Curriculum for

Diploma Programme in

ELECTRICAL ENGINEERING

For the State of Uttar Pradesh

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PREFACE

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 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 culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and 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, UP to revise the existing curricula of 6 diploma programmes as per the needs of the industry and making them 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 its effective implementation. However best the curriculum document is designed, if that 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 of the polytechnics to 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 thereby infuse the much needed dynamism in the system.

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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, UP
4)	Intake	:	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*	:	50 : 50 (Approx.)

8) Industrial Training:

Four weeks of industrial training is included after IV semester during summer vacation. Total marks allotted to industrial training will be 50.

9) Ecology and Environment :

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

10) Energy Conservation:

A subject on Energy Conservation has been incorporated in the curriculum.

11) Entrepreneurship Development:

A full subject on Industrial Management and Entrepreneurship Development has been incorporated in the curriculum.

12) Student Centred Activities:

A provision of 3-6 periods 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, self study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities, disaster management and safety etc.

13) 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 OF DIPLOMA HOLDERS IN ELECTRICAL ENGINEERING

(A) EMPLOYMENT OPPORTUNITIES

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

(1) 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
- Use of PLC and Microcontrollers.

(2) 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
- Programming of PLC
- Electric Traction Systems

(3) 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

(4) 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)
- Microcontroller based systems for different applications

3. LEARNING OUTCOMES OF THE PROGRAMME

Sr. No.	Learning Outcomes
After due completion of the course, a diploma holder in Electrical Engineering will be able to:	
1.	Communicate effectively in English with others
2.	Apply basic principles of mathematics to solve engineering problems
3.	Apply basic principles of physics and chemistry to solve engineering problems
4.	Prepare computerized reports, presentations using IT tools and computer application software
5.	Prepare and interpret drawings of engineering components
6.	Use cutting tools and tooling for fabrication of jobs by following safe practices during work
7.	Use energy conservation methods in various systems
8.	Use appropriate procedures for preventing environmental pollution and energy conservation
9.	Analyze AC circuits and apply electromagnetic induction principles in various electrical equipments and machines
10.	Test various active and passive components like resistor, inductor, capacitor, diode, transistor and use them as an amplifier and voltage stabilizer
11.	Select and use right kind of quality of electrical material required for a particular operation.
12.	Plan and execute given task/project as team member/leader
13.	Read and interpret drawings related to electrical machines, equipment and wiring installations
14.	Assemble distribution and extension boards and construct alarm and indicating circuits using relays, bells and push buttons
15.	Operate and maintain DC shunt, series and compound motors and three phase transformers
16.	Use measuring instruments, tools and testing devices for varied field applications
17.	Repair and maintain UPS and storage batteries and control speed of DC shunt motor and universal motor
18.	Design and use flip-flops, A/D and D/A converters in digital circuits
19.	Use MATLAB, SCILAB for designing and finding solutions to problems related to electrical systems
20.	Programme and develop microcontroller based systems
21.	Use of PLC and make suitable ladder logic programmes for different applications

22.	Operate and maintain indoor and outdoor substations and prepare estimate for HT/LT (OH and underground cables) lines
23.	Operate and demonstrate microcontroller and PLC based systems in electrical control circuits for domestic and industrial processes
24.	Design cable trenches, lay underground cables and find faults in transmission/ distribution system
25.	Estimate and determine the cost of wiring installation, HT/LT overhead lines, Pole mounted Substation and prepare a tender document for a particular job
26.	Plan and execute minor projects related to electrical engineering
27.	Handle electrical energy based equipments for electric traction systems
28.	Manage resources effectively at the workplace
29.	Use measuring instruments for measurement of electrical or non-electrical quantities
30.	Apply the working principle of a mini hydro plant, fuel cells, thermo electric power, geothermal and tidal energy conversion methods
31.	Troubleshoot various auto electrical faults
32.	Apply all the knowledge and skill gained through various courses in solving a live problem/project in the industry
33.	Test and install various electrical equipment and machines

4. DERIVING CURRICULUM AREAS FROM LEARNING OUTCOMES OF THE PROGRAMME

The following curriculum area subjects have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Communicate effectively in English with others	Communication Skill
2.	Apply basic principles of mathematics to solve engineering problems	Applied Mathematics
3.	Apply basic principles of physics and chemistry to solve engineering problems	– Applied Physics – Applied Chemistry
4.	Prepare computerized reports, presentations using IT tools and computer application software	Basics of Information Technology
5.	Prepare and interpret drawings of engineering components	Engineering Drawing
6.	Use cutting tools and tooling for fabrication of jobs by following safe practices during work	General Workshop Practice
7.	Use energy conservation methods in various systems	Energy Conservation
8.	Use appropriate procedures for preventing environmental pollution and energy conservation	Environmental Studies
9.	Analyze AC circuits and apply electromagnetic induction principles in various electrical equipments and machines	Basic Electrical Engineering
10.	Test various active and passive components like resistor, inductor, capacitor, diode, transistor and use them as an amplifier and voltage stabilizer	Analog Electronics
11.	Select and use right kind of quality of electrical material required for a particular operation.	Electrical and Electronics Engineering Materials

12.	Plan and execute given task/project as team member/leader	Project work
13.	Read and interpret drawings related to electrical machines, equipment and wiring installations	Electrical Design, Drawing and Estimating
14.	Assemble distribution and extension boards and construct alarm and indicating circuits using relays, bells and push buttons	General Workshop Practice
15.	Operate and maintain DC shunt, series and compound motors and three phase transformers	Electrical Machine
16.	Use measuring instruments, tools and testing devices for varied field applications	Installation, Maintenance and Repair of Electrical Equipment
17.	Repair and maintain UPS and storage batteries and control speed of DC shunt motor and universal motor	Industrial Electronics and Control
18.	Design and use flip-flops, A/D and D/A converters in digital circuits	Digital Electronics
19.	Use MATLAB, SCILAB for designing and finding solutions to problems related to electrical systems	Applications of Computer Software in Electrical Engineering
20.	Programme and develop microcontroller based systems	Programmable Logic Control, Microcontroller and SCADA
21.	Use of PLC and make suitable ladder logic programmes for different applications	Programmable Logic Control, Microcontroller and SCADA
22.	Operate and maintain indoor and outdoor substations and prepare estimate for HT/LT (OH and underground cables) lines	Power Plant Engineering
23.	Operate and demonstrate microcontroller and PLC based systems in electrical control circuits for domestic and industrial processes	Programmable Logic Control, Microcontroller and SCADA

24.	Design cable trenches, lay underground cables and find faults in transmission/ distribution system	– Installation Maintenance and Repair of Electrical Equipment – Transmission and Distribution of Electrical Power
25.	Estimate and determine the cost of wiring installation, HT/LT overhead lines, Pole mounted Substation and prepare a tender document for a particular job	Electrical Design, Drawing and Estimating
26.	Plan and execute minor projects related to electrical engineering	Project work
27.	Handle electrical energy based equipments for electric traction systems	Utilization of Electrical Energy
28.	Manage resources effectively at the workplace	– Industrial Management and Entrepreneurship Development – Utilization of Electrical Energy – Energy Conservation
29.	Use measuring instruments for measurement of electrical or non-electrical quantities	Electrical Instrumentation and Measurement
30.	Apply the working principle of a mini hydro plant, fuel cells, thermo electric power, geothermal and tidal energy conversion methods	Renewable Source of energy
31.	Troubleshoot various auto electrical faults	Repair of Electrical Equipment
32.	Apply all the knowledge and skill gained through various courses in solving a live problem/project in the industry	Project Work
33.	Test and install various electrical equipment and machines	Installation, Maintenance and Repair of Electrical Equipment

5. ABSTRACT OF CURRICULUM AREAS

a) General Studies

1. Communication Skill
2. Environmental Studies
3. Energy Conservation
4. Industrial Management and Entrepreneurship Development

b) Applied Sciences

5. Applied Mathematics
6. Applied Physics
7. Applied Chemistry

c) Basic Courses in Engineering/Technology

8. Engineering Drawing
9. Basics of Information Technology
10. General Workshop Practice
11. Basics of Mechanical and Civil Engineering

d) Applied Courses in Engineering/Technology

12. Basic Electrical Engineering
13. Analog Electronics
14. Electrical Instrumentation and Measurement
15. Electrical and Electronics Engineering Materials
16. Digital Electronics
17. Electrical Machine
18. PLC, Microcontroller and SCADA
19. Electrical Design, Drawing and Estimating
20. Power Plant Engineering
21. Transmission and Distribution of Electrical Power
22. Switchgear and Protection

23. Industrial Electronics and Control
24. Installation, Maintenance and Repair of Electrical Machines
25. Electrical Design, Drawing and Estimating
26. Utilization of Electrical Energy
27. Industrial Training
28. Project Work

e) Elective

29. Renewable Sources of Energy
30. Electric Traction
31. Control of Electrical Machine
32. Energy Management

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS

Sr. No.	Subjects	Distribution in Periods per week in Various Semesters					
		I	II	III	IV	V	VI
1.	Communication Skill	6	-	-	6	-	-
2.	Applied Mathematics	5	5	5	-	-	-
3.	Applied Physics	7	7	-	-	-	-
4.	Applied Chemistry	7	-	-	-	-	-
5.	Engineering Drawing	8	-	-	-	-	-
6.	Basics of Information Technology	6	-	-	-	-	-
7.	General Workshop Practice	8	8	-	-	-	-
8.	Basic Electrical Engineering	-	9	-	-	-	-
9.	Basics of Mechanical and Civil Engineering	-	7	-	-	-	-
10.	Analog Electronics	-	8	-	-	-	-
11.	Electrical Instrumentation and Measurement	-	-	10	-	-	-
12.	Electrical and Electronics Engineering Materials	-	-	6	-	-	-
13.	Digital Electronics	-	-	9	-	-	-
14.	Electrical Machine	-	-	10	-	13	-
15.	Environmental Studies	-	-	3	-	-	-
16.	PLC, Microcontroller and SCADA	-	-	-	-	12	-
17.	Electrical Design, Drawing and Estimating	-	-	-	11	-	13
18.	Power Plant Engineering	-	-	-	5	-	-
19.	Transmission and Distribution of Electrical Power	-	-	-	7	-	-
20.	Energy Conservation	-	-	-	5	-	-
21.	Industrial Management and Entrepreneurship Development	-	-	-	-	6	-
22.	Switchgear and Protection	-	-	-	-	6	-
23.	Industrial Electronics and Control	-	-	-	10	-	-
24.	Universal Human Values				3		
25.	Elective	-	-	-	-	6	-
26.	Installation, Maintenance and Repair of Electrical Equipment	-	-	-	-	-	12
27.	Utilization of Electrical Energy	-	-	-	-	-	5
28.	Applications of Computer Software in Electrical Engineering	-	-	-	-	-	2
29.	Project work	-	-	-	-	-	12
30.	Student Centred Activities	1	4	5	1	5	4
Total		**48**	**48**	**48**	**48**	**48**	**48**

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7. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	*Communication Skill-1	4	-	2	4	20	10	30	50	2 ½	20	3	70	100
1.2	*Applied Mathematics -1	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
1.3	*Applied Physics -1	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
1.4	*Applied Chemistry	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
1.5	*Engineering Drawing-I	-	-	8	2	40		40	60	3			60	100
1.6	*Basics of Information Technology	-	-	6	2	-	40	40	-	-	60	3	60	100
1.7	General Workshop Practice-1	-	-	8	2	-	40	40	-	-	60	4	60	100
#Student Centred Activities		-	-	1	1	-	30	30	-	-	-	-	-	30
Total		19	-	29	25	120	140	260	260	-	180	-	440	700

* Common with other diploma programmes

Student Centred Activities 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 self study etc.

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
2.1	*Applied Mathematics -II	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
2.2	*Applied Physics-II	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
2.3	Basic Electrical Engineering	5	-	4	5	20	10	30	50	2 ½	20	3	70	100
2.4	**Basics of Mechanical and Civil Engineering	5	-	2	5	20	10	30	50	2 ½	20	3	70	100
2.5	Analog Electronics	4	-	4	5	20	10	30	50	2 ½	20	3	70	100
2.6	General Workshop Practice-II	-	-	8	2	-	40	40	-	-	60	4	60	100
#Student Centred Activities		-	-	4	1		30	30	-	-	-	-	-	30
Total		24	-	24	27	100	110	210	250	-	140	-	390	600

* Common with other diploma programmes

** Common with diploma in Chemical Engg.

Student Centred Activities 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 self study etc.

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THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
3.1	*Applied Mathematics -III	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
3.2	Electrical Instrumentation and Measurement	6	-	4	6	20	20	40	50	2 ½	40	3	90	130
3.3	Electrical and Electronics Engineering Materials	6	-	-	5	20	-	20	50	2 ½	-	-	50	70
3.4	Digital Electronics	5	-	4	5	20	20	40	50	2 ½	40	3	90	130
3.5	Electrical Machine - I	6	-	4	6	20	20	40	50	2 ½	40	3	90	130
3.6	*Environmental Studies	3	-	2	3	20	10	30	50	2 ½	20	3	70	100
#Student Centred Activities including Energy Conservation Awareness		-	-	3	2		30	30	-	-	-	-	-	30
Total		31	-	17	31	120	100	220	300	-	140	-	440	660

* Common with other diploma programmes

Student Centred Activities 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 self study etc.

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FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	*Communication Skill- II	4	-	2	4	20	10	30	50	2 ½	20	3	70	100
4.2	Industrial Electronics and Control	5	1	4	6	20	20	40	50	2 ½	40	3	90	130
4.3	Electrical Design, Drawing and Estimating-I	3	-	8	5	20	20	40	50	3	40	4	90	130
4.4	Power Plant Engineering	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
4.5	Transmission and Distribution of Electrical Power	6	1	-	5	20	-	20	50	2 ½	-	-	50	70
4.6	*Energy Conservation	3	-	2	3	20	10	30	50	2 ½	20	3	70	100
4.7	Universal Human Values	2	-	1	1	-	20	20	-	-	30	3	30	50
# Student Centred Activities		-	-	1	1	-	30	30	-	-	-	-	-	30
Total		28	2	18	29	120	110	230	300	-	150	-	450	680

Note: Industrial Training for 4 weeks after fourth semester during summer vacation.

Student Centred Activities 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 self study etc.

