Memory interfacing
    1.4 Concepts of interrupts
    1.5 Instruction sets of 8085 microprocessor

2. Introduction of Microcontrollers (08 Hrs)

    2.1. Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, Latch, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports
    2.2. Functions of each pin of 8051

2.3. Memory organization of 8051: Program and Data memory Map, External Memory Addressing and Decoding Logic of 8051
2.4. Stack, Stack Pointer and Stack operation
2.5. Timers/Counters logic diagram and its operation in various modes
2.6. I/O Ports structure: Port 0, Port 1, Port2, Port 3.

3. 8051 Programming (06 Hrs)

3.1. Addressing Modes : Immediate, Register, Direct, Indirect, Indexed, Relative and bit addressing
3.2. Instruction set: Data Transfer, Arithmetic, Logical, Branching, and Machine Control
3.3. Looping, Counting, Sorting and Indexing

4. 8051 Interfacing (06 Hrs)

4.1 Interface Input Devices with 8051 microcontroller: Switch: Pushbutton, DIP
4.2 Interface Output devices with 8051 microcontroller: Relay, LED, 7 segment LED, LCD
4.3 Interface actuator with 8051 microcontroller: DC Motor, Stepper motor

5. 8051 Applications (05 Hrs)

5.1. Stepper motor control for clock wise and anti-clock wise rotation.
5.2. Traffic light controller
5.3. Water level controller
5.4. Square wave generation using port pins of 8051

LIST OF PRACTICALS

Following exercises has to be performed on 8085

1. Study the hardware, functions, memory structure and operation of 8085-Microprocessor kit.
2. Write a program for Multiplication of two 8 bit numbers
3. Write a program for Division of two 8 bit numbers
4. Write a program to arrange a set of data in Ascending and Descending order.
5. Write a program to interface DC Motor and stepper motor with 8085.

Following exercises has to be performed on 8051

6. Write a program to convert a given Hex number to Decimal.
7. Write a program to find numbers of even numbers and odd numbers among 10 Numbers.
8. Write a program to find Largest and Smallest Numbers among 10 Numbers.
9. Write a program to interface Seven Segment Display with 8051.
10. Write a program to interface LCD with 8051.
11. Write a program for Traffic light Control using 8051.
12. Write a program for Elevator Control using 8051.

RECOMMENDED BOOKS

1. Gaonkar, Ramesh S., "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing (India).
2. Mazidi, M.A., J.C. Mazidi & R.D. McKinlay, "The 8051 Microcontroller & Embedded Systems Using Assembly and C".
3. Kenzie, Mac, "The 8051 Microcontroller".
4. Rao, Dr. Uma, & Andhe Paallavi, "The 8051 Microcontroller^Edition)".
5. Kalpathi, Ramani, & Ganesh Raja, "Microcontrollers & Applications".
6. Pont, Michael. J., "Embedded C", Pearson Education.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allocation (Out of 50)**
1	5	8
2	8	12
3	6	11
4	6	11
5	5	8
Total	**30**	**50**

5.4 INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

L	P
2	4

RATIONALE

Electrical Power system consists of a number of transformers, circuit breakers and other equipment which require installation, commissioning and regular maintenance to prevent permanent breakdown. Many times an engineering diploma holder has to carry out/supervise installation, commissioning and maintenance of various electrical equipment in power stations, substations and industry. This course will enable the diploma pass out student to understand the concepts, principles and acquire basic skills of installation, commissioning and maintenance of electrical equipment in power stations, substations and industry.

LEARNING OUTCOMES

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

- Install various electrical equipment as per IER Act by adopting all safety measures.
- Prepare specifications for different items required for transmission lines.
- Design and excavation of cable trenches. Lay underground cables.
- Find fault in a transmission/distribution system and rectify them.
- Carry out preventive maintenance to minimize breakdowns.

DETAILED CONTENTS

1. Electrical Accidents and Safety (8 hrs)

    1.1 Tools, accessories and instruments required for installation, maintenance and repair work.
    1.2 Types and causes of electrical accidents.
    1.3 Factors affecting severity of electric shock. artificial respiration of an electrocuted person.
    1.4 Preventive measures against electrical accident.
    1.5 General and specific safety rules to avoid electrical accident.
    1.6 Importance of "permit to work" in power station.
    1.7 Effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system

1.8 Safety tools and devices with their applications like Slogan, Board, Notice, Fire extinguisher.

2. Installation of Electrical Equipment (12 hrs)

2.1 Installation of transmission and Distribution Lines: Erection of steel structures, connecting jumpers, tee-off points, joints and dead ends; crossing of roads, streets, power/telecommunication lines and railway line crossings, clearances; earthing of transmission lines and guarding, spacing and configuration of conductors: Arrangement for suspension and strain insulators, bird guards, anti-climbing devices and danger plates; sizes of conductor, earthwire and guy wires, Testing and Commissioning.

2.2 Laying of Underground Cables: Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water, sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying, including laying of cable from the drum, laying cable in the trench, taking all measurements and making drawings, back filling of trenches with earth or sand, laying protective layer of bricks etc.) laying of cables into pipes and conduits and within buildings, introduction to cable filling compounds, epoxy resins and hardeners, cable jointing and terminations, testing and commissioning.

2.3 Elementary idea regarding inspection and handling of transformers; pole mounted substations, plinth mounted substations, grid substation, busbars, isolators, voltage and current transformers, lightning arrestors, dehydration. Earthing system, fencing of yard, equipment foundations and trenches etc.

3. Maintenance of Electrical Equipment (10 hrs)

3.1 Types of maintenance, maintenance schedules, Functions of maintenance department, reasons of failure of electrical equipment, preventive maintenance: need, classification, advantages, activities & frequency of maintenance, breakdown maintenance: concept, advantages

3.2 Maintenance of Distribution Transformers: Transformer maintenance and points to be attended to in respect of various items of equipment, Checking of insulation resistance, transformer oil level and BDV test of oil, measurement

of earth resistance

3.3 Maintenance of Motors: Preventive maintenance, trouble shooting of electric motors

3.4 Domestic Installation: Introduction; electrical iron, ceiling fan, washing machine, air cooler, vacuum cleaner, fluorescent tube light etc.

LIST OF PRACTICALS

1. Study of tools, accessories and instruments required during installation, maintenance and repair of electrical equipment's.
2. To study steps required for erection of steel structure alongwith connection of all accessories viz. jumpers, tee points, insulators, joints etc. while installation of a transmission line.
3. To study steps required for erection of distribution structure alongwith connection of all accessories viz. jumpers, tee points, insulators, joints etc. while installation of a distribution line.
4. Study of various tests done during installation and commissioning of transmission and distribution line.
5. Study of various methods of laying of underground cables and tests done before commissioning.
6. Prepare list of all electrical accessories required for installation of
   a) Pole mounted substation.
   b) Plinth mounted substation.
   c) Grid substation.
7. Study of various pre-installation and pre-commissioning tests done on following electrical equipments
   a) Electrical motors
   b) Electrical Generators
   c) Transformers
   d) Underground cables
8. Prepare maintenance schedule of Power transformer.
9. Prepare maintenance schedule of Distribution Transformer.
10. Prepare maintenance schedule of Grid substation.
11. Prepare maintenance schedule of Motors.

INSTRUCTIONAL STRATEGY

This subject needs theoretical and practical inputs. Demonstration at actual site may be arranged for conceptual understanding. The subject teacher should plan in advance about the visits to the actual sites and establish liaison with the appropriate authorities/ persons with the help of HOD and Principal of the institution. The students be taken to actual workplace and explain various test procedures.

RECOMMENDED BOOKS

1. Rao, S, "Testing, Commissioning, Operation and Maintenance of Electrical Equipment", Khanna Technical Publication, New Delhi.
2. Singh, Tarlok, "Installation, Commissioning and Maintenance of Electrical Equipment", S.K. Kataria, Sons, New Delhi.
3. Wadhwa, C.L., "Electrical Power System", New Age international Publications, New Delhi.
4. Relevant IS Code for-Installation, Maintenance and Commissioning of Electrical Equipment/Machines, Latest code.
5. Sharotri, SK, "Preventive Maintenance of Electrical Apparatus", Katson Publishing House, Ludhiana.

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1	8	14
2	12	20
3	10	16
Total	**30**	**50**

5.5.1 SMART GRID

L	P
3	-

RATIONALE

To enable the students to acquire knowledge on smart grid, different options of architectural design and communication technology for various aspects of smart grid. The student will be acquainted with system analysis and stability analysis in smart grid, renewable energy sources and storage integration with smart grid.

LEARNING OUTCOMES

At the end of the subject, the student will be able to:

- Comprehend concept of Conventional Grid and Smart Grid
- Illustrate Smart Grid automation including fault detection, isolation and service restoration
- Describe various communication and measurement technologies in Smart Grid
- Depict applications of Smart meters and phasor measurement units. Power quality and grid integrations
- Detail high performance computing for Smart Grid application.

DETAILED CONTENTS

1. Introduction to Smart Grid (9 Hrs)

    1.1 Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits
    1.2 Difference between Conventional & Smart Grid
    1.3 Concept of Resilient & Self Healing Grid.
    1.4 Present development & policies in Smart Grid.
    1.5 Various perspectives from experts and global Smart Grid initiatives.