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FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
-	Industrial Training	-	-	-	2	-			-	-	50	3	50	50
5.1	*Industrial Management and Entrepreneurship Development	5	-	-	4	20	-	20	50	2 ½	-	-	50	70
5.2	Switchgear andProtection	5	1	-	5	20	-	20	50	2 ½	-	-	50	70
5.3	PLC, Microcontroller and SCADA	6	-	6	7	20	35	55	50	2 ½	70	3	120	175
5.4	Electrical Machine – II	6	1	6	8	20	35	55	50	2 ½	70	3	120	175
5.5	**Elective	6	-	-	5	20	-	20	50	2 ½	-	-	50	70
#Student Centred Activities(SCA)		-	-	6	2	-	30	30	-	-	-	-	-	30
Total		28	2	18	33	100	100	200	250	-	190	-	440	640

* Common with other diploma programmes

** Elective (Any one out of the following)

5.5.1 Renewable Sources of Energy

5.5.2 Electric Traction

5.5.3 Control of Electrical Machine

5.5.4 Energy Management

Student Centred Activities 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 self study etc.

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	Installation, Maintenance and Repair of ElectricalEquipment	6	-	6	7	20	35	55	50	2 ½	70	3	120	175
6.2	Electrical Design, Drawing and Estimating II	5	-	8	7	20	20	40	50	3	40	4	90	130
6.3	Utilization of Electrical Energy	5	-	-	4	20	-	20	50	2.5	-	-	50	70
6.4	Application of Computer Software in Electrical Engineering	-	-	2	1	-	20	20	-	-	30	3	30	50
6.5	Project Work	-	-	12	5	-	50	50	-	-	100	3	100	150
#Student Centred Activities		-	-	4	2	-	30	30	-	-	-	-	-	30
Total		16	-	32	26	60	155	215	150	-	240	-	390	605

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

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8. GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 30 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

i. 10 Marks for general behavior and discipline
(by HODs in consultation with all the teachers of the department)

ii. 5 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)

a)	75 - 80%	2 Marks
b)	80 - 85%	4 Marks
c)	Above 85%	5 Marks

iii. 15 Marks maximum for Sports/NCC/Cultural/Co-curricular/ NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

a)	15	-	State/National Level participation
b)	10	-	Participation in two of above activities
c)	5	-	Inter-Polytechnic level participation

Note: There should be no marks for attendance in the internal sessional of different subjects.

1.1 COMMUNICATION SKILLS – I

L	T	P
4	-	2

RATIONALE

Knowledge of English Language plays 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 as parts of Communication Skill.

LEARNING OUTCOMES

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

.

- Understand the importance of effective communication
- Describe the process of communication
- Communicate effectively in different contexts
- Identify parts of speech
- Write correct sentences using appropriate vocabulary
- Reproduce and match words and sentences in a paragraph
- Write various types of paragraphs, notices for different purposes and composition on picture with appropriate format
- Read unseen texts with comprehension

.

DETAILED CONTENTS

1 Basics of Communication (13 periods)

1.1 Definition and process of communication
1.2 Types of communication - formal and informal, oral and written, verbal and non-verbal
1.3 Communications barriers and how to overcome them
1.4 Barriers to Communication, Tools of Communication

2 Application of Grammar (18 periods)

2.1 Parts of Speech (Noun, verb, adjective, adverb) and modals
2.2 Sentences and its types
2.3 Tenses
2.4 Active and Passive Voice
2.5 Punctuation
2.6 Direct and Indirect Speech

3 Reading Skill (10 periods)

Unseen passage for comprehension (one word substitution, prefixes, suffixes, antonyms, synonyms etc. based upon the passage to be covered under this topic)

4 Writing Skill (15 periods)

4.1 Picture composition
4.2 Writing paragraph
4.3 Notice writing

LIST OF PRACTICALS

Note: Teaching Learning Process should be focused on the use of the language in writing reports and making presentations.
Topics such as Effective listening, effective note taking, group discussions and regular presentations by the students need to be taught in a project oriented manner where the learning happens as a byproduct.

Listening and Speaking Exercises

1. Self and peer introduction
2. Newspaper reading
3. Just a minute session-Extempore
4. Greeting and starting a conversation
5. Leave taking
6. Thanking
7. Wishing well
8. Talking about likes and dislikes
9. Group Discussion
10. Listening Exercises.

INSTRUCTIONAL STRATEGY

Student should be encouraged to participate in role play and other student centred activities in class room and actively participate in listening exercises

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by RevathiSrinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; DhanpatRai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. Excellent General English-R.B.Varshnay, R.K. Bansal, Mittal Book Depot, Malhotra
5. The Functional aspects of Communication Skills – Dr. P. Prsad, S.K. Katria & Sons, New Delhi
6. Q. Skills for success – Level & Margaret Books, Oxford University Press.
7. E-books/e-tools/relevant software to be used as recommended by AICTE/UPBTE/NITTTR.

Websites for Reference:

1. http://www.mindtools.com/ page 8.html – 99k
2. http://www.letstalk.com.in
3. http://www.englishlearning.com
4. http://learnenglish.britishcouncil.org/en/
5. http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	13	24
2	18	32
3	10	16

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4	15	28
Total	**56**	**100**

1.2 APPLIED MATHEMATICS - I

L	T	P
5	-	-

RATIONALE

Contents of this course provide fundamental base for understanding elementary mathematics and their uses in solving engineering problems. Contents of this course will enable students to use basic mathematical function like logarithms, partial fractions, matrices and basic 2D, curves in solving various engineering problems of all fields.

LEARNING OUTCOMES

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

- Apply Binomial theorem to solve engineering problems
- Apply determinants properties and Crammer's rule to solve engineering problems
- Apply dot & cross product of vectors to find the solution of engineering problems
- Use complex numbers in various engineering problems
- Apply differential calculus and higher order to solve engineering problems
- Find velocity, acceleration, errors and approximation in engineering problems with application of derivatives.

DETAILED CONTENTS

1. Algebra -I (12 Periods)

   1.1 Series : AP and GP; Sum, nth term, Mean

   1.2 Binomial theorem for positive, negative and fractional index (without proof). Application of Binomial theorem.

   1.3 Determinants : Elementary properties of determinant of order 2 and 3, Multiplication system of algebraic equation, Consistency of equation, Crammer's rule

2. Algebra- II (12 Periods)

   2.1 Vector algebra : Dot and Cross product, Scaler and vector triple product.

   2.2 Complex number.
   Complex numbers, Representation, Modulus and amplitude Demoivre theorem, its application in solving algebraic equations, Mod. function and its properties..

3. Trigonometry (10 Periods)

3.1 Relation between sides and angles of a triangle : Statement of various formulae showing relationship between sides and angle of a triangle.

3.2 Inverse circular functions: Simple case only

4. Differential Calculus - I (18 Periods)

4.1 Functions, limits, continuity, - functions and their graphs, range and domain, elementary methods of finding limits (right and left), elementary test for continuity and differentiability.

4.2 Methods of finding derivative, Trigonometric functions, exponential function, Function of a function, Logaritimic differentiation, Differentiation of Inverse trigonometric function, Differentiation of implicit functions.

5. Differential Calculus - II (18 Periods)

5.1 Higher order derivatives, Leibnitz theorem (without proof). Simple applications.

5.2 Application - Finding Tangents, Normal, Points of Maxima/Minima, Increasing/Decreasing functions, Rate, Measure, velocity, Acceleration, Errors and approximation.

INSTRUCTONAL STRATEGY

The basic instructional strategy to teach basic mathematics, Binomial theorem, trigonometry, differential equations etc. should be conceptual with real world applications of relevant branch. More numerical and theory examples can be used for clear understanding of the content**.**

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3 Applied Mathematics-I by Chauhan and Chauhan, Krishna Publications, Meerut**.**

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4. Applied Mathematics-I (A) by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut

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SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	12	20
2.	12	20
3.	10	12
4	18	24
5	18	24
Total	**70**	**100**

1.3 APPLIED PHYSICS – I

L	T	P
5	-	2

RATIONALE

Applied physics includes the study of a diversified topics related to 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 behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this 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 learn and appreciate these concepts and principles. In all contents, SI units should be followed.

LEARNING OUTCOMES

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

- Identify the use of S.I. system of measurement with accuracy and how it is used in engineering
- Represent physical quantities as scalars and vectors, applying the physical laws and concepts of linear and circular motion in everyday life.
- Solve difficult problems (walking of man, horse and cart problem, flying of bird/ aircraft, etc.)
- Analyse and design banking of roads/railway tracks and apply conservation of momentum principle to Explain rocket propulsion, recoil of gun etc.
- Derive work, power and energy relationship and solve problems about work and power.
- Define work, energy and power and their units.
- Describe conservation of energy and its applications
- Understand the concept of rotational motion of a rigid body and its applications
- Apply the physical laws and concepts of gravity, its variation with longitude and latitude and its uses in space satellite etc. .
- Understand the concept of elasticity, surface tension, pressure and the laws governing movement of fluids.
- Express physical work in term of heat and temperature; Measure temperature in various processes on different scales (Celsius, Kelvin, Fahrenheit etc.)
- Distinguish between conduction, convection and radiation, identify the different methods for reducing heat losses
- Understand the laws of thermodynamics, Carnot cycle and their applications.

DETAILED CONTENTS

1. Units and Dimensions (10 Periods)

1.1 Need of Measurement in engineering and science, unit of a physical quantities - fundamental and derived units, systems of units (FPS, CGS and SI units)
1.2 Dimensions and dimensional formulae of physical quantities.
1.3 Principle of homogeneity of dimensions
1.4 Dimensional equations and their applications, conversion of numerical values of physical quantities from one system of units into another, checking the correctness of physical equations and deriving relations among various physical quantities
1.5 Limitations of dimensional analysis
1.6 Error in measurement, accuracy and precision of instruments, random and systematic errors, absolute error, relative error, and percentage error, Estimation of probable errors in the results of measurement (combination of errors in addition, subtraction, multiplication, division and powers), rules for representing significant figures in calculation.
1.7 Application of units and dimensions in measuring length, diameter, circumference, volume, surface area etc. of metallic and non metallic blocks, wires, pipes etc (at least two each).

2. Force and Motion (10 periods)

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 and its application to lawn roller.
2.4 Force, Momentum, Statement and Derivation of Conservation of linear momentum, its applications such as recoil of gun.
2.5 Impulse and its Applications
2.6 Circular motion (Uniform and Non-uniform), definition of angular displacement, angular velocity, angular acceleration, frequency, time period.
2.7 Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical)
2.8 Central force, Expression and Applications of Centripetal and centrifugal forces with examples such as banking of roads and bending of cyclist, Principle of centrifuge.
2.9 Application of various forces in lifts, cranes, large steam engines and turbines

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3. Work, Power and Energy (10 periods)

3.1 Work: and its units, examples of zero work, positive work and negative work, conservative and non-conservative force,
3.2 Friction: modern concept, types, laws of limiting friction, Coefficient of friction and its Engineering Applications.
3.3 Work done in moving an object on horizontal and inclined plane for rough and plane surfaces with its applications
3.4 Energy and its units: Kinetic energy and potential energy with examples and their derivation, work energy theorem.
3.5 Principle of conservation of mechanical energy for freely falling bodies, examples of transformation of energy.
3.6 Power and its units, calculation of power in numerical problems
3.7 Application of Friction in brake system of moving vehicles, bicycle, scooter, car trains etc.

4 Rotational Motion (10 periods)

4.1 Concept of translatory and rotatory motions with examples
4.2 Definition of torque with examples
4.3 Angular momentum, Conservation of angular momentum (quantitative) and its examples
4.4 Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid) (Formulae only). Concept of Fly wheel.
4.5 Rotational kinetic energy, Rolling of sphere on the slant plane
4.6 Comparison of linear motion and rotational motion.
4.7 Application of rotational motions in transport vehicles, and machines.

5 Motion of planets and satellites (08 periods)

5.1 Gravitational force, Kepler's law of planetary motion
5.2 Acceleration due gravity and its variation
5.3 Gravitational Potential and Gravitational potential energy
5.4 Motion of satellite, orbital velocity and time period of satellite, Total energy and Binding energy of a satellite, Escape energy and escape velocity

5.5 Types of satellites, Geo-stationary satellite, semi-synchronous, polar satellite (concept only) and their uses in science and technology

5.6 Concept of Black Holes

6. Properties of Matter (12 periods)

6.1 Elasticity: definition of stress and strain, different types of modulii of elasticity, Hooke's law, significance of stress strain curve

6.2 Pressure: definition, its units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications

6.3 Surface tension: concept, its units, angle of contact, Capillary action and determination of surface tension from capillary rise method, applications of surface tension, effect of temperature and impurity on surface tension

6.4 Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law and effect of temperature on viscosity, application in hydraulic systems.

6.5 Concept of fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem and their applications.

7. Heat and Thermodynamics (10 periods)

7.1 Difference between heat and temperature

7.2 Modes of transfer of heat (Conduction, convection and radiation with examples)

7.3 Different scales of temperature and their relationship

7.4 Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them

7.5 Heat conduction in a metal rod, Temperature gradient, Concept of Co-efficient of thermal conductivity, Uses and effects of Heat conduction in Daily life.

7.6 Isothermal and Adibatic process

7.7 Zeroth, First and second law of thermodynamics, Heat engine (concept Only), Carnot cycle.

7.8 Application of various systems of thermometry in refrigeration and air-conditioning etc.

LIST OF PRACTICALS

1 To find radius of wire and its volume and the maximum permissible error in these quantities by using both vernier calipers and screw gauge.

2 To find the value of acceleration due to gravity on the surface of earth by using a simple pendulum.

3 To determine the Radius of curvature of (i) convex mirror, (ii) concave mirror by spherometer

4 To verify parallelogram law of forces

5 To study conservation of energy of a ball or cylinder rolling down an inclined plane.
6 To find the Moment of Inertia of a flywheel about its axis of rotation
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 live 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 and animations can make the subject interesting and may develop scientific temper in the students. Teacher must plan a tour of Science Park/planetarium available in nearby areas in order to enhance the interest in this course.

MEANS OF ASSEMENTS

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Model Making,
- Actual Lab & Practical Work,
- VivaVoice

RECOMMENDED BOOKS

1 Text Book of Physics for Class XI (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 Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
4 B.Sc.Practical Physics by C L Arora, S. Chand Publication..
5 Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
6 Engineering Physics by DK Bhhatacharya & Poonam Tandan; Oxford University Press, New Delhi
7 Modern Engineering Physics by SL Gupta, Sanjeev Gupta, Dhanpat Rai Publications
8 V. Rajendran,physics-I, Tata McGraw-Hill raw Hill publication, New Delhi
9 Arthur Beiser, Applied Physics, Tata McGraw-Hill raw Hill publication, New Delhi
10 Physics Volume 1, 5th edition, Haliday Resnick and Krane, Wiley publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	15

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2	10	15
3	10	15
4	10	15
5	08	10
6	12	16
7	10	14
Total	**70**	**100**

1.4 APPLIED CHEMISTRY

L	T	P
5	-	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 engineers and technocrats to develop scientific temper and appreciate physical, chemical and engineering properties of materials. Hence the subject of Applied Chemistry.

LEARNING OUTCOMES

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

- Classify various substances based on state of aggregation
- Substantiate the laws and principles on which structure of atom is established.
- Explain and predict properties of substances.
- Explain sources of water and various characteristics of water (quantitatively).
- Explain cause and factors which can adversely affecting natural water quality and remedial measures available for water purification
- Think critically, develop and adapt water conservation techniques.
- Explain corrosion of metal and their preventive measures.
- explain chemical nature and causes of corrosion
- apply correct and efficient methods of corrosion prevention.
- explain chemistry of fuels and their relative advantages.
- select most efficient fuel for the engine and engineering applications.
- suggest how to subside air pollution caused by the use of fossil fuels

- explain the chemistry of various polymers and plastics
- verify suitability and select polymer/rubber/plastic materials for engineering applications.

DETAILED CONTENTS

1. Atomic Structure, Periodic Table and Chemical Bonding (14 periods)

    1.1 Fundamental particles- mass and charges of electrons, protons and neutrons with names of the scientists who discovered these fundamental particles.
    1.2 Bohr's model of atom and successes and limitations of atomic theory (qualitative treatment only).
    1.3 Atomic number, atomic mass number isotopes and isobars.
    1.4 Definition of orbit and orbitals, shapes of s and p orbitals only, quantum numbers and their significance,
    1.5 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).
    1.6 Modern periodic law and periodic table, groups and periods, classification of elements into s, p, d and f blocks (periodicity in properties - excluded)
    1.7 Chemical bonding and cause of bonding and types such as ionic bond in NaCl sigma (σ) and pi (π) covalent bonds in H_2, HCl, Cl_2, elementary idea of hybridization in $BeCl_2$, BF_3, CH_4, NH_3 and H_2O, VSEPR, Molecular orbital Theory
    1.8 States of Matter: Solid, Liquid & Gas, Metallic bonding- explanation with the help of electron gas (sea) model.

2. Fuelsand Lubricants (18 periods)

    2.1 Definition of fuel, classification of fuels, characteristics of good fuel, relative merits of gaseous, liquid and solid fuels
    2.2 Calorific value-higher calorific value, lower calorific value, determination of calorific value of solid or liquid fuel using Bomb calorimeter and numerical examples.
    2.3 Coal - types of coal and proximate analysis of coal
    2.4 Fuel rating – Octane number and Cetane number, fuel-structural influence on Octane and Cetane numbers
    2.5 Gaseous fuels – chemical composition, calorific value and applications of natural gas (CNG), LPG, producer gas, water gas and biogas.
    2.6 Elementary ideal on – hydrogen as future fuels, nuclear fuels.
    2.7 Lubricants: Definition and properties, mechanism, industrial application and its function in bearings.

2.8 Synthetic lubricants and cutting fluids.

3. Water (14 periods)

3.1 Demonstration of water resources on Earth using pie chart.

3.2 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 numerical, pH and buffer solutions and their applications.

3.3 Disadvantages caused by the use of hard water in domestic and boiler feed water. Primming and foaming and caustic embrittlement in boilers.

3.4 Removal of hardness -Permutit process and Ion-exchange process.

3.5 Physico-Chemical methods for Water Quality Testing

a) Determination of pH using pH meter, total dissolved solids (TDS)

b) Testing and Estimation of- alkalinity, indicator their types and application total hardness by EDTA method and O'Hener's Method. (chemical reaction of EDTA method are excluded).

c) Understanding of Indian Water Quality standards as per WHO

3.6 Natural water sterilization by chlorine and UV radiation and reverse osmosis.

3.7 Municipality waste water treatment. Definition of B.O.D and C.O.D.

4. Electrochemistry (4 periods)

Redox Reaction, Electrode Potential, Nernst equation, Electrochemical cell (Galvanic and Electrobytes); Nernst equation.

5. Corrosion and its Control (10 periods)

5.1 Definition of corrosion and factors affecting corrosion rate.

5.2 Theories of

a) Dry (chemical) corrosion- Pilling Bedworth rule

b) Wet corrosion in acidic atmosphere by hydrogen evolution mechanism

5.3 Definition of passivity and galvanic series

5.4 Corrosion control:

a) Metal coatings – Cathodic protection, Cementation on Base Metal Steel –Application of Metal Zn (Sheradizing),Cr (Chromozing) and Al (Calorizing), Sacrificial protection and impressed current voltage

b) Inorganic coatings – Anodizing and phosphating,

c) Organic coatings - use of paints varnishes and enamels

d) Internal corrosion preventive measures- alloying (with reference to passivating, neutralizing and inhibition) and heat treatment (quenching, annealing)

6. Organic compounds, Polymers and Plastics (10 periods)

6.1 Classification of organic compounds and IUPAC Nomenclature
6.2 Definition of polymer, monomer and degree of polymerization
6.3 Brief introduction to addition and condensation polymers with suitable examples (PE, PS, PVC, Teflon, Nylon -66 and Bakelite)
6.4 Definition of plastics, thermo plastics and thermo setting plastics with suitable examples, distinctions between thermo and thermo setting plastics
6.5 Applications of polymers in industry and daily life

LIST OF PRACTICALS

1. Estimation of total hardness of water using standard EDTA solution
   Estimation of total alkalinity of given water sample by titrating it against standard sulphuric acid solution
3. Proximate analysis of solid fuel)
4. Estimation of temporary hardness of water sample by O' Hener's Method.
5. Determination of flash and fire point of given lubricating oil using Able's flash point apparatus

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.

MEANS OF ASSEMENTS

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Model Making,
- Actual Lab & Practical Work,
- VivaVoice

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose & J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, Dhanapat Rai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.
5. Applied Chemistry - I by Dr. P. K Vij & Shiksha Vij, Lords Publications, Jalandhar.
6. Engineering Chemistry by Dr. Himanshu Pandey, Goel Publishing House, Meerut, India

SUGGESTED DISTRIBUTION OF MARKS

Topics	Time Allotted (hrs)	Marks Allotted (%)
1.	14	20
2.	18	24
3.	14	20
4.	4	6
5.	10	15
6.	10	15
Total	**70**	**100**

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1.5 ENGINEERING DRAWING - I

L	T	P
-	-	8

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 18 sheets to be prepared and atleast 2 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
- To make projections of Solid
- 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

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 1^{st} angle only
   4.5 Three views of orthographic projection of different objects. (At least one sheet in 3^{rd} angle)

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4.6 Identification of surfaces

5 Projection of Solid (02 sheets)

5.1. Definition and salient features of Solid
5.2. Types of Solid (Polyhedron and Solid of revolution)
5.3 To make projections, sources, Top view, Front view and Side view of various types of Solid.

6. Sections (02 sheets)

6.1 Importance and salient features
6.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.
6.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections
6.4 Orthographic sectional views of different objects.

7. Isometric Views (02 sheets)

7.1 Fundamentals of isometric projections and isometric scale.
7.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.

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

8.1 Civil Engineering sanitary fitting symbols
8.2 Electrical fitting symbols for domestic interior installations

*9. Introduction to AutoCAD (02 sheets)

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets on AutoCAD of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.

*** Auto CAD 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.

MEANS OF ASSESSMENT

- Sketches
- Drawing
- Use of software

RECOMMENDED BOOKS

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

1.6 BASICS OF INFORMATION TECHNOLOGY

L	T	P
-	-	6

RATIONALE

Information technology has great influence on all aspects of life. Primary purpose of using computer is to make the life easier. 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 tools using MS Office/Open Office/Libre Office using internet etc., form the broad competency profile of diploma holders. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

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.

LEARNING OUTCOMES

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

- Identify Computer Hardware Components, Network Components and Peripherals.
- Explain the role of an Operating System.
- Install System and Application Software.
- Explain the function of the system components including Processor, Motherboard and Input-output devices.
- Use Word Processing Software to prepare document.
- Use Spreadsheet Software to create workbooks and automate calculation.
- Use Presentation Software to create interactive presentation.
- Perform fundamental tasks common to most application software including print, scan, save, edit, cut, copy, paste, format, spell and grammar check.
- Find and evaluate information on the Web.
- Install Antivirus.
- Safeguard against Online Frauds, threats and crimes.
- Use online office tools(Google suits)

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Introduction to Computers and Peripherals.

   Components of Computer, Types of Computer, CPU, RAM, ROM, Hard disk, USB, Flash drive, CD, DVD,Blue ray, Keyboard, Mouse, Monitor, LCD, Printer, Plotter, Scanner, Modem, Sound Cards, Speakers, CMOS battery, Sharing of Printers.

2. Operation System and Application Software

   System Software, Application Software, Virtualization Software, Utility Software, MS Office/Open Office/Libreoffice, Working with window, Desktop components, Menu bars, creating shortcut of program. Installation of Application softwares, Antivirus and Drivers.

3. Word Processing, Spreadsheet and Presentation

   Usage and creation of word document, spreadsheets and presentation, Google Suits (Google drive, google sheet, google doc. Google presentation)

.

4. Internet

   Basics of Networking – LAN, WAN, Wi-Fi technologies, Concept of IP Addrsses, DNS, Search Engines, e-mail, Browsing and cyber laws.

LIST OF PRACTICAL EXERCISES

1. Identify various components, peripherals of computer and list their functions.
2. Installation of various application software and peripheral drivers
3. Installation of operating system (windows/linux/others)
4. Creation and Management (Rename, delete, search of file and folders)
5. Installation of Antivirus and remove viruses
6. Scanning and printing documents
7. Browsing, Downloading, Information using Internet
8. E-Mail ID creation, comparing, sending and receiving e-mail. Attaching a file with e-mail message.

. 9. Word Processing (MS Office/Open Office)

   a) File Management:
      - Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file

   b) Page set up:
      - Setting margins, tab setting, ruler, indenting

   c) Editing a document:
      - Entering text, cut, copy, paste using tool- bars

d) Formatting a document:
- Using different fonts, changing font size and colour, changing the appearance through bold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
- Aligning of text in a document, justification of document, inserting bullets and numbering
- Formatting paragraph, inserting page breaks and column breaks, line spacing
- Use of headers, footers: Inserting footnote, end note, use of comments, autotext
- Inserting date, time, special symbols, importing graphic images, drawing tools

e) Tables and Borders:
- Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
- Print preview, zoom, page set up, printing options
- Using find, replace options

f) Using Tools like:
- Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelops and lables
- Using shapes and drawing toolbar,
- Working with more than one window .

10. Spread Sheet Processing (MS Office/Open Office/Libre Office)

a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets

b) Menu commands:
Create, format charts, organise, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working

c) Work books:
Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations
Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting

d) Creating a chart:
Working with chart types, changing data in chart, formatting a chart, use chart to analyze data

Using a list to organize data, sorting and filtering data in list

e) Retrieve data with query:
Create a pivot table, customizing a pivot table. Statistical analysis of data

f) Exchange data with other application:
Embedding objects, linking to other applications, import, export document.

11. PowerPoint Presentation (MS Office/Open Office/Libre office)

a) Introduction to PowerPoint
- How to start PowerPoint
- Working environment: concept of toolbars, slide layout & templates.
- Opening a new/existing presentation
- Different views for viewing slides in a presentation: normal, slide sorter.

b) Addition, deletion and saving of slides

c) Insertion of multimedia elements
- Adding text boxes
- Adding/importing pictures
- Adding movies and sound
- Adding tables and charts etc.
- Adding organizational chart
- Editing objects
- Working with Clip Art

d) Formatting slides
- Using slide master
- Text formatting
- Changing slide layout
- Changing slide colour scheme
- Changing background
- Applying design template

12. Google Suits
Using Google drive, Google shut, Google docs, Google slides.

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/Libre office/Google Suit in addition to working on internet. The student should be made capable of working on computers independently.

MEANS OF ASSESSMENT

- Class Tests/Quiz
- Software Installation and Use
- Viva-Voce
- Presentation

RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Information Technology for Management by Henery Lucas, Tata McGraw Hills, New Delhi
3. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi
4. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
5. Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
6. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
8. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
9. On Your Marks - Net…Set…Go… Surviving in an e-world by Anushka Wirasinha, Prentice Hall of India Pvt. Ltd., New Delhi
10. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

Reference websites

1. www. tutorialspoint..com
2. www.sf.net
3. Gsuite.google.com
4. Spoken-tutorial.org
5. Swayam.gov.in

1.7 GENERAL WORKSHOP PRACTICE – I

(Common for Civil Engineering, Electrical Engineering and Chemical Engineering)

L	T	P
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RATIONALE

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

LEARNING OUTCOMES

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

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select proper tools for a particular operation.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment.

DETAILED CONTENTS

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1. Carpentry Shop
2. Painting and Polishing Shop
3. Electrical Shop
4. Welding Shop
5. Plumbing Shop

1. CARPENTRY SHOP

1.1 General Shop Talk

1.1.1 Name and use of raw materials used in carpentry shop : wood & alternative materials

1.1.2 Names, uses, care and maintenance of hand tools such as different types of Saws, C-Clamp, Chisels, Mallets, Carpenter's vices, Marking gauges, Try-squares, Rulers and other commonly used tools and materials used in carpentry shop by segregating as cutting tools, supporting tools, holding tools , measuring tools etc.