2. Smart Grid Technologies (9 hrs)

    2.1 Technology Drivers, Smart energy resources, Smart substations
    2.2 Substation Automation, Feeder Automation,

2.3 Transmission systems: Energy Management System (EMS), FACTS and HVDC
2.4 Wide area monitoring, Protection and control
2.5 Distribution systems: Distribution Management System (DMS), Volt/VAr control
2.6 Fault Detection, Isolation and service restoration, Outage management
2.7 High-Efficiency Distribution Transformers, Phase Shifting Transformers,
2.8 Plug in Hybrid Electric Vehicles (PHEV)

3. Smart Meters (9 Hrs)

3.1 Introduction to Smart Meters
3.2 Advanced Metering Infrastructure (AMI) drivers and benefits
3.3 AMI protocols, standards and initiatives
3.4 AMI needs in the smart grid
3.5 Phasor Measurement Unit (PMU)
3.6 Intelligent Electronic Devices (IED) & their application for monitoring and protection.

4. Power Quality Management in Smart Grid (9 Hrs)

4.1 Power Quality & EMC in Smart Grid
4.2 Power Quality issues of Grid connected Renewable Energy Sources
4.3 Power Quality Conditioners for Smart Grid
4.5 Web based Power Quality monitoring
4.6 Power Quality Audit

5. High Performance Computing (9 hrs)

5.1 Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN) for Smart Grid System
5.2 Broadband over Power Line (BPL)
5.3 IP based Protocols
5.4 Basics of Web Service and CLOUD computing to make Smart Grids smarter
5.5 Cyber Security for Smart Grid.

RECOMMENDED BOOKS

1. Bakre, Dr. Shashikant, “Smart Grid”, Nirali Prakashan.
2. Modi, Bharat, Anu Prakash, & Yogesh Kumar, “Fundamentals of Smart Grid Technology”, S.K. Kataria & Sons.
3. Shunmugalatha, Dr. A., Dr. T. Chandrasekar, Dr. B. Ashok Kumar, J. Rajeswari, and Dr. S. Senthilrani, “Smart Grid”, Technical Publication.
4. Salman K., “Introduction to the Smart Grid: Concepts, Technologies and Evolution”, IET Digital Library.
5. Ekanayake, Janaka, Kithsiri Liyanage, and Jianzhong Wu, “Smart Grid: Technology and Applications”, John Wiley & Sons.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1	9	10
2	9	10
3	9	10
4	9	10
5	9	10
Total	**45**	**50**

5.5.2 ELECTRIC VEHICLES

L	P
3	-

RATIONALE

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

LEARNING OUTCOMES

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

- Provide an overview of basics of electric vehicle history and components
- Comprehend various properties of batteries, their charging and discharging.
- Illustrate the electrical machine properties and measurement of electrical and non-electrical parameters involved electric vehicle drive systems
- Describe control system and control loops applied in power plants.
- Integrate electrical vehicles technology to understand the concepts of hybrid electric vehicles

DETAILED CONTENTS

1. Electric Vehicle Machines (9 Hrs)

Classification of the electric vehicles, understanding electric drivetrain
Permanent Magnet Synchronous Motor (PMSM), Permanent Magnet Brushless DC Motors PMBLDCM, Synchronous Reluctance Motor (SRM), induction motor for EVs Social and Environmental importance of Hybrid and Electric Vehicles; Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics.

2. Electrochemical Cells (12 Hrs)

Energy storage devices: Li-ion battery, supercapacitor, fuel cells, and flow batteries at cell level, Battery Management strategies.
Battery State of Charge: Estimation, Battery Cell equalization problem, thermal control, protection interface, Energy & Power estimation, battery testing. Battery Leakage, Causes of battery explosions, Thermal Runway: High discharge rates, Short circuits, charging and discharging, Battery Standards

3. Power Electronics Interface (12 Hrs)

Design and control of switched-mode power converters, On-board Charger (AC/DC), Traction Inverter (DC/AC), battery DC-DC converters. Charging Infrastructure Classification of EV charging infrastructure- AC chargers, DC chargers and Inductive charging. Indian and international standards for DC and AC EV charging.

4. Hybrid Electric Vehicles (9 Hrs)

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

5. Overview of Policies (3 Hrs)

Indian Government policies relevant to electric vehicles Future Orientation

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1	9	08
2	12	14
3	12	14
4	9	10
5	3	04
Total	**45**	**50**

5.5.3 SENSORS & IoT

L	P
3	-

RATIONALE

The Internet is the main source and also the base of every aspect of the things that we do. The Internet of Things covers all about connecting the multiple devices or things with the use of internet sensors and also the infrastructure. This course curriculum aims to provide exposure to the Internet of Things (IoT) industry, the technology used to create IoT devices, the means through which they interact and store data, and the types of distributed systems required to support them. The scope and the demand for the Internet of Things are high, and also the salary levels keep increasing because of the increasing demand.

LEARNING OUTCOMES

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

- Classify the sensors and explain the types and working of sensors.
- Comprehend various smart sensors and actuators.
- Detail the concept of Internet of Things and its applications
- Design and implement IoT systems using Arduino
- Explore the potential applications of IoT in various industries

DETAILED CONTENTS

1. Introduction to Sensors (7 Hrs)

Sensors, Classification of sensors, Static and Dynamic characteristics of sensors, Sensor Selection guidelines. 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. Vibrometer and accelerometer.

2. Smart Sensors And Actuators (11 Hrs)

Introduction to smart sensors, bio-sensors, nano-sensors and micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration

micro sensors, chemical sensors, temperature micro sensors, MEMS Sensors.
Micro Actuators: Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

3. Internet of Things (IoT) (11 Hrs)

Introduction**,** Definition, Characteristics, Physical design, Logical design, Functional blocks of IoT system, Communication models & APIs, Advantage & Disadvantage of IoT.

4. Implementation of IoT using Arduino (11 Hrs)

Arduino Uno Architecture, Basics of Embedded C programming for Arduino, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino, Interfacing of Actuators with Arduino, Interfacing of Relay Switch and Servo Motor with Arduino.

5. Challenges and Applications of IoT (5 Hrs)

Challenges in IoT- Design challenges, Development challenges, Security challenges, Other challenges.
IoT Applications- IoT applications in Transportation, Agriculture, Smart Cities, Healthcare.

RECOMMENDED BOOKS

1. D, Patranabis, “Sensors and Transducers”, Wheeler Publisher.
2. Fraden, Jacob, “Hand Book of Modern Sensors: Physics, Designs and Application”, Springer.
3. Madisetti, Vijay, and Arshdeep Bahga, “Internet of Things: A Hands on Approach”, University Press.
4. Kanetkar, Yashavant, Shrirang Korde, “21 Internet of Things (IOT) Experiments”
5. Rai, Neerparaj, “Arduino Projects For Engineers”, BPB Publications.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1	7	08
2	11	12
3	11	12
4	11	12
5	5	06
Total	**45**	**50**

5.6 MINOR PROJECT WORK

L	P
-	8

RATIONALE

Minor Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

LEARNING OUTCOMES

After undergoing the minor project work, students will be able to:

- Apply in totality the knowledge and skills gained through the course work in the solution of particular problem by undertaking a project.

- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study

- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.

- Develop first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.

- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

General Guidelines

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance. Students should be allotted a problem of interest to him/her. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students in a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work **should not be considered** as merely conventional industrial training in which students are sent at work places with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

The projects given to students should be such for which some one is waiting for solution.

Suggestive List

Depending upon the interests of the students and location of the organization, the students may be asked to do Market study in the following cases:

1. Various types of cables available in the market, their current rating/specifications, different makes/manufacturing companies (minimum three), comparison of cost between different makes.

2. Various types of domestic/wiring components such as switches, sockets, holders etc., their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.
3. Various types of protective devises used in domestic and industrial wiring such as MCBs, ELCB/RCCB, fuses etc. their specifications, make (minimum three), and comparison of cost between different makes.
4. Various types of electric lamps (lumeneries) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes. 5. Various types of Electrical Appliances (domestic and commercial) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes. (compare any one type)
6. Survey and study of house wiring accessories, manufacturers, rates, specifications, their literature collection for their design 147
7. Study of LT/HT components, detailed specifications from catalogues of manufacturers, drawings, rates, availability in local market

Minor project assignments may also include following studies:

1. Study of different types of sources of light, their connections, and to measure intensity of light with lux-meter:
    - 1.1 Fluorescent lamp/ tube
    - 1.2 HP mercury vapour lamp
    - 1.3 HP sodium vapour lamp
    - 1.4 Compact Fluorescent lamp (CFL)
2. Study of induction furnace by visiting a factory and to prepare a report
3. Study of welding equipment along with its accessories
4. Study of the electroplating plant by visiting an industry and preparing a report
5. Study of refrigerator/air conditioner and to prepare a report of its electrical circuit
6. Study of an electric locomotive by visiting any locomotive repair shop at a nearby station

EVALUATION OF STUDENTS FOR MINOR PROJECT

The criteria for evaluation of minor project work is as follows :

Criteria	Weightage
Punctuality and Regularity	10 %
Planning and Execution	30%
Initiative in learning new things	10%
Report Writing	20%
Presentation and Viva	30%

Note :

A viva voce examination will be conducted at the end of minor project for assessing the work of student. The examination Committee for this purpose will consist of a professional and the teacher who has guided the project.

PERSONALITY DEVELOPMENT CAMP

This is to be organized at a stretch for two to three days. Extension lectures by experts or teachers from the polytechnic will be delivered on the following broad topics. There will be no examination for this camp.

1. Communication Skills

2. Correspondence and job finding/applying/thanks and follow-up

3. Resume Writing

4. Interview Techniques: In-Person interviews; telephonic interviews, panel interviews; group interviews and video conferencing etc.

5. Presentation Techniques

6. Group Discussion Techniques

7. Aspects of Personality Development

8. Motivation

9. Leadership

10. Stress Management

11. Time Management

12. Interpersonal Relationship

13. Health and Hygiene

6.1 PLC BASED INDUSTRIAL AUTOMATION

L	P
2	2

RATIONALE

This subject plays a very important role in understanding of the automation of various processes for industries. The students at this level must have required the knowledge of various sensors and actuators used for automation of different processes. This subject will give exposure to the students about the hardware as well as ladder logic programming of Programmable Logic Controller (PLC). It will further help the students to acquire knowledge about the role of PLC in industrial Automation.

LEARNING OUTCOMES

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

- Comprehend the need of PLC for Industrial Automation
- Describe the working of PLC and its programming
- Apply the various types of Instructions for PLC
- Create ladder logic programs for various industrial automation process.

DETAILED CONTENTS

1. Introduction to PLC (7 Hrs)

   Introduction about Programmable Logic Controller, History of PLC, Concept of Relays, Limitations of Relays and Relays Based Logic Circuits, Advantages of PLC over Relay Logic, Need of PLC for Industrial Automation.

2. Working of PLC (7 Hrs)

   Architecture of PLC, CPU, Input Modules, Output Modules, Memory, Power Supply and Communications, PLC Operation, Scan Time, Types of Programming Languages for PLC.

3. Instruction Set for PLC (8 Hrs)

Basic Instructions, Program Flow Instructions, Time Instructions, Counter Instructions, Sequencing Instructions, Comparison Instructions, Arithmetic Instructions.

4. Ladder Diagram Programming (8 Hrs)

Ladder Logic Programming, Rung in a Ladder Logic Program, Ladder Diagram Programs based on: Basic Instructions, Timer Instructions, Counter Instructions, Comparison Instructions, Math Functions, and Applications of PLC.

LABORATORY/FIELD EXPERIENCES

1. Demonstration of various components/sub-components of a PLC.
2. Learning functions of different modules of a PLC system.
3. Programming a PLC using a Hand held programmer
4. Programming a PLC using a computer interface.
5. Demonstration to programming language, ladder diagram concepts, using instruction list syntax.
6. PLC Programming practices based on ladder diagrams using relays, timers, counters, sequencers.
7. Basic logic operations, AND, OR, NOT functions
8. Logic control systems with time response as applied to clamping operation
9. Sequence control system e.g. in lifting a device for packaging and counting
10. Use of PLC for an application:
    - Packaging
    - Process controls
    - Car parking
    - Doorbell operation
    - Traffic light control
    - Microwave Oven
    - Washing machine
    - Motor in forward and reverse direction
    - Star-Delta, DOL Starters
    - Paint Industry
    - Filling of Bottles
    - Room Automation
11. Case study of a PLC based instrumentation scheme in a process industry.

RECOMMENDED BOOKS

1. W. Webb, John, and Ronald A Reis, “Programmable Logic Controllers – Principles and Applications”, Prentice Hall Inc., New Jersey.
2. Rathore, Umesh, “Basic Instrumentation System & Programmable Logic Controller”, Katson Books.
3. Petruzella, Frank, “Programmable Logic Controllers (English)”, Tata McGraw Hill.
4. Bolton, George, “Programmable Logic Controllers (English”, ELSEVIER INDIA.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allocation (Out of 50)**
1	7	11
2	7	11
3	8	14
4	8	14
Total	**30**	**50**

6.2 ELECTRICAL POWER – II

L	P
3	2

RATIONALE

In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma pass out have become more complex than what they used to be earlier. He is required to work with modern electrical equipment and maintain reliability of supply. The course is designed to understand the concepts, principles involved in the construction and working of generating stations and protective switch gear system so that one can handle, install, maintain them and also take decisions at his/her level in different situations. The teaching of this subject requires reinforcement in the form of visits to substations, power stations and well designed laboratory experiences. A practice-oriented approach to the teaching of this subject is suggested.

LEARNING OUTCOMES

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

- Identify the faults in overheads and underground power system
- Operate and maintain protective switchgears
- Handle, operate and maintain protective devices
- Use and select protective relays and protective scheme
- Maintain over-voltage protection scheme

DETAILED CONTENTS

1. Faults (06 hrs)

    1.1 Common type of faults in both overhead and underground systems, symmetrical/ unsymmetrical faults. Single line to ground fault, double line to ground fault, 3- phase to ground fault, open circuit.

    1.2 Methods to determine fault location in underground cables by Murray Loop Test, Varley Loop Test.

2. Switch Gears (12 hrs)

2.1 Purpose of protective switchgear, difference between switch, isolator and circuit breakers with the help of circuit diagram, function of isolator and circuit breaker

2.2 Circuit breakers: Principles of Arc extinction, Definitions: Arc voltage, restriking voltage, recovery voltage and Rate of Rise of Restriking Voltage (RRRV), constructional features of Oil Circuit Breaker (OCB), Variable Capicantce Diode (VCD), Air Circuit Breaker (ACB), SF6 circuit breakers and their working, bulk and minimum oil circuit breakers.

2.3 Rating of Circuit Breakers, Selection of Circuit Breakers.

2.4 Miniature circuit breakers: ELCB, MCB for distribution system.

3. Protection Devices (12 hrs)

3.1 Need and Characteristics of a protection system.

3.2 Fuses: function of fuse, selection of fuses, types of fuses such as HV and LV fuses, rewire-able, cartridge, High Rupturing Capacity (HRC) fuse, advantages and disadvantages and applications of HRC fuse.

3.3 Earthing: Purpose of earthing, methods of controlling earth resistance, equipment earthing, substation earthing, system earthing and neutral earthing as per Indian Electricity rules.

3.4 Relays: Types of relays

a) Electromagnetic and Thermal relays, their construction and working.

b) Induction type over-current relay, earth fault relay, instantaneous over current relay, their construction, working and functions.

c) Directional over-current, differential relay, their construction, working and functions.

d) Distance relay, its construction, working and function.

e) Static and digital relays their construction, working, functions and applications.

4. Protection Scheme (10 hrs)

4.1 Relays for generator protection.

4.2 Relays for transformer protection including Buchholz relay protection.

4.3 Protection of feeders and bus bars, over current and earth fault protection.

4.4 Distance protection for transmission system.

4.5 Relays for motor protection.

5. Protection against Over-voltage (05 hrs)

5.1 Causes of over voltages, concept of lightening phenomenon with wave shape of voltage.

5.2 Lightning arrestors: Rod gap, horn gap, metal oxide type, their construction and working.

5.3 Protection of overhead transmission Line and substation against over-voltages due to lightening.

LIST OF PRACTICALS

1. Location of fault in underground cable by Murray loop method.
2. Study of transformer oil dehydration and testing of the dielectric strength of transformer oil.
3. Study of different types of circuit breakers and isolators by visiting power station and to prepare detailed report.
4. Study for testing of Circuit Breakers as per IS codes by visiting nearby substation or High. Voltage Lab and to prepare detailed report.
5. Plot the time-current characteristics of over current relay.
6. Electrical Power measurement by using instrument transformers and protection of circuit using CTs.
7. Earthing of different Equipments/Main Distribution Board and Energy Meter Box.
8. Perform the overload and short circuit test of MCB as per IS specifications.
9. Plot the time-current characteristics of Kit-Kat fuse wire.
10. Usage of Clamp meter and measurement of current on any LT line with the help of clamp meter.

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of generating stations and substations be arranged and various equipment, accessories and components explained to the students. The protection schemes should be shown at the site and engineers from field may be invited for delivering expert lectures on these topics. Help of Video Films may be taken to explain the layout; construction and working of different power equipment.

RECOMMENDED BOOKS

1. Ashfaq, Haroon, "Switchgear and Protection", Khanna Book Publishing Co. (P) Ltd. Nai Sarak, Delhi.
2. Marwah, G.L., I.S. Bhullar and Ramandeep Kaur, "Electrical Power – II", Eagle Prakashan (Regd.) Old Road, Jalandhar City.
3. Sahdev, S.K., "Electrical Power – II", Uneeke Publication Jalandhar.
4. Raina, K.B., S.K. Bhattacharya, "Electrical Design Estimating and Costing", New Age International (P) Ltd., Publishers, New Delhi.
5. Vishwakarma, DN, Badri Ram and Soumya R Mohanty, "Power System Protection and Switchgear", Mc Graw – Hill Publishing Co. Ltd. New Delhi.
6. Gupta, J.B., "Switchgear and Protection (Advance Power Systems)", Ess Kay Publication, Nai Sarak, Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allocation (Out of 50)**
1	6	7
2	12	13
3	12	13
4	10	11
5	5	6
Total	**45**	**50**

6.3 UTILIZATION OF ELECTRICAL ENERGY

L	P
3	2

RATIONALE

An electrical technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks, to select equipment, processes and components in different situations. The contents have been designed keeping the above objectives in view. Besides giving the student basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas.