1.1.3 Specification of tools used in carpentry shop.

1.1.4 Different types of Timbers, their properties, uses & defects.

1.1.5 Seasoning of wood.

1.2. Practice

1.2.1 Practices for Basic Carpentry Work

1.2.2 Sawing practice using different types of saws

1.2.3 Assembling jack plane — Planning practice including sharpening of jack plane cutter

1.2.4 Chiselling practice using different types of chisels including sharpening of chisel

1.2.5 Making of different types of wooden pin and fixing methods. Marking measuring and inspection of jobs.

1.3 Job Practice

Job 1	Marking, sawing, planning and chiselling and their practice
Job II	Half Lap Joint (cross, L or T – any one)
Job III	Mortise and Tenon joint (T-Joint)
Job IV	Dove tail Joint (Lap or Bridle Joint)

1.4. Demonstration of job showing use of Rip Saw, Bow saw and Tenon saw, method of sharpening various saws.

2. PAINTING AND POLISHING SHOP

2.1. Introduction of paints, varnishes, Reason for surface preparation, Advantages of Painting, other method of surface coating ie. Electroplating etc.

2.2. Job Practice

Job 1: To prepare a wooden surface for painting apply primer on one side and to paint the same side. To prepare french polish for wooden surface and polish the other side.

Job II: To prepare metal surface for painting, apply primer and paint the same.
Job III: To prepare a metal surface for spray painting, first spray primer and paint the same by spray painting gun and compressor system.

The sequence of polishing will be as follows:

i) Abrasive cutting by leather wheel
ii) Polishing with hard cotton wheel and with polishing material
iii) Buffing with cotton wheel or buff wheel.

3. ELECTRICAL SHOP

3.1 Study, 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.

3.2 Study of electrical safety measures and protective devices.

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

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

3.3 Study of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc.

3.4 Introduction to the construction of lead acid battery and its working.

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

3.5 Introduction to battery charger and its functioning.

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

4. WELDING SHOP

4.1 Introduction and importance of welding as compared to other material joining processes. Specifications and type of welding machines, classification and coding of electrodes, welding parameters, welding joints and welding positions. Materials to be welded, safety precautions.

4.2 Job Practice

Job I	Practice of striking arc (Minimum 4 beads on 100 mm long M.S. flat).
Job II	Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level).
Job III	Preparation of lap joint using arc welding process.
Job IV	Preparation of T-joint using gas welding or arc welding on 100 mm x 6 mm MS Flat

5. PLUMBING SHOP

5.1. Use of personal protective equipments, safety precautions while working and cleaning of shop.

5.2. Introduction and demonstration of tools, equipment and machines used in plumbing shop.

5.3. Introduction of various pipes and pipe fittings of elbow, nipple, socket, union etc.

5.4. Job Practice

Job 1 : Preparation of job using elbow, bend and nipple

Job II: Preparation of job using Union, Tap, Plug and Socket.

Job III: Threading practice on pipe with die

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

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

2.1 APPLIED MATHEMATICS - II

L	T	P
5	-	-

RATIONALE

Basic elements of integral calculus, differential calculus, numerical methods, differential m equations included in this course will play a vital role in understanding engineering problem mathematically. This will also develop analytical as well as conceptual abilities among students.

LEARNING OUTCOMES

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

- Calculate simple integration by methods of integration
- Evaluate the area under curves, surface by using definite integrals.
- Calculate the area and volume under a curve along areas
- Solve the engineering problems with numerical methods.
- Understand the geometric shapes used in engineering problems by co-ordinate geometry.

DETAILED CONTENTS

1. Integral Calculus - I (20 Periods)

Methods of Indefinite Integration

1.1 Integration by substitution.
1.2 Integration by rational function.
1.3 Integration by partial fraction.
1.4 Integration by parts.
1.5 Integration of special function

2. Integral Calculus - II (20 Periods)

2.1 Meaning and properties of definite integrals, Evaluation of definite integrals.
2.2 Application : Length of simple curves, Finding areas bounded by simple curves Volume of solids of revolution, centre of mean of plane areas.
2.3 Simposns 1/3rd and Simposns3/8th rule and Trapezoidal Rule : their application in simple cases. Numerical solutions of algebraic equations; Bisections method, Regula-Falsi method, Newton-Raphson's method(without proof), Numerical solutions of simultaneous equations; Gauss elimination method(without proof)

3. Co-ordinate Geometry (2 Dimension) (18 Periods)

3.1 Circle
Equation of circle in standard form. Centre - Radius form, Diameter form, Two intercept form.

4. Co-ordinate Geometry (3 Dimension) (12 Periods)

4.1 Straight lines and planes in space
Distance between two points in space, direction cosine and direction ratios, Finding equation of a straight line (without proof)

INSTRUCTONAL STRATEGY

Basic elements of Differential Calculus, Integral Calculus and differential equations can be taught conceptually along with real engineering applications in which particular algorithm and theory can be applied. Numerical examples will be helpful in understanding the content of the subject.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3 Applied Mathematics-II by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-I (B) by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	20	28
2.	20	28
3.	18	24
4	12	20

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Total	**70**	**100**

2.2 APPLIED PHYSICS – II

L	T	P
5	-	2

RATIONALE

Applied physics includes the study of a diversified topics related to 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 behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this 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 learn and appreciate these concepts and principles. In all contents, SI units should be followed.

LEARNING OUTCOMES

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

- Define wave motion its types (Transverse and Longitudinal), Periodic and Simple Harmonic Motion, solve simple problems.
- Define the terms: frequency, amplitude, wavelength, velocity of a wave.
- Explain various Engineering, Medical and Industrial applications of Ultrasonics.
- Apply acoustics principles to various types of buildings to get best sound effect
- Explain diffraction, interference, polarization.
- Define capacitance and its unit. They will be able to explain the function of capacitors in simple circuits, solve simple problems using C=Q/V
- Explain the role of free electrons in insulators, conductors and semiconductors, qualitatively the terms: potential, potential difference, electromotive force.
- Explain the concept of electric current, resistance and itsmeasurement.
- List the effects of an electric current and their common applications, State and apply Ohm's law, calculate the equivalent resistance of a variety of resistor combinations, determine the energy consumed by an appliance, distinguish between AC and DC electricity
- Explain Biot-Savart Law, Ampere’s law, Lorenz Force.
- State the laws of electromagnetic induction, describe the effect on a current-carrying conductor when placed in a magnetic field
- Explain operation of moving coil galvanometer, simple DC motor

- Apply the knowledge of diodes in rectifiers, adapters IC's and various electronic circuits. Apply the concept of light amplification in designing of various LASER based instruments and optical sources.
- Explain total internal reflection and apply this concept for optical fibre and its uses in Medical field and Communication.

DETAILED CONTENTS

1. Wave motion and its applications (12 periods)

   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 Wave equation y = r sin wt, phase, phase difference, principle of superposition of waves

   1.3 Simple Harmonic Motion (SHM): definition and characteristic, expression for displacement, velocity, acceleration, time period, frequency in S.H.M., Energy of a body executing S. H. M., simple pendulum, concept of simple harmonic progressive wave,

   1.4 Free, Damped and forced oscillations, Resonance with examples, Q-factor

   1.5 Definition of pitch, loudness, quality and intensity of sound waves, intensity level, Echo and reverberation, Sabine formula for reverberation time(without derivation), coefficient of absorption of sound, methods to control reverberation time and their applications, Accoustics of building defects and remedy.

   1.6 Ultrasonics –production, detection, properties and applications in engineering and medical applications.

2. Wave Optics (6 periods)

   2.1 Dual nature of light, wave theory of light, laws of reflection and refraction, Snell's law, Power of lens, magnification.

   2.2 Two-Source Interference, Double-Slit interference, Interference due to thin films, Fresnel's biprism.

   2.3 use of interference making highly efficient solar panel.

   2.4 diffraction, Single Slit diffraction, Intensity calculation etc

   2.5 Polarization of electromagnetic waves, polarizing sheets, polarizing by Reflection (Brewser's law), Malus law, use of polariods.

3. Electrostatics (12 periods)

3.1 Concept of charge, Coulombs law, Electric field of point charges, Electric lines of force and their properties, Electric flux, Electric potential and potential difference.

3.2 Gauss law of electrostatics: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.

3.3 Capacitor and its working principle, Capacitance and its units. Capacitance of parallel plate capacitor. Series and parallel combination of capacitors (numericals), charging and discharging of a capacitor.

3.4 Dielectric and its effect on capacitance, dielectric break down.

3.5 Application of electrostatics in electrostatic precipitation of microbes and moisture separation from air and gases in industry for pollution control (Brief explanation only)

4. Current Electricity (12 periods)

4.1 Electric Current, Resistance, Specific Resistance, Conductance, Specific Conductance, Series and Parallel combination of Resistances. Factors affecting Resistance, Colour coding of carbon Resistances, Ohm's law. Superconductivity.

4.2 Kirchhoff's laws, Wheatstone bridge and its applications (meter bridge and slide wire bridge)

4.3 Concept of terminal potential difference and Electro motive force (EMF), potentiometer.

4.4 Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy

4.5 Examples of application of DC circuits in various electrical and electronics equipment such as C.R.O, T.V., Audio-Video System, Computers etc.

5. Magneto Statics and Electromagnetism (12 periods)

5.1 Magnetic poles, force on a moving charge, circulating charges, force on a current carrying wire, Hall effect, torque on a current loop.

5.2 Magnetic field due to moving charge(Biot-Savart Law), due to current (Biot-Savart Law), parallel currents, field of a solenoid, Ampere's law.

5.3 Faraday's law, Lenz' law, motional emf, induced electric fields.

5.4 Magnetic dipole and force on a magnetic dipole in a non-uniform field, Magnetization, Gauss' law for magnetism.

5.5 Types of magnetic materials. Dia, para and ferromagnetic materials with their properties,

5.6 Application of electromagnetism in ac/dc motors and generators.

6. Semiconductor physics (8 periods)

6.1 Types of materials (insulator, semi conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction diode and its V-I characteristics
6.2 Diode as rectifier – half wave and full wave rectifier (centre taped),
6.3 Semiconductor transistor, pnp and npn (concepts only)
6.4 Application of semiconductor diodes (Zener, LED) and that of transistor as amplifier and oscillator.

7. Modern Physics (8 Periods)

7.1 Lasers: concept of energy levels, ionizations and excitation potentials; spontaneous and stimulated emission; laser and its characteristics, population inversion, Types of lasers; Ruby and He-Ne lasers, engineering and medical applications of lasers.
7.2 Fibre optics: Total internal reflection and its applications, Critical angle and conditions for total internal reflection, introduction to optical fibers, light propagation, types, acceptance angle and numerical aperture, types and applications of optical fibre in communication.
7.3 Introduction to nanotechnology, nanoparticles and nano materials,

LIST OF PRACTICALS (To perform minimum six experiments)

1. To determine the velocity of sound with the help of resonance tube.
2. To find the focal length of convex lens by displacement method.
3. To find the refractive index of the material of given prism using spectrometer.
4. To find the wavelength of sodium light using Fresnel's biprism.
5. To verify laws of resistances in series and parallel combination
6. To verify ohm's laws by drawing a graph between voltage and current.
7. To measure very low resistance and very high resistances using Slide Wire bridge
8. Conversion of Galvanometer into an Ammeter and Voltmeter of given range.
9. To draw hysteresis curve of a ferromagnetic material.
10. To draw characteristics of a pn junction diode and determine knee and break down voltages.
11. To find wave length of the laser beam.
12. To find numerical aperture of an optical fiber.

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live 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 and animations can make the subject interesting and may

develop scientific temper in the students. Teacher must plan a tour of Science Park/planetarium available in nearby areas in order to enhance the interest in this course.

MEANS OF ASSESSMENT

- Assignment & Quiz
- Mid-Term and End-Term written test
- Model Making
- Actual Lab & Practical Work
- Viva-Voice

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. A Text Book of Optics, Subramanian and Brij Lal, S Chand & Co., New Delhi
4. Practical Physics, by C. L. Arora, S Chand publications
5. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
6. Modern Engineering Physics by SL Gupta, Sanjeev Gupta, Dhanpat Rai Publications.
7. Physics Volume 2, 5th edition, Haliday Resnick and Krane, Wiley publication
8. Fundamentals of Physics by Haliday, Resnick & Walker 7th edition, Wiley publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	12	18
2	6	8
3	12	18
4	12	16
5	12	16
6	8	12
7	8	12
Total	**70**	**100**

2.3. BASIC ELECTRICAL ENGINEERING

L	T	P
5	-	4

RATIONALE

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

LEARNING OUTCOMES

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

- **Identify and able to take readings on various electrical equipments(voltmeter, ammeter, CRO, wattmeter, multi-meter)**
- **Determination of voltage-current relationship in a DC circuit under specific physical conditions**
- **Measure resistance of an ammeter and a voltmeter**
- **Verify DC circuits (Thevenin, Nortons, Superposition theorem, Maximum Power Transfer Theorem)**
- **Verify Kirchhoff's Current and Voltage Laws in a dc circuit**
- **Find the ratio of inductance of a coil having air-core and iron-core respectively and to observe the effect of introduction of a magnetic core on coil inductance**
- **Test a lead - acid storage battery**
- Measure power and power factor in a single phase R-.L-.C. Circuit and calculation of active and reactive powers in the circuit.
- Measure voltages and currents in polyphase a.c. circuits for star ard delta connections.

DETAILED CONTENTS

1. Overview of DC Circuits (08 periods)

   1.1 Definition of basic terms, such as current, EMF, Potential Difference (PD); Ohm's Law and its limitations; Factors affecting resistors and capacitors; simple problems on series and parallel combinations of resistors with their wattage considerations.

   1.2 Application of Kirchhoff's current law and Kirchhoff's voltage law to simple circuits. Star – Delta connections and their conversion.

2. DC Circuit Theorems (06 periods)

Superposition principle, Maximum Power Transfer Theorem, Thevenin's theorem, Norton's theorem, application of network theorems in solving D.C. circuit problems.

3. Voltage and Current Sources (04 periods)

3.1 Concept of voltage source, symbol and graphical representation characteristics of ideal and practical sources.
3.2 Concept of current sources, symbol, characteristics and graphical representation of ideal and practical current sources.
3.3 Inter Conversion of Voltage-Source and Current Source.

4. Electro Magnetic Induction (10 periods)

4.1 Concept of electro-magnetic field produced by flow of electric current, magnetic circuit, concept of magneto-motive force (MMF), flux, reluctance, permeability, analogy between electric and magnetic circuit.\
4.2 Faraday's laws of electro-magnetic induction, principles of self and mutual induction, self and mutually induced e.m.f, simple numerical problems.
4.3 Concept of current growth, decay and time constant in an inductive (RL) circuit.
4.4 Energy stored in an inductor, series and parallel combination of inductors.