LEARNING OUTCOMES

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

- Design lighting scheme for domestic, industrial and commercial installation.
- Design and select a suitable heating arrangement for a particular job.
- Handle and maintain electric welding equipment and electrolytic plant.
- Correct faults in electric circuits of refrigerators, air conditioners.
- Maintain electric traction lives and track.

DETAILED CONTENTS

1. Illumination (6 hrs)

    1.1. Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux.

    1.2. Laws of illumination – simple numerical Illumination schemes, indoor and outdoor illumination levels

    1.3. General ideas about time switches, street lighting, flood lighting, monument lighting and decorative lighting, light characteristics.

2. Electric Heating (6 hrs)

2.1. Resistance heating: direct and indirect resistance heating, electric ovens, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit
2.2. Induction heating: principle of core type and coreless induction furnace.
2.3. Electric arc heating: principle of direct and indirect arc heating,
2.4. Dielectric heating, applications in various industrial fields
2.5. Solar Heating and its applications.

3. Electric Welding (8 hrs)

3.1. Principles of resistance welding, types – spot, projection, seam and butt welding.
3.2. Principle of arc production, electric arc welding, types- AC and DC arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications.
3.3. Advantages of using coated electrodes, welding control circuits, welding of aluminum and copper.
3.4. Advantages of electric welding

4. Electrolytic Processes: (8 hrs)

4.1. Need of electro-deposition
4.2. Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing
4.3. Factors affecting electro-deposition
4.4. Principle of galvanizing, anodizing and its applications

5. Refrigeration, Air Conditioning and Water Cooling: Principle of air conditioning vapour pressure, refrigeration cycle, eco-friendly refrigerants. (5 hrs)

6. Electric Drives and Traction (12 hrs)

6.1 Advantages of electric drives, Characteristics of different mechanical loads and Types of motors used as electric drive.
6.2 Advantages of electric traction, Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main line and their speed-time curves

6.3 Electrical block diagram and accessories of an electric locomotive and different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector / pentagraph etc.

6.4 Factors affecting scheduled speed, Power supply arrangements and types of motors used for electric traction

LIST OF PRACTICALS

1. Study of different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for fluorescent lamp, mercury vapour lamp, sodium vapour lamp, halogen lamp, neon lamp, compact fluorescent lamp(CFL), types of chokes.
2. Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple designproblems.
3. Calculation of resistance heating elements (simple problems).
4. To study construction, working and applications of core type and coreless induction furnace by visiting a nearby industry.
5. To study construction, working and applications of arc furnace by visiting a nearby industry.
6. Study of welding equipment for resistance welding.
7. Power supply and equipment required for AC/DC arc welding.
8. Study of equipment and accessories for electroplating.
9. Study of Electrical circuit used in
   a) Refrigerator
   b) Air-conditioner, and
   c) Water cooler
10. Selection of drive for Domestic Appliances and applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.

INSTRUCTIONAL STRATEGY

It is desired to give ample practical examples in the class while teaching this subject. Teacher must supplement his/her classroom teaching with aids such as models, charts, and video films from time to time. This subject requires demonstrations and exposure to actual workplace/industry/field. For this purpose, the subject teacher should do advance planning for visits/studies related to each topic in consultation with HOD and Principal of the polytechnic/institution. Students should be taken for visits to nearest electrified railway track and railway station to study the electric traction system.

RECOMMENDED BOOKS

1. Partap, H, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai &Sons, Delhi.
2. Gupta, JB, "Utilization of Electrical Energy", Kataria Publications, Ludhiana.
3. Sahdev, "Utilization of Electrical Energy", Uneek Publication, Jalandhar.
4. Uppal, Dr. SL, "A Text Book of Electrical Power", Khanna Publications, Delhi.
5. Partap, H, "Modern Electric Traction", Dhanpat Rai & Sons, Delhi.
6. Taylor, OS, "Utilization of Electrical Energy", Pitman Publications.
7. Wadhwa, CL, "Generation, Distribution and Utilization if Electrical Power", Wiley Eastern Ltd., New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allocation (Out of 50)**
1	6	7
2	6	7
3	8	9
4	8	9
5	5	6
6	12	17
Total	**45**	**50**

6.4 ELECTRICAL ESTIMATING AND COSTING

L	P
3	-

RATIONALE

The subject of estimation and costing is a crucial aspect of electrical engineering education for diploma holders. It provides them with the necessary knowledge and skills to estimate the costs involved in electrical installations, understand materials and methods used, and ensure compliance with safety regulations and quality standards. This subject is designed to develop the requisite knowledge and skills of estimation and costing in students of diploma in electrical engineering.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Identify and select appropriate materials and methods for electrical installations.
- Analyze and compare cost estimates to determine the most economical solutions for electrical installations, materials, labor and overhead costs.
- Prepare different types of contracts and tender processes used in the electrical industry.
- Follow safety regulations and quality standards in electrical installations.

DETAILED CONTENTS

1. Introduction (5 hrs)

    1.1 Purpose of estimating and costing and proforma for making estimates
    1.2 Preparation of materials schedule and costing price list
    1.3 Preparation of tender document, net price list, market survey, overhead charges, labor charges, electrical point method and fixed percentage method, contingency, profit, purchase system and enquiries,
    1.4 Comparative statements, orders for supply and payment of bills.
    1.5 Prepare detailed tender specifications.
    1.6 Prepare purchase orders.

2. Types of Wiring (4 hrs)

2.1 Selection and design of wiring schemes for particular situation (domestic and Industrial).

2.2 Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables (to be prepared/arranged)

3. Estimating and Costing (18 hrs)

3.1 Domestic installations; standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load)

3.2 Industrial installations; relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list ofmaterials.

3.3 Service line connections estimate for domestic and Industrial loads (over-head and underground connections) from pole to energy meter

3.4 Estimating and costing of repairs and maintenance of any one domestic appliance.

4. Estimating Material Required (12 hrs)

4.1 Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

4.2 Substation: Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating, earthing of substations, Key Diagram of 66 KV/11KV Substation.

4.3 Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

4.4 Estimating and costing of overhead service connection (single phase and three phase).

4.5 Estimating and costing of overhead, 440V, 3-phase, 4/3 wire distribution line.

4.6 Estimating and costing of underground service connection (single phase and three phase).

5. Preparation of Tender Documents (06 hrs)

Prepare tender notices for at least 2-3 projects, tender – constituents finalization, specimen tender

INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing leading to preparation of small tender document. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

RECOMMENDED BOOKS

1. Uppal, S.L., "Electrical Estimating and Costing", Khanna Publishers, New Delhi.
2. Raina, K.B., "Electrical Design Estimating and Costing", New Age Publications.
3. Singh, Surjit, "Electrical Estimation and Costing", Dhanpat Rai & Co., New Delhi.
4. Gupta, J.B., "Electrical Installation, Estimating and Costing", SK Kataria and Sons, New Delhi.
5. Bhattacharya, A.K., "Electrical Estimating and Costing", Tata McGraw Hill, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1	5	06
2	4	04
3	18	20
4	12	12
5	6	08
Total	**45**	**50**

6.5 MAJOR PROJECT WORK

L	P
16	-

RATIONALE

Project work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

LEARNING OUTCOMES

After undergoing the project work, students will be able to:

- Apply in totality the knowledge and skills gained through the course work in the solution of particular problem.
- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study
- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- Develop abilities like interpersonal skills, communication skills, positive attitude and values etc.

General Guidelines

The individual students have different aptitudes and strengths. Project work, therefore, should match the strength of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to them as project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students.

There should not be more than 6 students in a group. The project work identified in collaboration with industry should be preferred.

This project work should not be considered as merely conventional industrial/field training in which students are sent to work places with either minimal or no supervision. The project work is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant industry/field organizations for providing such an experience to students. It is necessary that each organization is visited well in advance to identify the project. The chosen project needs to match with the curricular interest of students and should be of professional value to industrial/ field organizations.

Some of the suggested projects are given below:

Projects related to designing small electrical equipment / instruments.

- Projects related to increasing productivity in electrical manufacturing areas.
- Projects related to quality assurance.
- Projects connected with repair and maintenance of plant and equipment.
- Projects related to design of PCBs.
- Projects related to design of small oscillators and amplifier circuits.
- Design and fabrication in the field of electrical engineering applications
- Projects related to design, fabrication, testing and application of simple digital circuits and components.
- Projects related to microprocessor/microcontroller based circuits/ instruments.

1. Projects related to estimate the material required to provide a service connection to a consumer’s premises for domestic purposes
2. Projects related to preparation of a proposal for substation, calculating the total load (estimating and costing) and Installation of security system

There is no binding to take up the above projects as it is only a suggestive list of projects.

A suggestive criterion for assessing student performance by an external and an internal (teacher) examiner is given in the table below:

Sr. No.	**Performance Criteria**	**Max. Marks**	**Rating Scale**						
			Outstanding	**Excellent**	**Very Good**	**Good**	**Above Average**	**Average**	**Pass**
1.	Planning	10	10	9	8	7	6	5	4
2.	Execution	30	30	27	24	21	18	15	12
3.	Quality of Project	20	20	18	16	14	12	10	8
4.	Report Writing	20	20	18	16	14	12	10	8
5.	Presentation/ Viva voce	20	20	18	16	14	12	10	8
Total marks		**100**	**100**	**90**	**80**	**70**	**60**	**50**	**40**

Important Note

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner may be a person from industry/organization, who has been associated with the project-oriented professional training of the students or a senior faculty from technical institute.