5. Batteries (08 periods)

5.1 Basic idea of primary and secondary cells
5.2 Construction, working principle and applications of Lead-Acid, Nickel-Cadmium and Silver-Oxide batteries
5.3 Charging methods used for lead-acid battery (accumulator)
5.4 Care and maintenance of lead-acid battery
5.5 Series and parallel connections of batteries
5.6 General idea of solar cells, solar panels and their applications
5.7 Introduction to maintenance free batteries

6. AC Fundamentals (10 periods)

6.1 Concept of alternating quantities
6.2 Difference between ac and dc
6.3 Concepts of: cycle, frequency, time period, amplitude, instantaneous value, average value, r.m.s. value, maximum value, form factor and peak factor.
6.4 Representation of sinusoidal quantities by phasor diagrams.
6.5 Equation of sinusoidal wave form for an alternating quantity and its derivation

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

7. AC Circuits (18 periods)

7.1 Concept of inductive and capacitive reactance
7.2 Alternating voltage applied to resistance and inductance in series.
7.3 Alternating voltage applied to resistance and capacitance in series.
7.4 Introduction to series and parallel resonance and its conditions
7.5 Power in pure resistance, inductance and capacitance, power in combined RLC circuits. Power factor, active and reactive power and their significance, definition and significance of power factor.
7.6 Definition of conductance, susceptance, admittance, impedance and their units
7.7 Introduction to polyphase a.c. systems, advantages of polyphase system over single phase system. Relations between line and phase value of voltages and currents for star and delta connections and their phasor diagram, power in polyphase circuits.

8. Various Types of Power Plants (06 periods)

8.1 Brief explanation of principle of power generation practices in thermal, hydro and nuclear power stations and their comparative study. A Visit to a nearby Power Station(s) may be organized for better understanding and exposure.
8.2 Elementary block diagram of above mentioned power stations

LIST OF PRACTICALS

1. Operation and use of measuring instruments viz voltmeter, ammeter, CRO, Wattmeter, multi-meter and other accessories
2. Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions.
3. Measurement of resistance of an ammeter and a voltmeter
4. Verification of dc circuits:
   a. Thevenin's theorem,
   b. Norton's theorem,
5. Observation of change in resistance of a bulb in hot and cold conditions, using voltmeter and ammeter.
6. Verification of Kirchhoff's Current and Voltage Laws in a dc circuit
7. To find the ratio of inductance of a coil having air-core and iron-core respectively and to observe the effect of introduction of a magnetic core on coil inductance
8. Charging and testing of a lead - acid storage battery.
9. Measurement of power and power factor in a single phase R-.L-.C. circuit and calculation of active and reactive powers in the circuit.

10 Verification of line to line and line to neutral voltages and current in star and delta connections.

Note: Visit to a nearby Power Station(s) may be arranged to demonstrate various aspects of subject

INSTRUCTIONAL STRATEGY

Basic electrical engineering being a fundamental subject, it needs to be handled very carefully and in a manner such that students develop clear understanding of the related concepts and principles. The teacher may lay more emphasis on laboratory work and give home assignments to students to inculcate self-study and problem solving abilities amongst them.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Presentation
- Model Making

RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhogal, Tata Mc Graw-Hill Education Pvt Ltd., New Delhi.
2. Experiments in Basic Electrical Engineering by SK Bhattacharya, KM Rastogi; New Age International (P) Ltd.; Publishers New Delhi.
3. Electrical Technology by BL Theraja, S Chand and Co, New Delhi.
4. Basic Electrical Engineering by JB Gupta; SK Kataria and Sons, New Delhi.
5. Basic Electrical Engineering by Asfaque Husain, Jain Book Depot, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	08	11
2.	06	09
3.	04	06
4.	10	14
5.	08	11
6.	10	14
7.	18	26
8	06	09
Total	**70**	**100**

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2.4 BASICS OF MECHANICAL AND CIVIL ENGINEERING

L	T	P
5	-	2

RATIONALE

Apart from the common core subjects, some engineering subjects are included in the diploma course of electrical engineering. One of these subjects is Elementry Mech. Engg. to impart some necessary knowledge and skill about mechanical nature. Inclusion of the subject is further justified by the fact that in practical field, any job of electrical and civil technician is intermingled with either civil or mechanical engineering. As such the relevant basic topics of these disciplines are included in the content of the subject.
Some study exercises along with some field work have been suggested to give feel of jobs and equipments involved.

LEARNING OUTCOMES

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

- Apply Thermodynamics Laws.
- Use of various energy sources.
- Solve basics problems related to fuel and combustion.
- Have an idea of loading on machine components.
- Explain the application of different types of bearings.
- Explain the uses of different types of gears and springs.
- Explain the working principle of different lubrication systems.

SECTION A - MECHANICAL ENGINEERING

DETAILED CONTENTS

1. Thermal Engineering (14 periods)

1.1 Sources of Energy

Definition, Concept of thermodynamic system and surroundings, Closed system, Open system, Isolated system, Thermodynamics definition of work.Zeroth law of thermodynamics

Basic ideas, conventional and nonconventional forms- Thermal, Hydel, Tidal, wind, Solar, Biomass and Nuclear and their uses.

1.2 Fuels & Combustion:

Combustion of fuels- their higher and lower calorific values. Combustion equations for carbon, sulphur, hydrogen and their simple compounds. Calculation of minimum amount of air required for complete combustion. Combustion analysis n mass basis and on volume basis. Concept of excess air in a boiler furnace combustion. Heat carried away by flue gases. Analysis of flue gases by Orsat apparatus. Simple numerical problems

Idea of specific properties of liquid fuels such as detonation, knock resistance (cetane and octane numbers), viscosity, solidification point, flash point and flame point.

2. Machine Components (20 periods)

Brief idea of loading on machine components.

(i) Pins, Cottor and Knuckle Joints.

(ii) Keys, Key ways and spline on the shaft.

(iii)Shafts, Collars, Cranks, Eccentrics.

(iv) Couplings and Clutches.

(v) Bearings-Plane, Bushed, Split-step, ball, Roller bearing, Journal bearing, Foot step bearing, thrust bearing, collar bearing and Special type bearings and their applications.

(vi) Gears

Different types of gears, gear trains and their use for transmission of motion. Determination of velocity ratio for spur gear trains; spur gear, single and double helical gears, Bevel gears, Mitre wheel, worms, Rack and Pinion. Simple and compound and epicyclic gear trains and their use. Definition of pitch and pitch circle & module.

(vii) Springs

Compression, Tension, Helical springs,Torsion springs, Leaf and Laminated springs. Their use and material.

3. Lubrication (08 periods)

Different lubrication system for lubricating the components of machines.

Principle of working of wet sump and dry sump system of lubrication. (Explain with simple line diagram). Selection of lubricant based on different application (Requirement with the help of manufacturer catalogue).

SECTION B : CIVIL ENGINEERING

4. Construction Materials (06 periods)

Properties and uses of various construction materials such as stones, bricks, lime, content and timber with their properties, physical/field testing, elements of brick masonry.

5. Foundations (08 periods)

5.1 Bearing capacity of soil and its imporance

5.2 Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines.

6. Concrete (08 periods)

Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/field testing of concrete, mixing of concrete, placing and curing of concrete..

7. RCC (06 periods)

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building.

Note: While imparting instructions, teachers are expected to lay more emphasis on concepts and principles. It will be better if the classes for general engineering are conducted by organized demonstrations for explaining various concepts and principles.

LIST OF PRACTICALS

1. Study and Sketch of Pins and Cottor
2. Study and Sketch of Keys and Key ways
3. Study and sketch of Couplings andClutches
4. Study and Sketch of Bearings
5. Study and Sketch of Springs
6. Study of green energy
7. Testing of bricks
   a) Shape and size
   b) Soundness test
   c) Water absorption

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d) Crushing strength

8 Testing of concrete
   a) Slump test
   b) Compressive Strength of concrete cube

9 The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on basic principles and use charts in class, visits to labs and industry may be arranged to demonstrate certain materials and practices.

MEANS OF ASSESSMENT

- Sessional Tests
- End term Tests
- Practicals
- Viva-Voce

RECOMMENDED BOOKS

1. Textbook of Concrete Technology 2nd Edition, by Kulkarni, PD Ghosh TK and Phull, YR; New Age International(P) Ltd, Publishers, New Delhi
2. Materials of Construction by Ghosh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
3. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. Concrete Technology by J.Jha and Sinha; Khanna Publishers, Delhi
5. Building Construction by Jha and Sinha; Khanna Publishers, Delhi
6. Building Construction by Vairani and Chandola; Khanna Publishers, Delhi
7. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, New Delhi
8. Soil Mechanics and Foundation Engineering by SK Garg; Khanna Publishers, New

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	14	20
2.	20	28
3.	08	12
4	06	08

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5	08	12
6	08	12
7	06	08
Total	**70**	**100**

2.5 ANALOG ELECTRONICS

L	T	P
4	-	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 function and applications. This understanding should facilitate in operation and maintenance equipment, which are electronically controlled.

In this course, topics like semi-conductor Diodes, Bipolar transistors, rectifiers, single stage and multistage amplifiers and field effect transistors have been included.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Use P.N. junction as rectifier
- Use Zener diode as voltage stabilizer
- Use bi-polar transistors and its application as an amplifier and as a switch
- Analyse amplifier and enhance the gain of amplifier
- Use unipolar transistors as amplifier
- Identify and testing of various active and passive components such as resistor, inductor, capacitor, diode and transistor

DETAILED CONTENTS

1. Semiconductor Diodes (12 periods)

    1.1 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. Concept of junction capacitance in forward and reverse biased conditions. Breakdown mechanism

    1.2 Ideal diode, Semiconductor diode characteristics, static and dynamic resistance

1.3 Use of diode as half wave and full wave rectifiers (centre tapped and bridge type), relation between DC output and AC input voltage, efficiency of rectifier
1.4 Concept of ripples, filter circuits – shunt capacitor, series inductor, and pie (π) filters and their applications
1.5 Diode ratings/specifications
1.6 Various types of diodes such as zener diode, varactor diode, schottky diode, light emitting diode, tunnel diode, photo diode; their working characteristics and applications
1.7 Zener diode and its characteristics
1.8 Use of zener diode for voltage stabilization

2 Bi-polar Transistors (06 periods)

2.1 Concept of junction transistor, PNP and NPN transistors, their symbols and mechanism of current flow
2.2 Transistor configurations: common base (CB), common emitter (CE) and common collector (CC), current relation and their input/output characteristics; comparison of the three configurations

3. Transistor Biasing and Stabilization (10 periods)

3.1 Transistor biasing, its need, operating point, effect of temperature on the operating point of a transistor and need of stabilization of operating point.
3.2 Different biasing circuits, limitations, simple problems to calculate operating point in different biasing circuits. Use of Thevenin's theorem to determine operating point
3.3 Concept of h-parameters of a transistor
3.4 Use of data book to know the parameters of a given transistor

4. Single-Stage Transistor Amplifiers (10 periods)

4.1 Single stage transistor amplifier circuit in CE configuration, function of each component
4.2 Working of single stage transistor amplifier, physical and graphical explanation, phase reversal
4.3 Concept of DC and AC load line
4.4 Voltage gain of single stage transistor amplifier using characteristics of the device
4.5 Concept of input and output impedance
4.6 AC equivalent circuit of single stage transistor amplifiers
4.7 Calculation of voltage gain using AC equivalent circuit
4.8 Frequency response of a single stage transistor amplifier

5. Multi-Stage Transistor Amplifiers (10 periods)

5.1 Need of multi-stage transistor amplifiers – different types of couplings, their purpose and applications.
5.2 Knowledge of various terms such as voltage gain, current gain, power gain, frequency response, decibel gain and band width
5.3 RC coupled two-stage amplifiers, circuit details, working, frequency response, applications
5.4 Loading effect in multistage amplifiers
5.5 Elementary idea about direct coupled amplifier, its limitations and applications
5.6 Transformer coupled amplifiers, its frequency response. Effect of co-efficient of coupling on frequency response. Applications of transformer coupled amplifiers

6. Field Effect Transistor (FET) (08 periods)

6.1 Construction, operation, characteristics and applications of a N channel JFET and P channel JFET
6.2 JFET as an amplifier
6.3 Types, construction, operation, characteristics and applications of a MOSFET
6.4 Comparison between BJT, JFET and MOSFET

LIST OF PRACTICALS

1. a) Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor and different types of switches used in Electronic circuits
   b) Measurement of resistances using multimeter and their comparison with colour code values
2. To plot V-I characteristics of a Semiconductor diode and to calculate its static and dynamic resistance
3. a) To plot V-I characteristics of a zenor diode and finding its reverse breakdown voltage
   b) Fabrication of a zenor diode voltage stabilizer circuit using PCB
4. Observation of input and output wave shapes of a half-wave rectifier and verification of relationship between dc output and ac input voltage
5. Observation of input and output wave shapes of a full wave rectifier and verification of relationship between dc and ac input voltage
6. Observation of input and output wave shapes of a full wave rectifier with (i) shunt capacitor) (ii) series inductor (iii) Π filter circuits
7. Plotting input and output characteristics of a transistor in CB configuration
8. Plotting input and output characteristics of a transistor in CE configuration

9. 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.

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.

MEANS OF ASSESSMENT

- Assignments and quiz/class Tests
- Midterm and End-term tests
- Laboratory and Practical work
- Presentations
- Viva-Voce

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuit by NN Bhargava, Kulshreshta and SC Gupta, Tata McGraw Hill Education Pvt Ltd, New Delhi.
2. Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
3. Electronics Devices and Circuits by Millman and Halkias; McGraw Hill.
4. Electronic Devices and Circuits by Dharma Raj Cheruku and Battula Tirumala Krishna: Pearson Education (Singapore) Pvt Ltd., Indian Branch, 482 F.I.E Patparganj, Delhi- 92
5. Basic Electronics by JB Gupta, SK Kataria and Sons, New Delhi
6. Electronics Devices and circuit by Boylested, Tata McGraw Hill, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	12	21
2	06	11
3	10	18
4	10	18
5	10	18

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6	08	14
Total	**56**	**100**

2.6 GENERAL WORKSHOP PRACTICE –II

(Common for Civil Engineering, Electrical Engineering and Chemical Engineering)

L	T	P
-	-	8

RATIONALE

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

LEARNING OUTCOMES

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

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select proper tools for a particular operation.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment.

DETAILED CONTENTS (PRACTICAL EXERCISES)

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1 Fitting Shop
2 Sheet Metal Shop
3 Mason Shop
4 Machine Shop

1. FITTING SHOP

1.1 Use of personal protective equipment and safety precautions while working.
1.2 Basic deburring processes.
1.3 Introduction to fitting shop tools, marking and measuring devices/equipment.
1.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminium etc.)
1.5 Identification of various steel sections (flat, angle, channel, bar etc.).
1.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing).
1.7 Job Practice

Job I Marking of job, use of marking tools, filing and use of measuring instruments. (Vernier caliper, Micrometer and Vernier height gauge).
Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of ±.25 mm.
Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping
Job IV Drilling and tapping practice on MS Flat.

2. SHEET METAL SHOP

2.1. Introduction to sheet metal shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.
2.2 Introduction and demonstration of hand tools used in sheet metal shop.
2.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine,
2.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.
2.5 Study of various types of nuts, bolts, rivets, screws etc.
2.6 Job Practice

Job I: Shearing practice on a sheet using hand shears.
Job II: Practice on making Single riveted lap joint/Double riveted lap Joint.
Job III :Practice on making Single cover plate chain type, zig-zag type and single rivetted Butt Joint.

3 MASON SHOP

3.1. Introduction and importance of Mason shop

3.2. Introduction of tools, equipment and machines used in Mason shop

3.3. Job Practice

Job I : Preparation of simple bond

Job II : Preparation of Arched bond

Job III: Preparation of RCC structure (column and beam)

4 MACHINE SHOP

4.1 Study and sketch of lathe machine

4.2 Study and Sketch of grinders, milling machine, drilling machine and CNC machine.

4.3 Plain and step turning and knurling practice.

4.4 Study and sketch of planning/shaping machine and to plane a rectangle of cast iron.

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

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

3.1 APPLIED MATHEMATICS –III

L	T	P
5	-	-

RATIONALE

Contents of this course provide understanding of some elementary and advanced mathematics algorithms and their applications of solving engineering problems. Content of this course will enable students to use some advanced techniques like Beta-Gamma function, Fourier series, Laplace transform and probability distributions in solving complex engineering problems.

LEARNING OUTCOMES

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

- Understand matrix operations and uses of matrix in different problems.
- Apply elementary row and column operations in finding inverse of a matrix.
- Find Eigen values, Eigen vectors of a matrix and their different properties.
- Understand degree/order of differential equations and their solution techniques.
- Use differential equations in engineering problems of different areas.
- Find Fourier series expansion of a function
- Apply Laplace transform and their applications in solving engineering problems.
- Understand concept of probability distribution and their applications.

DETAILED CONTENTS

1. Matrices (16 Periods)

1.1 Algebra of Matrices, Inverse
Addition, Multiplication of matrices, Null matrix and a unit matrix, Square matrix, Symmetric, Skew symmetric, Hermitian, Skew hermition, Orthagonal, Unitary, diagonal and Triangular matrix, Determinant of a matrix.
Definition and Computation of inverse of a matrix.

1.2 Elementry Row/Column Transformation
Meaning and use in computing inverse and rank of a matrix.

1.3 Linear Dependence, Rank of a Matrix
Linear dependence/independence of vectors, Definition and computation of rank of matrix. Computing rank through determinants, Elementary row transformation and through the concept of a set of independent vectors, Consistency of equations.

1.4 Eigen Pairs, Cayley-Hamilton Theorem

Definition and evaluation of eign values and eign vectors of a matrix of order two and three, Cayley-Hamilton theorem (without Proof)and its verification, Use in finding inverse and powers of a matrix.

2. Differential Calculus (15 Periods)

2.1 Function of two variables, identification of surfaces in space, conicoids

2.2 Partial Differentiation

Directional derivative, Gradient, Use of gradient f, Partial derivatives, Chain rule, Higher order derivatives, Euler's theorem for homogeneous functions, Jacobians.

2.3 Vector Calculus

Vector function, Introduction todouble and triple integral,differentiation and integration of vector functions, gradient, divergence and curl, differential derivatives.

3. Differential Equation (15 Periods)

3.1 Formation, Order, Degree, Types, Solution

Formation of differential equations through physical, geometrical, mechanical and electrical considerations, Order, Degree of a differential equation, Linear, nonlinear equation.

3.2 First Order Equations

Variable seperable, equations reducible to seperable forms, Homogeneous equtions, equations reducible to homogeneous forms, Linear and Bernoulli form exact equation and their solutions.

3.3 Higher Order Linear Equation :

Property of solution, Linear differential equation with constant coefficients (PI for $X= e^{ax}$, Sinax, Cosax, X^n, $e^{ax}V$, XV

3.4 Simple Applications

LCR circuit, Motion under gravity, Newton's law of cooling, radioactive decay, Population growth, Force vibration of a mass point attached to spring with and without damping effect. Equivalence of electrical and mechanical system

4. Integral Calculus-II (12 Periods)

4.1 Beta and Gamma Functions

Definition, Use, Relation between the two, their use in evaluating integrals.

4.2 Fourier Series

Fourier series of f(x),-n<x<n, Odd and even function,Half range series.

4.3 Laplace Transform

Definition, Basic theorem and properties, Unit step and Periodic functions, inverse laplace transform, Solution of ordinary differential equations

5. Probability and Statistics (12 Periods)

5.1 Probability
Introduction, Addition and Multiplication theorem and simple problem.

5.2 Distribution
Discrete and continuous distribution, Bionimal Distribution, Poisson distribution, Normal Distribution.

INSTRUCTONAL STRATEGY

The content of this course is to be taught on conceptual basis with plenty of real world examples. The basic elements of Laplace transform, Differential equations and Applications of differential equations can be taught with engineering applications of relevant branch.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3 Applied Mathematics-III by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-II by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	16	24
2.	15	20
3.	15	20
4	12	18
5	12	18
Total	**70**	**100**

3.2 ELECTRICAL INSTRUMENTATION AND MEASUREMENT

L	T	P
6	-	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 he performs the duties of installation, operation, maintenance and testing by measuring instruments. Persons working on control panels in power plants, substations and in industries 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:

- Connect and repair different indicating and recording instruments in electric circuits
- Measure different electrical quantities like current, voltage, power, energy, power factor, frequency etc.
- Select the type and range of instruments to be used for the job
- Operate CT (Current Transformer) and PT (Potential Transformer) for measurement
- Select and use suitable sensors for measurements of different non-electrical quantities
- Use instruments for measuring different electrical quantities
- Use sensors for measuring non electrical quantities
- Operate on smart metering system in industry

DETAILED CONTENTS

1. Introduction to Electrical Measuring Instruments: (05 Periods)

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

2. Ammeters and Voltmeters (Moving coil and moving iron type) (06 Periods)

   2.1 Concept of ammeter 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. Wattmeters (Dynamometer Type) (06 Periods)

   Construction, working principle, merits and demerits of dynamometer type wattmeter, Digital wattmeters.

4. Energymeter (10 Periods)

   4.1 Induction Type: Construction, working principle, merits and demerits of single-phase and three-phase energy meters
   4.2 Errors and their compensation
   4.3 Simple numerical problems
   4.4 Construction and working principle of maximum demand indicators

   4.5 Digital energy meter (diagram, construction and application)

5. Miscellaneous Measuring Instruments: (18 Periods)

   5.1 Construction, working principle and application of Meggar, Earth tester(analog and digital) Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter)
   5.2 Instrument Transformers: Construction, working and applications
   a) CT

b) PT

6. Electronic Instruments: (06 Periods)

6.1 Cathode Ray Oscilloscope: Block diagram, working principle of CRO and its various controls. Applications of CRO.
6.2 Digital multi-meter (only block diagram) and Applications

7. LCR meters. (04 Periods)

Study of LCR meters and their applications

8. Power Measurements in 3-phase circuits by (04 Periods)

8.1 Two wattmeter method in balanced and unbalanced circuits and simple problems
8.2 Three wattmeter method

9. Transducers (10 Periods)

Introduction, Types of Transducers (1 phase,3 phase)

Basic concept of pressure measurement, flow measurement, level measurement, displacement measurement using transducers

10. Measurement of Temperature (09 Periods)

Different types of thermometers, thermocouple, resistance temperature detector and their construction, principle and working. Thermal Imager Camera (Concept)

11. Smart Metering System (06 Periods)

AMI (Advance Metering Infrastructure), Functions of AMI, cyber Security, Advantages
Smart Meter Technology: AMR (Automatic Metering Reading), inverse/reverse metering system in solar power plant, MRI (Meter Reading Instrument)

LIST OF PRACTICALS

1. Use of analog and digital multimeter for measurement of voltage, current (A.C/D.C) and resistance
2. Measurement of pressure by using LVDT

3. To measure the value of earth resistance using earth tester.
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 and power factor of a three-phase balanced load by two wattmeter method.
6. Measurement of voltage and frequency of a sinusoidal signal using CRO and draw wave shape of signal.
7. Measurement of power in a 3 phase circuit using CT, PT and 3-phase wattmeter.
8. Use of LCR meter for measuring inductance, capacitance and resistance.
9. To record all electrical quantities from the meters installed in the institution premises.
10. To measure Energy at different Loads using Single Phase Digital Energy meter
11. Measurement of temperature by using thermister/Thermal Imager
12. Calibration of single phase and three-phase energy meter and digital energy meter

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical Measurements and Measuring Instruments by Golding and Widdis; Wheeler Publishing House, New Delhi
2. Electrical Measurements and Measuring Instruments by SK Sahdev, Uneek International Publications, Jalandhar
3. A Course in Electrical Measurement and Measuring Instruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi
4. Electric Instruments by D. Cooper
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
6. Electronics Instrumentation by Umesh Sinha, Satya Publication, New Delhi
7. Basic Electrical Measurements by Melville B. Staut.
8. Electrical Measurement and Measuring Instruments by JB Gupta, SK Kataria and Sons, New Delhi
9. Electrical Measurement and Measuring Instruments by ML Anand, SK Kataria and Sons, New Delhi
10. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	05	06
2	06	08
3	06	08
4	10	12
5	18	20
6	06	08
7	04	04
8	04	04
9	10	12
10	09	10
11	06	08
Total	**84**	**100**

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3.3 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

L	T	P
6	-	-

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 and electronic 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 electrical and electronics engineering materials/component
- Select proper conducting material for a particular application
- Select a proper insulating material for a particular application
- Suggest an alternate material if proper material is not available
- Procure various electrical and electronics engineering material available in the market
- Select proper magnetic material for a particular application
- Make use of engineering material used for fabrication of particular electrical machine
- Select gaseous material for particular application

DETAILED CONTENTS

1. Classification (10 Periods)

   Classification of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. Conducting Materials (12 Periods)

   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
   2.3.1 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.

2.3.2 Aluminium:
General properties as conductor: resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications in the field of electrical engineering.

2.3.3 Steel:
Mechanical properties of steel, applications in the field of electrical engineering.

2.3.4 Introduction to bundle conductors and its applications.

2.3.5 Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), their practical applications with reasons for the same

2.4 Applications of special metals e.g. Silver, Gold, 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. Review of Semi-conducting Materials (12 Periods)

Semi-conductors and their properties, Materials used for electronic components like resistors, capacitors, diodes, transistors and inductors etc.

4. Insulating materials; General Properties: (10 Periods)

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

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

4.3 Thermal Properties:
Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics

4.4 Chemical Properties:
Solubility, chemical resistance, weatherability

4.5 Mechanical properties, mechanical structure, tensile structure

5. Insulating Materials and their applications: (10 Periods)

5.1 Plastics

5.1.1 Definition and classification

5.1.2 Thermosetting materials:
Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Melamine-formaldehyde), epoxy resins - their important properties and applications

5.1.3 Thermo-plastic materials:
Polyvinyl chloride (PVC), polyethylene, silicones, their important properties and applications

5.2 Natural insulating materials, properties and their applications

- Mica and Mica products
- Asbestos and asbestos products
- Ceramic materials (porcelain and steatite)
- Glass and glass products
- 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

5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF- their properties and applications

6. Magnetic Materials: (10 Periods)

6.1 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.

6.2 Soft Magnetic Materials:

6.2.1 Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines

6.2.2 Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine

6.2.3 Nickel-iron alloys

6.2.4 Soft Ferrites

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

7. Special Materials (10 Periods)

Thermocouple, bimetals, leads soldering and fuses material and their applications, thermistor, sensistor, varistors and their practical applications.

8. Materials for Electrical Machines (10 Periods)

Introduction to various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc

INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components 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 electronic gadgets etc .and be encouraged to do practical work independently and confidently.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi
2. Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi
3. Electrical Engineering Materials by Sahdev, Uneek International Publications, Jalandhar
4. Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi
5. Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi
6. Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi
7. Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City
8. Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi
9. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

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SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1.	10	12
2.	12	14
3.	12	14
4.	10	12
5.	10	12
6.	10	12
7.	10	12
8.	10	12
Total	**84**	**100**

3.4 DIGITAL ELECTRONICS

L	T	P
5	-	4

RATIONALE

Digital electronics has made extremely rapid advances in the last five decades. It has important applications in communication entertainment, instrumentation, control, automation etc. Thus it appears that there is no end to its usefulness. In fact, the light and the new world belong to it. So it is necessary to give the knowledge of digital electronics to the electrical students. Microprocessor is one of the most exciting technological advancement among the semiconductor devices in recent times. It has a tremendous impact on the Industrial processes due to its high reliability, flexibility and control capacity both at the design and the Implementation stages. The decreasing cost with increasing facilities act as catalysts in widening their scope of applications.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Add, multiply, subtract binary to hexa decimal number system
- Use 1's and 2's compliment method for addition and subtraction
- Draw the symbols of various gates and write the truth tables for those gates
- Use boolean laws for the simplification of logical expressions
- Use the de-morgan's theorem for simplification
- Apply K-map technique for simplifications
- Apply half adder, full adder, encoder, decoder, multiplexer and demultiplexer
- Use various flip-flops in digital circuits
- Use converted from A/D and D/A conversions
- Use various types of numbers in digital circuits

DETAILED CONTENTS

1. Number Systems (10 Periods)

   1.1 Decimal, binary, octal and hexa-decimal number systems and their inter-conversion
   1.2 Binary and Hexadecimal addition, subtraction and multiplication
   1.3 1's and 2's complement methods of addition/subtraction

2. Gates (08 Periods)

Definition, symbol and truth tables for inverter, OR, AND, NAND, NOR and X-OR exclusive-AND gates

3. Boolean Algebra (12 Periods)

3.1 Boolean Relations and their applications
3.2 DeMorgan's Theorems
3.3 K-Map upto four variables

4. Combinational Circuits (12 Periods)

4.1 Half adder, Full adder
4.2 Encoder, Decoder
4.3 Multiplexer/Demultiplexer
4.4 Display Devices (LED, LCD and 7-segment display)

5. Flip-Flops (09 Periods)

5.1 J-K Flip-Flop
5.2 R-S Flip-Flop
5.3 D-Type Flip-Flop
5.4 T-Type Flip-Flop
5.5 Applications of Flip-Flops

6. Introduction of Shift Registers and Counters (08 Periods)

7. A/D and D/A Converters (06 Periods)

7.1 A/D converter (Counter ramp, successive approximation method of A/D Conversion)
7.2 D/A converters (Binary weighted, R-2R D/A Converter)

8. Semi-conductor Memories (05 Periods)

8.1 Types of semi-conductor memories: RAM, ROM, EPROM, EEPROM
8.2 Static and dynamic RAM
8.3 Merits, demerits, and applications

LIST OF PRACTICALS

1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, X-OR gates
2. Construction of Half Adder using gates
3. Construction of Full Adder using gates
4. To verify the truth table for JK flipflop

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5. Construction and testing of any counter
6. Verification of operation of a 8-bit D/A Converter

INSTRUCTIONAL STRATEGY

The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing), A/D, D/A converters and other Topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. More emphasis while teaching this subject should be given on practical aspects along with the theory input. Lots of programming exercises may be given to the students. Mini projects based on microprocessor operations may be identified and given to students as assignments.