4. It is proposed that the institute may organize an annual exhibition of the project work.

9. RESOURCE REQUIREMENT

9.1 PHYSICAL RESOURCES

9.1.1 Equipment requirement:

Following Laboratories are required for Diploma Programme in Electrical Engineering:

1. Innovation and Computing Laboratory
2. Fundamentals of Electrical Engineering Laboratory
3. Electrical Workshop Practice
4. Electrical Machines
5. Electronics Devices & Circuits
6. Computer Programing Applications
7. Basics of Digital Electronics
8. Electrical Measurement and Instrumentation
9. Industrial Electronics and Control of Drives
10. Electrical Engineering Design and Drawing
11. Electrical Power
12. Microcontroller and Applications
13. Installation and Maintenance of Electrical Equipment
14. PLC based Industrial Automation
15. Utilization of Electrical Energy

Note: Some of the laboratories can be clubbed keeping in mind best utilization of space and equipment as follows:

Sr. No.	Particulars	Qty.
ELECTRICAL ENGINEERING AND MEASUREMENT LABORATORY		
1.	Measuring Instruments: Portable moving coil permanent magnet 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in teak wood/ebonite case, accuracy 1.5%	
a)	Ammeter 0-5-10 Amp	8
b)	Ammeter 50 mA , 100 mA, 1000 mA	6
c)	Ammeter 0-10 Amp – 20 A	6
d)	Ammeter 0 -2.5- 5 Amp	8
e)	Voltmeter 0-30 V	8
f)	Voltmeter 0-10-15 V, 0-200 – 300 V, 0-200-500 V	6

2.	Stabilized DC Power Supply with maximum voltage regulation of 0.01 to 0.05% Ripple in output less than 1 mV (rms), stability 0.2% + 30 mV, input supply 230V AC single phase, 50 Hz and DC output 0-10V,0-1.5A and also with short circuit (0-30 V) and over load protection with measuring devices	8
3.	Lead Acid Batteries 12 V, 11 plates, 30 amp hour capacity	2
4.	Battery Charger: SCR based automatic 12 V, AC input voltage 230 V, output dc voltage 0-12 V, 0-2 amp. rating provided with voltmeter, ammeter of suitable range	1
5.	Breadboards	10
6.	Sliding Rheostats: Wound with evenly oxidised iron free Nickel copper wire on vitreous enamelled round steel tube. Contactors should be of laminated phosphor bronze sheet, Resistance tolerance ranges + 20% or 5% double tube	2
7.	Standard Resistance: 0.01 ohm,10 amp, Fixed on bakelite base with brass terminals, 4 terminal arrangement, immersed in moisture free oil contained in a vessel sealed from the top	2
8.	Colour coded resistances of different values viz 5ohm, 10 ohm, 50 ohm 200 ohm, 250 ohm, 500 ohm, 1000 ohm	40 each
9.	Decade Resistance Boxes: Constantan coils, Accuracy + 0.5% to 1% single dial 10x10x10, 10x1000, 10 x10000 ohms.	1
10.	Capacitors: enclosed in a polished hard wood/bakelite box, with four brass terminals	6
11.	Resistance Box: Constantan coils ratings 1 ohm to 10 megaohm	1
12.	Tungsten filament lamp, Single phase, 220 volts, 50Hz	10
13.	Induction coil of 50 turns and 100 turns wound on non-magnetic material cylindrical surface with provision to connect galvanometer.	4
14.	Solenoid consisting of Induction coil of 100 turns wound on a cylindrical loop made of non-magnetic material with provision to connect galvanometer.	4
15.	Spot Reflecting Galvanometer: Housed in bakelite case with lamp scale arrangement, Taut band type movement, shock proof, scale 150 mm long lamp operated on 220 V, AC mains, with shunt multiplying power of 1/10, 1/100, 1/1000, Resistance 125 ohm, sensitivity 0.04 micro amp. per mm , critically damped, time period 2 sec.	1
16.	Hydrometer for measuring specific gravity of lead acid battery range 1100 - 1300	6
17.	Cell discharge tester: used for testing voltages of cells and batteries centre zero, housed in bakelite case with wooden handle movement, permanent magnet and moving coil type, knife edge pointer, range 3-0-3 volts	1
18.	Multimeter a) Analog Hand Held Multimeter, suitable to measure DC Voltage : 0 – 2.5V/10V/50V/250V/1000V with Accuracy : ± 3%, AC Voltage : 0 – 10V/50V/250V/1000V, with Accuracy : ± 4%, DC Current : 0 – 2.5mA/25mA/250mA/10A with Accuracy : ± 3%,	6

	Resistance : 0 – 2k/20k/2M/20MΩ with Accuracy : ± 3% and having facility for Transistor Polarity Test ,diode test, capacitor test	
	b) Digital Multimeter: Three and half digits LCD display, manually operated multimeter with AC/DC, 1A current resistance upto 10 Mohm, complete with leads manual and batteries, accuracy 0.5% for dc and 1% for AC measurement Voltage upto 1000V	2
19.	3-Way Key fixed in bakelite with brass terminals	1
20.	Reversing switch: Switch frame double sided, external connection provision for reversing, silver contact, phosphor bronze blades operated by insulated lever, six terminals to connect external loads 5A/10 amp	1
21.	Earth tester: 500 volt, 0.10-100 ohms with 3/4 terminals, complete with all accessories (hammers, screw driver, 3 spikes with connecting leads, as per ISS) Accuracy + 1% FSD, housed in teak wood/ebonite case, with leather case	2
22.	Moving Iron Voltmeter/Ammeter: Portable moving iron measuring Instrument, housed in teak wood/ebonite case, scale 150 mm knife edge pointer, with anti mirror, critically damped, accuracy 1% FSD	
	a) 0-500 mA-1000 mA	2
	b) 0-5-10 amp	8
	c) 0-2 amp	1
	d) 0-125-250 volts	5
	e) 0-250-500 volts	4
23.	Wattmeter: Portable dynamometer type, housed in teak wood/ebonite case, scale 150 mm knife edge pointer with anti parallax, current range 0-5-10 amp Voltage range 0-250-500 volt or 125-250 volt	3
24.	Rheostats: Sliding Rheostats wound with evenly oxidised iron free nickel copper on vitreous enamelled round steel tube. Contactors should be made of laminated phosphor bronze sheet. Resistance tolerances + 2%	
	a) Single tube 150 ohm – 2 A	3
	b) Single tube 300 ohm – 5 A	3
	c) Double Tube 500 ohms – 20 A, 30 A	3
	d) Double Tube 440 ohms – 3 A	3
	e) Double Tube 110 ohms – 10 A	3
25.	Dimmerstat: Single phase 0-230 V, output 0-270 V, 10A	2
26.	Inductance: Coil mounted provision for change in value, well polished teak board with terminals fitted with 2.5 Kg variable core	3
27.	Variable Inductor: Single phase, 250 V, mounted on well polished teak wood frame with terminals, 2.5 kW, continuously variable core type.	1
28.	Digital Energy meters:	
	a) single phase, 50 Hz, 5A/10A, 250 V, accuracy+ 1%	1
	b) 3 phase, 4 wire,.440 V, 20-40A, 50 Hz, accuracy + 1%	1

29.	Standard energy meter	
	a) single phase, Induction type 50 Hz, 5A/10A 250 V	1
	b) 3 phase, Induction type, 4 wire.440 V 10 A, 50 Hz.	1
30.	Phase Regulator: 10A, 250V,2.5 KVA variable power factor and lagging to leading arrangement indicator	1
31.	Power Factor Meter: Dynamometer type, eddy current type damping, frequency 50Hz,scale length 150mm, current range upto20 amp, voltage range 300 volts, PF range 0.5 lag, unity, 0.5 lead, Wood/ebonite, with antiparallax mirror, knife edge pointer.	1
32.	Load: 3 phase variable resistive load, 415 V, 10 KW, trolley mounted tube type provided with switches to vary the load in twenty steps	2
33.	Continuously variable inductive load, 415 V, 10 kW terminal for end connections	1
34.	Digital LCR/Q Bridge: Capable of measuring resistance inductive and capacitance of range, 8 amps.0.012 to 10 Mega ohm, 4 to 10000 H, 0.5 pico farad to 10 F Direct reading of the factor from 0.15	1
35.	Clamp Meter 0-10 A 220 V 50 Hz	2
36.	Current Transformer 0-10 A 220 V 50 HZ Single Phase	2
37.	Potential Transformer 0-250V 50 HZ Single Phase	2
38.	Experimental Kit to measure temperature using N.T.C. Thermistor having arrangement for reading temperature on 3 ½ digit LCD display heating rod, power supply AC 220V, 50Hz, suitable amplifier and protection system	1
39.	Measurement of temperature using thermocouple Thermocouple trainer kit with arrangements of thermocouple sensor for copper constantan thermocouple, oven for heating, LCD Display, 2 No.s thermometers suitable to measure temperature from 0°C to 200°C.	1
40.	Experimental Kit to measure temperature using RTD Transducer Kit	1
41.	Experimental kit for Measurement of pressure by using LVDT	1
42.	Frequency meter:	
	a) Digital, 4 digit LED display frequency meter suitable for use on 230 V AC main supply range 20-99 Hz	1
	b) Vibrating Reed type 230 V, having 21 reed 40-60 Hz. abs Body	1
	c) Moving Coil type, portable housed in phenolic moulded body with antiparallax mirror. Scale and knife edge pointer, range 40-60 Hz, 230 V	1
43.	Phase sequence indicator: Portable, housed in a plastic moulded casing, rotating disc type, supported with one meter long red, yellow and blue leads with clips, rating 30 sec. 500 V, burden 15 VA voltage 50 to 500 V frequency 25 to 50 Hz.	1
44.	Flux meter: Operated on 230 V ac portable with selector switch, output, 10 mV on all ranges 0-50, 0-100, 0-200, 0-500, 0-1K, 0-2K, 0-10K gauss. Accuracy + 1% with built in calibration	1
45.	Cathode Ray Oscilloscope 10 MHz Vertical deflection Bandwidth DC-10 MHz(-3db) Rise time 30 ms, Deflection coefficient 12 calibrated steps, 5 mV/cm to 20 V	1