RECOMMENDED BOOKS

1. Modern Digital Electronics by RP Jain, Tata McGraw Hill, Education Pvt. Ltd. New Delhi
2. Digital Principles and Electronics by Malvino and Leach, Tata McGraw Hill, New Delhi
3. Digital Electronics by SN Ali
4. Digital Electronics by Rajive Sapra, Eshan Publications, Ambala City
5. Digital Fundamentals by Floyd and Jain , Pearsons Education (Singapore) Pte Ltd Patparganj, Delhi 110092
6. Digital Electronics by Jamwal, Dhanpat Rai and Co. New Delhi
7. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	10	15
2.	08	12
3.	12	16
4.	12	16
5.	09	14
6.	08	12
7.	06	08
8.	05	07
Total	**70**	**100**

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3.5 ELECTRICAL MACHINES - I

L	T	P
6	-	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 undergoing the subject, students will be able to:

- Operate and maintain D.C. Generator
- Operate and maintain D.C. shunt, series and compound motors
- Execute speed control on D.C. Motors
- Select which type of D.C. motor suits a particular job
- Connect and use single phase transformer
- Operate auto transformers
- Conduct open CKT and short CKT tests on a single phase transformer
- Test polarity of windings of a three phase transformer and connect windings in various configurations
- Operate and maintain three phase transformers

DETAILED CONTENTS

1. Introduction to Electrical Machines (20 Periods)

    1.1 Definition of motor and generator
    1.2 Torque development due to alignment of two fields and the concept of torque angle
    1.3 Electro-magnetically induced emf
    1.4 Elementary concept of an electrical machine
    1.5 Comparison of generator and motor
    1.6 Generalized theory of electrical machines

2. DC Machines (25 Periods)

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 emf
2.4 Factors determining the electromagnetic torque
2.5 Various types of DC generators
2.6 Significance of back e.m.f., the relation between back emf and Terminal voltage
2.7 Armature Reaction
2.8 Methods to improve commutation
2.9 Performance and characteristics of different types of DC motors
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 Electric Braking
2.13 Applications of DC motors
2.14 Faults in dc machines and their retrospective
2.15 Losses in a DC machine
2.16 Determination of losses by Swinburne's test
2.17 Rating and Specifications of DC machines

3. Single Phase Transformer (25 Periods)

3.1 Introduction
3.2 Constructional features of a transformer and parts of transformer
3.3 Working principle of a transformer
3.4 EMF equation
3.5 Transformer on no-load and its phasor diagram
3.6 Transformer – neglecting voltage drop in the windings – Ampere turn balance – its phasor diagram
3.7 Mutual and leakage fluxes, leakage reactance
3.8 Transformer on load, voltage drops and its phasor diagram
3.9 Equivalent circuit diagram
3.10 Relation between induced emf and terminal voltage, voltage regulation of a transformer- mathematical relation
3.11 Losses in a transformer
3.12 Open circuit and short circuit test. Calculation of efficiency, condition for maximum efficiency-maintenance of Transformer, scheduled Maintenance
3.13 Auto transformer construction, working and applications
3.14 Different types of transformers including dry type transformer.
3.15 Rating and Specifications of single phase transformer

4. Three Phase Transformer (14 Periods)

4.1 Construction of three phase transformers and accessories of transformers such as Conservator, breather, Buchholtz Relay, Tap Changer (off load and on load) (Brief idea)
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, phase and line 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
4.8 Rating and Specifications of three phase transformers

LIST OF PRACTICALS

1. To measure the angular displacement of rotor of the three phase synchronous machine with respect to the stator on application of DC to the field winding and simultaneously to each phase-winding in sequence
   OR
   Measurement of the angular displacement of the rotor of a slip-ring induction motor on application of DC to stator of motor winding in sequence and simultaneously to each phase of rotor winding
2. Speed control of DC shunt motor (i) Armature control method (ii) Field control method
3. Study of DC series motor with starter (to operate the motor on no load for a moment)
4. Determine efficiency of DC motor by Swinburne's Test at (i) rated capacity (ii) half full load
5. To perform open circuit and short circuit test for determining: (i) equivalent circuit (ii) the regulation and (iii) efficiency of a transformer from the data obtained from open circuit and short circuit test at full load
6. To find the efficiency and regulation of single phase transformer by actually loading it.
7. Checking the polarity of the windings of a three phase transformer and connecting the windings in various configurations
8. Finding 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 configuring conditions.

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.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, Education Pvt Ltd. New Delhi
2. Electrical Machine by B.L. Thareja, S. Chand Publication, New Delhi.
3. Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi
5. Electrical Machines by JB Gupta, SK Kataria and Sons, New Delhi
6. Electrical Machines by Smarajit Ghosh-Pearson Publishers, Delhi.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

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SUGGESTED DISTRIBUTION OF MARKS

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1.	20	10
2.	25	35
3.	25	35
4.	14	20
Total	**84**	**100**

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3.6 ENVIRONMENTAL STUDIES

L	T	P
3	-	2

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

LEARNING OUTCOMES

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

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain 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.
- Analyze the impact of human activities on the environment

DETAILED CONTENTS

1. Introduction (04 Periods)

   1.1 Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.

2. Air Pollution (04 Periods)

   2.1 Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.

3. Water Pollution (08 Periods)

   3.1 Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O_2, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

4. Soil Pollution (06 Periods)

   4.1 Sources of soil pollution

4.2 Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
4.3 Effect of Solid waste
4.4 Disposal of Solid Waste- Solid Waste Management

5. Noise pollution (06 Periods)

Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.

6. Environmental Legislation (08 Periods)

Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).

7. Impact of Energy Usage on Environment (06 Periods)

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

LIST OF PRACTICALS

1. Determination of pH of drinking water
2. Determination of TDS in drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil
10. Determination of N&P (Nitrogen & Phosphorus) of soil
11. To measure the noise level in classroom and industry.
12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies

like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests,
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	10
2	04	10
3	08	20
4	06	14
5	06	14
6	08	20
7	06	12
Total	**42**	**100**

4.1 COMMUNICATION SKILLS – II

L	T	P
4	-	2

RATIONALE

Knowledge of English Language plays 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 as parts of Communication Skill.

LEARNING OUTCOMES

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

- Frame correct sentences with illustrations
- Comprehend the language correctly
- Interpret the language correctly
- Use given material in new situations.
- Correspond effectively using various types of writings like letters, memos etc.
- Communicate effectively in English with appropriate body language making use of correct and appropriate vocabulary and grammar in an organised set up and social context.

DETAILED CONTENTS

1. Functional Grammar (16 periods)
   - 1.1 Prepositions
   - 1.2 Framing Questions
   - 1.3 Conjunctions
   - 1.4 Tenses

2 Reading (16 periods)

- 2.1 Unseen Passage for Comprehension (Vocabulary enhancement - Prefixes, Suffixes, one word substitution, Synonym and Antonym) based upon the passage should be covered under this topic.

3 Writing Skill (24 periods)

- 3.1 Correspondence

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a) Business Letters- Floating Quotations, Placing Orders, Complaint Letters.
b) Official Letters- Letters to Government and other Offices

3.2 Memos, Circular, Office Orders
3.3 Agenda & Minutes of Meeting
3.4 Report Writing

LIST OF PRACTICALS

Note: Teaching Learning Process should be focused on the use of the language in writing reports and making presentations.
Topics such as Effective listening, effective note taking, group discussions and regular presentations by the students need to be taught in a project oriented manner where the learning happens as a byproduct.

Speaking and Listening Skills

1. Debate
2. Telephonic Conversation: general etiquette for making and receiving calls
3. Offering- Responding to offers.
4. Requesting – Responding to requests
5. Congratulating
6. Exploring sympathy and condolences
7. Asking Questions- Polite Responses
8. Apologizing, forgiving
9. Complaining
10. Warning
11. Asking and giving information
12. Getting and giving permission
13. Asking for and giving opinions

INSTRUCTIONAL STRATEGY

Students should be encouraged to participate in role play and other student-centered activities in class rooms and actively participate in listening exercises

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by RevathiSrinivas; Abhishek Publications, Chandigarh.
2 Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3 High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

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Websites for Reference:

1. http://www.mindtools.com/ page 8.html – 99k
2. http://www.letstalk.com.in
3. http://www.englishlearning.com
4. http://learnenglish.britishcouncil.org/en/
5. http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	28
2	16	28
3	24	44
Total	**56**	**100**

4.2 INDUSTRIAL ELECTRONICS AND CONTROL

L	T	P
5		14

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 Engineering 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 this subject, it has been incorporated in the curriculum.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Use Power diode with load R and R-L.
- Use SCR, TRIAC and Diac as per requirement of circuit
- Control fan speed using Triac and Quadriac
- Control speed of D.C. shunt motor or universal motor
- Demonstrate the output wave shape on CRO
- Repair UPS and Inverter
- Maintain storage batteries
- Maintain panels used in the modern control process

DETAILED CONTENTS

1. Introduction to SCR (18 Periods)

1.1 Power diode characteristics, application of general purpose diode, fast recovery diode and Schottkey diode, use in R, RL series circuit.
1.2 Construction and working principles of an SCR, two transistor analogy and characteristics of SCR
1.3 SCR specifications and rating
1.4 Construction, working principles and V-I characteristics of DIAC, TRIAC and Quadriac
1.5 Basic idea about the selection of heat sinks for SCR and TRIACS
1.6 Methods of triggering a Thyristor. Study of triggering circuits
1.7 UJT, its Construction, working principles and V-I characteristics, UJT relaxation oscillator
1.8 Commutation of Thyristors
1.9 Series and parallel operation of Thyristors
1.10 Applications of SCR, TRIACS and Quadriac such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger etc.
1.11 dv/dt and di/dt protection of SCR.

2. Controlled Rectifiers (12 Periods)

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
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. Inverters, Choppers, Dual Converters and Cyclo Convertors (24 Periods)

3.1 Inverter-introduction, working principles, voltage and current driven series and parallel inverters and applications
3.2 Choppers-introduction, types of choppers and their working principles and applications
3.3 Dual converters-introduction, working principles and applications
3.4 Cyclo-converters- introduction, types, working principles and applications

4. Thyristor Control of Electric Drives (18 Periods)

4.1 DC drives control (Basic Concept)
4.2 Half wave drives
4.3 Full wave drives
4.4 Chopper drives
4.5 AC drives control
4.6 Phase control
4.7 Variable frequency a.c. drives
4.8 Constant V/F application
4.9 Voltage controlled inverter drives
4.10 Constant current inverter drives
4.11 Cyclo convertors controlled AC drives
4.12 Slip control AC drives

5 Uninterrupted power supplies (12 Periods)

5.1 UPS online, off line
5.2 Storage devices (batteries)
5.3 SMPS, CVT

LIST OF PRACTICALS

1. To draw V-I characteristics of an SCR
2. To draw V-I characteristics of a TRIAC
3. To draw V-I characteristics of a DIAC

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4. To draw uni-junction transistor characteristics
5. Observe the output wave of an UJT relaxation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC Quadriac (fabrication of this circuit)
8. Speed-control of a DC shunt motor or universal motor
9. To observe the output wave shape on CRO of
   (a) Single phase half controlled full wave rectifier
   (b)Single phase controlled rectifier

INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. The available video films on the subject must be shown to the students.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests.
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

BOOKS RECOMMENDED

1. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell, Macmillan International editions.
2. Fundamentals of Power Electronics by S Rama Reddi, Narosa Publishing House Pvt. Ltd, New Delhi
3. Power Electronics, Circuits Devices and Applications by Mohammad H. Rashid
4. Power Electronics by PC Sen
5. Power Electronics by Dr. PS Bhimbra, Khanna Publishers, New Delhi
6. Industrial Electronics & Control by SK Bhattacharya & S Chatterji, New Age international Publications(P) Ltd, New Delhi
7. Power Electronics by SK Sahdev, Uneek Publication, Jalandhar
8. Industrial Power Electronics by JC Karhava, King India Publication,
9. Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi
10. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

Websites for Reference:

http://swayam.gov.in

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1.	18	20
2.	12	15
3.	24	25
4.	18	20
5.	12	20
Total	**84**	**100**

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4.3 ELECTRICAL DESIGN, DRAWING AND ESTIMATING - I

L	T	P
3	-	8

RATIONALE

A diploma holder in Electrical Engineering is supposed to have ability to read, understand and interpret engineering drawings and communicate through sketches and drawings. He is also expected to prepare working drawings of panels, transmission and distribution. The contents of this subject has 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
- Recognize various electrical devices placed on the panels/distribution boards and to design the panels
- Recognize the internal details of various electrical machines and devices
- Read schematic and wiring diagrams of electrical devices
- Read and interpret electrical installation plan
- Communicate about circuits and devices through sketches and drawings
- Determine various types of wiring systems and their use
- Practice and execute any type of wiring
- Estimate and determine the cost of wiring installation
- Estimate the material required for HT and LT lines
- Prepare a tender document for a particular job
- Estimate the material required for pole-mounted sub-stations

DETAILED CONTENTS (To make 16 Sheets)

1. Symbols and Signs Conventions (2 Sheets)

   Various Electrical Symbols used in Domestic and Industrial Installation and Power System (Generation, Transmission and Distribution including Sub-stations) as per BIS Code.