	in input impedance 1 M ohm started by 25 p.f input coupling DC-AC-GND Max. input voltage-500 V(DC+ peak AC)	
46.	Transformer: Single phase, core type, natural air cooled, 230/110 V, 1 KVA, 50Hz	1
47.	Shunt: 0-75 A	1

ELECTRICAL MACHINES AND POWER LABORATORY

1.	Static Converter: 3-Phase, 415 V, 50 Hz, output 230 V dc 15 KW, regulation + 1%, servo controlled, thyristorised	1
2.	Separately excited DC Generator, 230 Volt, 5 H.P , 1440 rpm complete with appropriate panel board with voltmeters, ammeters, switches, indicators, starter and field regulator	2
3.	DC Shunt Motor - Shunt Gen. Set: DC shunt motor 230 V, 3 kW, 1440 rpm coupled with DC shunt generator, 230 V, 3kW, complete with appropriate panel board with meters, switches, indicators starter and field regulator	1
4.	DC shunt motor 230 V, 3 HP, 1440 rpm complete with appropriate panel board, starter and loading arrangements (Belt assembly)	1
5.	DC Compound motor Gen. set.: DC shunt motor 230 V, 3 kW, 1440 rpm coupled with DC compound generator, 230V, 3kw, complete with appropriate panel board, starter and field regulator	1
6.	DC Series motor: DC series motor, 230 V, 3 HP , 1440 rpm with breaking (eddy current or drum pulley) arrangement and appropriate panel board and over speed safety precautions e.g. light shunt winding etc.	1
7.	Synchronous Generator, 3 phase, 415 Volt, 5 H.P., with Prime mover, Excitor, Starter, output terminals brought out to connect load.	2
8.	Squirrel Cage Induction Motor: 3-phase squirrel cage induction motor 3 Kw, 415 V, 50 Hz, 1440 rpm all six terminals brought out, complete with appropriate panel board, starter etc	1
9.	Slip ring Induction motor: Three-phase, wound rotor induction motor, 3Kw, 415 V. 50 Hz, 1440 rpm with stator and rotor terminals brought out coupled with a dc shunt generator, 230V, 3 KW with appropriate panel board and starter	1
10.	Pole Changing/Winding Study Motor: Three phase, double speed, 440V. 50 Hz, 1-3 kW induction motor with all the coil terminals brought out for connecting winding for different speeds	1
11.	Single phase Induction Motor Capacitor start with centrifugal switch 0.5 KW with suitable loading arrangement and appropriate panel board.	1
12.	1-phase transformer: Single phase transformer, 230/115 V, 50 Hz, 3 KVA housed in a metal tank	4
13.	3-Phase transformer: Three phase transformer, 415/230V,50 Hz, 5 KVA all terminals brought out, housed in a metal tank	2
14.	Variacs:	
	a) One phase, 230 V, 50 Hz, 8-A auto transformer continuously valuable, housed in a metal body, portable	3

	b)	One phase, 230 V, 50 Hz, 15-A transformer continuously valuable, housed in a metal body, portable	2
	c)	Three phase, 230 V, 50 Hz, 30 A, 415-V transformer continuously valuable housed in a metal body, portable phase	3
15.	Loading Rheostats:		
	a)	Resistance type, single phase, 230V, 15A, each natural air cooled, housed in metal body fitted with switches and mounted on trolleys	3
	b)	Resistance type, three phase 440V, 15A, natural air cooled, housed in metal body, switches and base wheels, six terminals brought out	1
	c)	Continuously variable choke type loading coil, coil upto 15A, three phase, 440V, 50Hz, housed in a metal case on wheels (Trolley Aid)	2
	d)	Capacitor bank, variable in steps through switches, 440V, 3 phase, 15A max. housed in a portable metal case	1
16.	Rheostats: Wire wound Rheostats (Approx. of following rating) 440 Ohm, 3A		15
	110 Ohm 8A		10
17.	Tachometer: Digital non-contact type tachometers 0-10,000 rpm, 3 1/2 digit		4
18.	Stroboscope: with calibrated dial for frequency/rpm measurement		1
19.	DC Ammeters: Portable moving coil permanent magnet 150 mm uniform scale with anti parallax mirror, knife edge, pointer, housed in a teak wood/ebonite case, accuracy + 1-5%		
	a)	Ammeter 0-3 amp	6
	b)	Ammeter 0-25 amp	6
	c)	Ammeter 0-50A	6
20.	DC Voltmeters Portable moving coil permanent magnet 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in a teak wood/ebonite case, accuracy + 1-5%		
	a)	0-15	4
	b)	0-50	2
	c)	0-150	3
	d)	0-300	10
	e)	0-600	1
21.	AC Ammeters Portable moving iron, 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in a teak wood/ebonite case, accuracy +1.5%		
	a)	0-1A	3
	b)	0-3A	3
	c)	0-10A	7
	d)	0-20A	7
22.	AC Voltmeters Portable moving iron 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in a teak wood/ebonite case, accuracy +1.5%		
	a)	0-1V	3
	b)	0-15V	3

	c)	0-30/60 V	4
	d)	0-150/300 V	10
23.	Multimeter:		
	a)	Digital/type: 3 1/2 digit LCD display manually operated multimeters with AC/DC 10 A and 10 mega ohm, accuracy+ 0.5% for DC and +1% for AC	2
	b)	Indicating type DC voltage: Sensitivity 10 k ohm/v range - 300 kV, 1, 3, 10, 30, 100, 300, 1000V; AC voltage - sensitivity 10 K ohm/V Range 1,3,10, 30, 100,300,1000V etc.	2
24.	Wattmeters: Portable dynamometer type: Portable dynamometer measuring instrument housed in a teak wood/ebonite case scale 150 mm, knife edge pointer with antiparallax mirror, critically damped, accuracy + 1%		
	a)	75/300/600 V and 1.5/3A (LPF)	2
	b)	75/300/600 V and 1.5/20A (UPF)	2
	c)	75/150/300 V and 15/30A	4
	d)	110/220/440 V and 15/30A	4
25.	Portable Power factor meters: Dynamometer type, eddy current type, damping, frequency cycle 50 Hz , scale length 150 mm, current rated upto 20A, Volt-300V. p.f. range 0.5 lag-unity 0.5 lead, housed in teak wood/ebonite case with antiparallex mirror with knife edge pointer		
	a)	Portable type single phase single element type 110 V/240 V or 1 A or 5 A	1
	b)	Portable type 3-phase single element type 110 V/ 240 V, 1 A or 5 A	1
26.	Frequency Meter:		
	a)	Pointer type Portable type housed in phenolic moulded body with ant parallax mirror scale knife, edge pointers range 40-60 Hz, 230 V, 110 V or 240 V or 45-55 Hz	1
	b)	Read type 230 V, range 40-60 Hz and 21 Read	1
	c)	Digital type. 3 1/2 digit: LED, display frequency meter suitable for use on 230V AC main supply range 20-99Hz	1
27.	Synchroscope: Suitable for 110V AC, 1-phase, 50 Hz alongwith potential transformer, 230V and 415V on primary and 110V on secondary side		1
28.	Phase Shifting Indicator: Suitable for 50 V to 500 AC from 25 Hz to 55 Hz		2
29.	Tong Testing Ammeter: 0-15 A/50A/100A Clip-on type		3
30.	Current Transformer: 100-50-25-10/5A		2
31.	Potential Transformer:		
	a)	10 VA, 440/110 V	1
	b)	10 VA, 220/110 V	1
32.	DC Regulated Power Supplies: 0-30V, 5A, DC and also with short circuit and over lead protection with measuring devices		2
33.	Rectifier-Inverter Set: 3-Phase, 3KVA, 415V, 50Hz on rectifier input side 3 phase,		

3 KVA,25 to 150 Hz on the output side

34. Earth tester: 500 volt, 0.10-100 ohms with 3/4 terminals, complete with all accessories (hammers, screw driver, 3 spikes with connecting leads, as per ISS) Accuracy + 1% FSD, housed in teak wood/ebonite case, with leather case — 2

NOTE: It is recommended to introduce universal machines in as many numbers as possible from the point of view of modernization of the machine laboratory for setting up of the same experiment for the complete group as well as from the point of view of teaching machines from the unified theory of machines. However, the choice is left to the individual polytechnics to have flexibility in this regard

ELECTRICAL WORKSHOP

1. Coil Winding Machine: Bench mounted, power driven with clutch and brake built into winding head, electromagnetic traverse clutch system for setting winding length of wire range .05 to 1.5 mm dia. Max. winding speed 250 to 5500 rpm speeds, coil dimensions Max. dia 150 mm, electric motor 0.5 HP, 1725, 230 V AC single phase, 50 Hz with essential spare — 1
2. Bench Drilling Machine: Drilling capacity 13 mm, slotted and adjustable drilling, Table size 250 x 250 mm app. Belt driven with 4 speed ranges from 50 to 2000 rpm, electric motor power 0.5 kw. suitable for an electrical supply of 240 V AC single phase 50 Hz — 1
3. Portable Drilling Machine: Hand electric drill machine with speed control having specification Drilling 10 mm, no load speed 700 rpm, 435 W capacity, Supply voltage 230 V, 50Hz supply — 3
4. Multi meter: Laboratory service type with large and easy to read mirror scale with over head protection high accuracy, voltage range a.c/ d.c 0-600 V Current Ranges - AC 50 mA - 10 amp. DC 10 mA - 10 amp Ohmmeter 2 Ohm to 20 K Ohm Accuracy DC voltage and current + 1% AC voltage and current + 2%, Ohmmeter + 3% with test leads and carrying case — 2
5. Meggar: Insulation tester having hand driven generator to generate 500 volts DC having effective range of measuring insulation resistance from 0 to 100 M ohm. Confirming to IS 2992/1965 — 2
6. Fans of various type with one having solid State speed regulator:
   a) Ceiling fan: 1200 mm, 1500 mm sweep operating at 230V, 50Hz, — 1
   b) Table fan: 400 mm sweep operating at 230 V, 50 Hz, supply AC — 1
   c) Exhaust fan: 375 mm sweep operating at 230 V, 50 Hz, supply AC main 0.25 HP — 1
   d) Desert cooler, complete with 375 mm sweep, 1400 rpm, 1/4 HP motor operating at 230 V, 50 Hz, AC, complete supporting frame fan, water circulating pump, float and control switches etc — 1
7. Electrical Appliances:
   1. Electric Kettle: 750 watts, 230V single phase AC, 50Hz, capacity 1 lit.
      a) Filament type — 3

		b)	Rod type rated 1000 watt.	3
	2.	a)	Electric Iron, 500 watt, 230 V, Ordinary, 50 Hz, 1 Kg weight	6
		b)	Electric Iron, 500 watt, 230 V, Automatic, 50 Hz, 1/2 Kg	6
	3.		Electric Toaster: 500 watt	1
	4.		Geyser 15 lit capacity, 2 Kw, 230 Volts 50 Hz, AC	2
	5.		Immersion rod: 1000 watt, 230 Volts 50Hz, AC supply operated	12
	6.		Room Heater 1000 watt, 230 V, 50 Hz, AC supply	
	a)		Parabolic type	6
	b)		Rod type (single rod/double rod)	6
	7.		Air convector: 1000 watts, 230 V, 50 Hz, with 2 temperature settings	2
	8.		Mixer cum grinder: 250 watts, 230 volts, 50 Hz, 1 1/2 lit. capacity with various attachments (food processor)	1
	9.		Heater: Wire wound type, 1000 watts, 230 V, 50 Hz supply	
	10.		Hot plate: Single/double filament 1500/2000 watts, with control knobs operating at 230 V, 50 Hz, AC supply	6 4
	11.		Electrical Oven: 2 KW, with temperature control devices and temperature indicating meters operating at 230 volts, 50 Hz AC supply	1
	12.		Electric Shaver: 40-60 watts, to be operated at 230 V, 50 HP supply	1
	13.		Electric Lighter: to be operated at 230 v, 50 Hz Electric/Electronic	1
8.	Digital clip-on meter: Digital Clip-on meter with following specifications:			3
	i)		Display 3.5 digits	
	ii)		Max. reading 1999	
	iii)		AC current Resolution Accuracy Range 200 Amps to 100 mA +1.25 to 5 digit 100 Amps to Amp	
	iv)		AC Voltage 2000 V to 0.1 V : +1% to 5 digit 1000 V to 0.1 V : + 1% to 5 digit	
	v)		Resistance 200 M Ohms to 0.1 ohms + 1.00%	
			Instruments should be provided, with test leads and carrying case	
9.	Miniature Circuit Breakers(MCBs)			
	a)		16, 40 and 60 amps in single phase	6 each
	b)		100 amps 3 phase	6 each
	c)		200 amps 3 phase	6 each
10.	Electric Lamps:			
	a)		Mercury vapour lamp 120 watt, 230v, 50 Hz AC supply complete with choke, lamp holder and power factor capacitor	2
	b)		Mercury vapour lamp ML type 120/125 watt, 230 v, 50 Hz supply	2
	c)		Sodium vapour lamp 120 watt/250 watt, 230 volts, 50 Hz with choke	
	d)		Flourescent tube: 20/40 watt, 230 V,50 Hz, single phase with choke, starter and fittings various sizes and types i.e. round etc.	4
	e)		Halogen lamps: 1000 watts/1500 watt, 230 v, 50 Hz complete with fittings(Fluorescent tube light)	2 1

	f) Filament Lamps	
	- 60 W lamp, 230 V	100
	- 60 W lamp, 100 V	100
	- 60 W lamp, 230 V	100
	- 200 W lamp	100
	- 500 W lamp	100
	- 100 W – 110 V lamp	100
	- 100 W - 150 V lamp	100
	g) CFL LAMP	50
11.	Voltage Stablizer: 500 VA, input 170/260 volts, output 210- 240 volts automatic with voltmeter	2
12.	Automobile Electrical Wiring Demonstration working model for automobile Electric wiring	2
13.	Screw Driver Set: Electrician type round nickel plated steel blade, flat tip with plastic insulated handle following sizes: Blade Sizes	6 each
	i) 2.5 x 60 mm	
	ii) 3 x 80 mms	
	iii) 4 x 120 mm	
	iv) 5 x 160 mm	
	v) 5 x 200 mm	
14.	Combination Pliers: 205 mm length with thick plastic insulated handle Insulated for 500 V (Taparia, PYE make)	8
15.	Long Nose Pliers: 150 mm insulated for 500 volts	12
16.	Diagonal Pliers: 150 mm insulated for 500 volts suitable for cutting hard wires	6
17.	Adjustable Wrench Chromium plated adjustable wrench lengths 255 mm max. opening 30 mm	6
18.	a) Flat nose pliers: Rectangular section jaw and smooth gripping surface plastic insulated handles length 130 mm	3 each
	b) Slip Nose Pliers with slim long grains of half round section and smooth gripping surfaces plastic insulated handle length 130 mm	6
	c) Round Nose Pliers: With slim long round grains and plastic insulated handles lengths 130 mm	3
19.	Ball Pien Hammer: Ball pein hammer with polished fall and pein wooden handle having wts	3 each
	i) 250 gms	
	ii) 500 gms	
	iii) 800 gms	
20.	Screw Holding Screw Driver Set: Screw driver set fitted with spring each clips to secure screw head round or hexagonal chromium plated blade with plastic handle set of three screw driver blade size i) 4 x 50 mm	6
	ii) 4 x 75 mm	

	iii) 4 x 100 mm	
21.	Instrument Makers Screw Driver Set: Set of screw drivers with chrome vanedium set steel shaft and fluted nickel plated steel handle with hexagonal end shaft width 0.8 to 3.8 mm complete with plastic case	2
22.	Tweezers	
	a) With blunt serrated Jaws stainless steel nickel plated length 160 mm	1
	b) Pointed ends serrated jaws stain less steel nickel plated length 130 mm	1
23.	Work shop Scissors Stainless steel, scissors suitable for cutting insulation, paper, plastic etc. length approx. 150 mm	6
24.	Adjustable Hacksaw Frame: Extra robust tubular steel frame cast handle adjustable for hacksaw blade from 250 - 300 mm with set of 10 spare blades	4
25.	Hand Drill Machine: Two speed hand drill machine with enclosed gear adjustable crank, supporting handle, self centering chuck for straight shank drills upto 10 mm	6
26.	Bench Vice: Drop forged steel bench vice with jaw width 100 mm, Jaw opening 120 mm, Jaw depth 75 mm, quick release complete with i) One pair of detachable aluminium protective jaw plates ii) One pair of detachable fibre protective jaw plates	2
27.	Bearing Puller Three legs heavy duty bearing puller of size 100 mm/200 mm	1
28.	Automatic Centre Punch: Spring loaded action knurled shank centre punch length 115 mm and dia at point 2mm	2
29.	Wire Gauge: Suitable upto 0-76 SWG	1
30.	Try Square: Engineers try square from stainless steel with stock 90 degrees all sides accurately finished legs 150 x 100 mm	2
31.	Measuring tape: Pocket measuring tape of steel spring return device, flexible, clearly graduated in metric readings 2 mts long	6
32.	Files Set: Hand files with plastic handles for each general metal treatment double cut 200/350 mm long consisting of i) Flat smooth cut ii) Flat second cut iii) Half round second cut iv) Half round smooth cut v) Round second cut vi) Round smooth cut vii) Square second cut viii) Square smooth cut ix) This single cut smooth 20 x 3.3mm x) Triangular file 200 mm	2
33.	Wire Stripper: Stripper with side mounted spring return and adjustable jaws via look screws for cable insulation maximum 4 mm dia length 150 mm.	2
34.	Screw Driver Mains Voltage Tester: Flat tip screw driver with built in new test	2

	lamp transparent plastic handle insulated block, metal pocket clip suitable upto 400 v. AC blade 4 x 100 mm Overall length 180 mm	
35.	Cable Knife: Electrician knife blade made from stainless steel with length 50 mm plastic moulded handle overall length 180 mm	12
36.	Soldering Gun Kit: Instant action soldering device trigger controlled with built in illumination of soldering butt bakelite housing, normal power 45 watts, with approx. 2 mts supply cord suitable for electric supply of 230 volt AC, single phase 50 Hz. Accessories: (i) Fine bit (ii) Bit for plastics	3
37.	Rubber Mallet: Soft Rubber with wooden handle approx. 200 gms	6
38.	Screw Extractor Set: Left hand thread for easy removal of broken right hand threaded screw and bolts. Set of three extractors for screws with die from 3 to 11 mm	3
	Figure Stamp Set for marking made from high grade stainless steel figure height 4mm complete with plastic box	2
39.	Soldering Iron: Soldering iron 35 watts, 65 W, 100 Watts operating at 230 V, 50 Hz supply	2
40.	Oil Can: 0.75 lit capacity	2
41.	Blow Lamp: 1 Pint kerosene oil capacity blow lamp	2
42.	Hand Saw: Hand saw 10" (254) size 10 teeth per inch teak wood handle	6
43.	Chisels: Former chisel mode of carbon steel of size 6 mm x 15 mm	3
44.	Wrench Set: Set of 5(3/8 to 1 inch) chrome vanadium sets steel, offset type, 12 points, accurately sizes capacity 3/8x7/16, 1/2x9/16, 5/8x1/16, 3/4x7/8 and 15/16x1 inch (in metric sizes)	2
45.	Pipe Wrench: High tensile steel, drop forged, hardened and tempered app. cap. 6 to 50 mm dia	3
46.	Tap Wrench Set: Set of 4, bar type, adjustable for general purpose, made of best quality steel, approx. cap. 1.5 to 25 mm square	6
47.	Electric Pneumatic Drilling Hammer: Drill capacity, 5-22 mm in concrete, 5-10 mm in steel rated voltage 235 volts, 50 Hz, AC, full load input 450 watt, full load speed 650 rpm. Impact rate 3270 Blows/minute	1
48.	Work Bench: Steel construction but with wooden bench top not less than 50 mm thick with two steel drawers both lockable approx. size 1200x600x850 mm solid construction	1
49.	Fire Extinguisher: Multipurpose fire extinguishers, suitable for electric installation and petrol fire, app. cap. 10 kg. rechargeable includes wall bracket and 2 recharging kits	5
50.	Electrical Accessories	

	a) Piano type switches	5
	b) 3 Pin Socket 5A	5
	c) 3 Pin socket 15A	5
	d) Ceiling rose	5
	e) Cleats	20
	f) Clamps	20
	g) Sample of Batten wiring	5 Meters
	h) Sample of Casing Capping wiring	5 Meters
	i) Sample of Conduit wiring	5 Meters
ELECTRONICS AND AUTOMATION LABORATORY		
1.	DC regulated low voltage variable power supply	10
2.	DC regulated multiple output power supply	4
3.	Audio oscillator	4
4.	Wide band RC Oscillator	4
5.	RF Signal Generator	2
6.	Pulse Generator	2
7.	Function Generator	4
8.	Digital Storage Oscillos.	5
9.	Electronic Multimeter DC and AC with different ranges	10
10.	Electronics digital Multimeter three and a half digit	10
11.	Digital LCR- Q meter	2
12.	Transistor tester type 911	1
13.	Audio output power meter	2
14.	AC Millivoltmeters	4
15.	DC Millivoltmeters	2
16.	DC Voltmeter	5
17.	DC Ammeter	5
18.	Single Phase VARIAC	3
19.	Rheostat of different wattage and resistance	5
20.	Servo stabilizer power supply	1
21.	IC Bread Boards	20
22.	Distortion factor meter	1
23.	Decade resistance, capacitance and inductance (four each)	12
24.	Strip chart recorder	1
25.	Digital Panel meters	6
26.	Digital thermometer	1
27.	Digital Lux meter	1
28.	CROs 20 MHz (Scientific Make)	6 Nos.
29.	Function Generators Audio Frequency	6 Nos.
30.	Rectifier Kits	6 Nos.
31.	Filter Circuit Kit	6 Nos.

32.	Bread Boards	12 Nos.
33.	Transistor Kits	
	(a) CB	6 Nos.
	(b) CE	6 Nos.
34.	FETs	6 Nos.
35.	Operational Amplifier Kits	6 Nos.
36.	Raw Materials	LS
37.	Breadboards	20
38.	Various IC of AND, NOT, OR, XOR, NAND, NOR gates	50 each
39.	Trainer Board to Study flip flops	5
40.	Trainer Board to Study encoder/ decoder	5
41.	Trainer Board to Study multiplexer/ demultiplexer	5
42.	Trainer Board to Study Shift Registers SIPO, SISO	5
43.	Trainer Board to Study Shift Registers PISO, PIPO	5
44.	Interfacing Cards with 8051 -Sensors cards -Wifi cards -bluetooth cards -DC motor interface with motor -LCD interface	LS
45.	Micro-controller Kit 8051 based	10
46.	Digital IC Tester Model - Nikki	1 No.
47.	Universal Programmer	1 No.
48.	Morgan Chopper Kit	6 Nos.
49.	Joner Chopper	6 Nos.
50.	Series Inverter	6 Nos.
51.	Parallel Inverter	6 Nos.
52.	Speed Control of dc motor (Thyristorized)	6 Nos.
53.	Single Phase Cyclo Convertor with Thyristors	6 Nos.
54.	Kit for study of effect of free wheeling diode on power factor	6 Nos.
55.	SCR Characteristics	6 Nos.
56.	Gate Triggering Characteristics of SCR	6 Nos.
57.	AC Phase Control Trainer Kit using	6 Nos.
58.	Kit to Study 3-phase Control Bridge Convertor	6 Nos.
59.	UJT Characteristics and its Application as Relaxation Oscillator	6 Nos.
60.	Thyristor control experimental kits Instrumentation/Transducer experimental kit. Basic electronic experiment kit	LS
61.	Trainer Kit to study characteristics of DIAC	6 Nos.
62.	Trainer Kit to study characteristics of TRIAC	6 Nos.
63.	Trainer Board to Study Half Wave Controlled Rectifier	6 Nos.

64.	Trainer Board to Study Full Wave Controlled Rectifier	6 Nos.
65.	Trainer Board for SCR based Lamp intensity control	6 Nos.
66.	Trainer Board for SCR fan speed control	6 Nos
PLC SCADA LABORATORY		
1.	PLC Trainer Kits	LS
2.	PLC Simulator Software	LS
3.	PLC interface cards	LS
INNOVATION AND COMPUTING LAB		
1.	Desktop Computers Core i5 (11^{th} 12^{th} or 13^{th} -gen) 8 GB/16GB of RAM 512GB or larger Hard Disk, SSD drive, USB Port, TFT Screen 19",	30
2.	Laser Printer	2
3.	Color Printer	2
4.	Software: PSIM, PSPICE MATLAB AutoCAD	

NOTE:

In addition to the above, laboratories in respect of physics, chemistry, Computer Centre etc will be required for effective implementation of the course. Provision for photocopiers, PC facilities along with LCD Projection System etc. has also to be made.

9.1.2 Space Requirement:

Norms and standards laid down by All India Council for Technical Education (AICTE) may be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

9.1.3 Furniture Requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) may be followed for working out furniture requirement for this programme.

9.2 Human Resources:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staff pattern, workload norms, qualification, experience and job description of teaching staff, lab attendants, and other administrative and supporting staff may be worked out as per norms and standards laid down by All India Council for Technical Education (AICTE).

10. LIST OF CONTRIBUTORS/EXPERTS

a) Online Curriculum Workshops for Designing the Contents of First Year Subjects for Diploma Programmes for Punjab State on 22nd April, 2022, 26th April, 2022, 28th April, 2022, 12th May, 2022 13th May, 2022, 16th May, 2022, 17th May, 2022, 24th May, 2022 and 6th June, 2022 at NITTTR, Chandigarh

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b) Online Curriculum Workshops for Designing the Contents of Open Electives for Diploma Programmes for Punjab State on 27th March, 2023, and 8th May, 2023, at NITTTR, Chandigarh

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16.	Dr. A B Gupta, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh

c) Online Workshops to Develop the Curriculum of Diploma Programme in 'Electrical Engineering' for the State of Punjab on 5th May, 2022, 26th May, 2022, 3rd August, 2022, 25th August, 2022, 16th November, 2022, 20th December, 2022, and 11th October, 2023 at NITTTR, Chandigarh

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