2. Wiring Diagram

   2.1. Wiring diagram of light, fan, bell and alarm circuits. (6 Sheets)
   2.2. Staircase and godown wiring
   2.3 Traffic light signal control circuit at crossroads

3. Panels/Distribution Boards (6 Sheets)

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

4. Orthographic projections of Simple Electrical Parts (8 Sheets)

- Bus bar post/ Kit Kat
- Pin type and shackle type insulator (Pin Type 11kV/66kV)
- Bobbins of a small transformer / choke
- Stay insulators/Suspension type insulators
- Rotor of a squirrel cage induction motor
- Motor body (induction motor) as per IS Specifications (using outside dimensions)
- Slip rings of 3-phase induction Motor.
- Stator of 3 phase Induction motor (Sectional View)

5. Prepare atleast 2 wiring diagram and block diagrams for circuits/systems using any Engineering Graphic package (preferably CAD) (4 Sheets)

6. Introduction to Estimating & Costing (04 periods)

Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, preparation of tender document (with 2-3 exercises), net rice list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills.

7. Types of Wiring (04 periods)

Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial). 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)

8. Estimating and Costing (18 periods)

8.1 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)

8.2 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 of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the light load (3-phase supply system)

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8.3 Service line connections estimate for domestic and industrial loads (over-head and underground connections) from pole to energy meter.

9. Estimating Materials Required (12 Periods)

9.1 Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

9.2 Substation:Types of substations, substation schemes and components, estimate of 11/0.4 kV pole mounted substation up to 200 kVA rating, earthling of substations, single Diagram of 66 kV/11 kV, 132KV/11KV, 220KV/33KV Substation

9.3Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

10. Preparation of Tender Documents (04 Periods)

Tender – constituents, finalization, specimen tender.
Procedure to take financial loans from banks for taking contracts.

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.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Sketching
- Design and Drawing
- Workshop Job
- Model prototype making

LIST OF PRACTICALS

1. Framing of Tender and reply to tender to get job/project
2. Identification of wiring for different applications
3 Prepare an estimate for a Two room residential building as per given plan
4 Prepare an estimate for service connection for residential building having connected load

RECOMMENDED BOOKS

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1. Electrical Engineering Design and Drawings by Surjeet Singh, Dhanpat Rai and Co, New Delhi
2. Electrical Engineering Design and Drawings by SK Bhattacharya, SK Kataria and Sons, New Delhi
3. Electrical Engineering Design and Drawings by Ubhi& Marwaha, IPH, New Delhi
4. Electrical Design and Drawing by SK Sahdev, Uneek Publications, Jalandhar
5. Electrical Engineering Drawing by Surjit Singh, SK Kataria and Sons, New Delhi
6. Electrical Installation, Estimating and Costing by JB Gupta, SK Kataria and Sons, New Delhi
7. Estimating and Costing by SK Bhattacharya, Tata McGraw Hill, New Delhi
8. Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., New Delhi
9. Estimating and Costing by Praveen Kumar; North Publication, Jalandhar
10. Estimating and Costing by SL Uppal, Khanna Publishers, New Delhi
11. Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, New Delhi
12. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

Websites for Reference:

http://swayam.gov.in

4.4 POWER PLANT ENGINEERING

L	T	P
5	-	-

RATIONALE

The majority of the diploma passouts who get employment in State Electricity Boards have to perform various activities in the field of generation, transmission and distribution of electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, transmission and distribution networks 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 to keep them abreast 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 required for a particular area and environment
- Calculate effective cost generation
- Explain the working of various plants for power generation

DETAILED CONTENTS

1. Power Generation (06 Periods)

   1.1 Main resources of energy, conventional and non-conventional
   1.2 Different types of power stations-thermal, hydro, gas, diesel and nuclear power stations, comparison of generating stations.

2. Thermal Station (10 Periods)

   Main parts and working of stations-thermodynamic cycles, fuel handling, combustion and combustion equipment, problem of ash disposal, circulating water schemes and supply of make up water, choice of pressure of steam generation and steam temperature, selection of appropriate vaccum; economizer, air pre-heater feed water heaters and dust collection. Characteristics of turbo alternators, steam power plant heat balance and efficiency.

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3. Hydro-Electric Plant (8 Periods)

Hydrology, stream flow, hydrograph, flow duration curves. Types of hydroelectric plants and their fields of use, capacity calculations for hydropower, Dams, head water control, penstrocks, water turbines, specific speeds, turbine governors. Hydroplant auxiliaries, plant layout, automatic and remote control of hydroplants, pumped storage projects, cost of hydro-electric projects. Cooling of alternators.

4. Nuclear Power Plant (9 Periods)

Elements of nuclear power plant, nuclear reactor, fuels, moderators, coolants, control. Classification of nuclear power stations. Cost of nuclear power.

5. Diesel Power Plant (6 Periods)

Diesel engine performance and operation, Plant layout, Log sheets, applications, selection of engine size.

6. Gas Turbine Plant (9 Periods)

Plant layout, methods of improving output and performance. Fuels and fuel systems. Methods of testing. Open and clsed cycle plants. Operating characteristics. Applications. Free piston engine plants, limitation and applications. Non conventional energy sources.

7. Combined Working of Power Plant (10 Periods)

Advantages of combined working of different types of power plants. Need for co-ordination of various types of power plants in power systems, base load stations and peak load stations.

8. Economics of Generation (12 Periods)

8.1 Fixed and running cost, load estimation, load curves, demand factor, load factor, diversity factor, power factor and their effect on cost of generation, simple problems.

8.2 Base load and peak load power stations, concept of regional and national grid, reason of grid failure and its remedies.

9. Non Conventional Source of Energy (5 Periods)

Introduction, Concept of Solar Energy, Bio Mass Energy, Wind Energy, Tidal Energy, Geothermal Energy, Microhydel Energy, Biodiesel Energy.

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INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3rd edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
3. Electrical Power –I by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand and Co., New Delhi
5. Electrical Power System by JB Gupta, SK Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi
8. Electrical Power System by S Channi Singh, Tata McGraw Publishing Co. New Delhi
9. Electrical Power by Soni Gupta and Bhatnagar; Dhanpat Rai & Sons, New Delhi
10. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference: http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	06	08
2	10	14
3	08	12
4	09	12

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5	06	08
6	09	14
7	10	14
8	12	18
Total	70	100

4.5 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

L	T	P
6	1	-

RATIONALE

The majority of the diploma passouts who get employment in State Electricity Boards have to perform various activities in the field of transmission and distribution of electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in transmission and distribution networks 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 to keep them abreast with modern techniques in transmission and distribution of electrical power.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Select suitable supporting structure, insulators, conductors and other accessories for transmission lines and distribution lines
- Prepare layout plan for HT and LT lines/distribution system
- Prepare estimate for HT and LT (OH and underground cables) lines
- Operate and maintain indoor and outdoor substations
- Use various methods for improvement of power factor
- Assess the revenue and energy loss in power distribution

DETAILED CONTENTS

1. Transmission Systems (28 Periods)

   1.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission both AC and DC

   1.2 Comparison of different system: AC versus DC for power transmission, conductor material and sizes from standard tables

   1.3 Constructional features of transmission lines: Types of supports, types of insulators, Types of conductors, Selection of insulators, conductors, earth wire and their accessories, Transposition of conductors and string efficiency of suspension type insulators, Bundle Conductors.

   1.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice related problems; Indian electricity rules pertaining to clearance

   1.5 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

   1.6 Transmission Losses

   1.7 Economic Principle of Transmission
   Kelvin's law, limitation of Kelvin's law modification in Kelvin's law

2. Distribution System (21 Periods)

2.1 Lay out of HT and LT distribution system, constructional feature of distribution lines and their erection. LT feeders and service mains; Simple problems on AC radial distribution system, determination of size of conductor
2.2 Preparation of estimates of HT and LT lines (OH and Cables).
2.3 Constructional features of LT (400 V), HT (II kV) underground cables, advantages and disadvantages of underground system with respect to overhead system.
2.4 Losses in distribution system
2.5 Faults in underground cables-determine fault location by Blavier Test, Murray Loop Test, Varley Loop Test

3. Substations: (21 Periods)

3.1 Brief idea about substations; out door grid sub-station 220/132 KV, 66/33 KV outdoor substations, pole mounted substations and indoor substation
3.2 Layout of 33/11 KV & 220/33KV distribution substation and various auxiliaries and equipment associated with it.

4. Power Factor: (14 Periods)

4.1 Concept of power factor
4.2 Reasons and disadvantages of low power factor
4.3 Methods for improvement of power factor using capacitor banks, Static VAR Compensator (SVC)

5. Revenue and Energy loss (14 Periods)

Technical losses and Commercial losses, Input energy calculation, Sales calculation, Billing efficiency, Collection efficiency, Total energy billed (KWH), Percent aggregated technical and commercial losses.

Note: Students should visit power generation plants, sub-stations etc.

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

MEANS OF ASSESSMENT

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- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3rd edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
3. Electrical Power –I by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand and Co., New Delhi
5. Electrical Power System by JB Gupta, SK Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi
8. Electrical Power System by S Channi Singh, Tata McGraw Publishing Co. New Delhi
9. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	28	30%
2	21	20%
3	21	20%
4	14	15%
5	14	15%

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Total	**98**	**100**

4.6 ENERGY CONSERVATION

L	T	P
3	-	2

RATIONALE

The requirement of energy has increased manifolds in last two decades due to rapid urbanization and growth in industrial/service sector. It has become challenging task to meet ever increasing energy demands with limited conventional fuels and natural resources. Due to fast depletion of fossil fuels and a tremendous gap between supply and demand of energy, it is essential to adopt energy conservation techniques in almost every field like industries, commercial and residential sectors etc. Energy conservation has attained priority as it is regarded as additional energy resource. Energy saved is energy produced. This course covers the concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in general industry and details out energy audit methodology and energy audit instruments.

LEARNING OUTCOMES

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

- define principles and objectives of energy management and energy audit.
- understand Energy Conservation Act 2001 and its features.
- understand various forms & elements of energy.
- identify electrical and thermal utilities. Understand their basic principle of operation and assess performance of various equipments.
- identify areas of energy conservation and adopt conservation methods in various systems.
- evaluate the techno economic feasibility of the energy conservation technique adopted.

DETAILED CONTENTS

1. Basics of Energy

    1.1 Classification of energy- primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy with special reference to solar energy, Capacity factor of solar and wind power generators.
    1.2 Global fuel reserve
    1.3 Energy scenario in India and state of U.P. Sector-wise energy consumption (domestic, industrial, agricultural and other sectors)
    1.4 Impact of energy usage on climate

2. Energy Conservation and EC Act 2001

    2.1 Introduction to energy management, energy conservation, energy efficiency and its need

2.2 Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance. Prominent organizations at centre and state level responsible for its implementation.

2.3 Standards and Labeling: Concept of star rating and its importance, Types of product available for star rating

3. Electrical Supply System and Motors

3.1 Types of electrical supply system

3.2 Single line diagram

3.3 Losses in electrical power distribution system

3.4 Understanding Electricity Bill: Transformers Tariff structure, Components of power (kW, kVA and kVAR) and power factor, improvement of power factor, Concept of sanctioned load, maximum demand, contract demand and monthly minimum charges (MMC)

3.5 Transformers: Introduction, Losses in transformer, transformer Loading, Tips for energy savings in transformers

3.6 Electric Motors

Types of motors, Losses in induction motors Features and characteristics of energy efficient motors, Estimation of motor loading, Variation in efficiency and power factor with loading, Tips for energy savings in motors

4. Energy Efficiency in Electrical Utilities

4.1 Pumps: Introduction to pump and its applications, Efficient pumping system operation, Energy efficiency in agriculture pumps, Tips for energy saving in pumps

4.2 Compressed Air System: Types of air compressor and its applications, Leakage test, Energy saving opportunities in compressors.

4.3 Energy Conservation in HVAC and Refrigeration System: Introduction, Concept of Energy Efficiency Ratio (EER), Energy saving opportunities in Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration Systems.

5. Lighting and DG Systems

5.1 Lighting Systems: Basic definitions- Lux, lumen and efficacy, Types of different lamps and their features, Energy efficient practices in lighting

5.2 DG Systems: Introduction, Energy efficiency opportunities in DG systems, Loading estimation

6. Energy Efficiency in Thermal Utilities

6.1 Thermal Basics: Thermal energy, Energy content in fuels, Energy Units and its conversions in terms of Metric Tonne of Oil Equivalent (MTOE)

6.2 Energy Conservation in boilers and furnaces : Introduction and types of boilers, Energy performance assessment of boilers, Concept of stoichiometric air and excess air for combustion, Energy conservation in boilers and furnaces, Do's and Don'ts for efficient use of boilers and furnaces

6.3 Cooling Towers: Basic concept of cooling towers, Tips for energy savings in cooling towers

6.4 Efficient Steam Utilization

7. Energy Conservation Building Code (ECBC)

7.1 ECBC and its salient features

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7.2 Tips for energy savings in buildings: New Buildings, Existing Buildings

8. Waste Heat Recovery and Co-Generation

8.1 Concept, classification and benefits of waste heat recovery
8.2 Concept and types of co-generation system

9. General Energy Saving Tips
Energy saving tips in:

9.1 Lighting
9.2 Room Air Conditioner
9.3 Refrigerator
9.4 Water Heater
9.5 Computer
9.6 Fan, Heater, Blower and Washing Machine
9.7 Colour Television
9.8 Water Pump
9.9 Cooking
9.10 Transport

10. Energy Audit

10.1 Types and methodology
10.2 Energy audit instruments
10.3 Energy auditing reporting format

PRACTICAL EXERCISES

1. To conduct load survey and power consumption calculations of small building.
2. To check efficacy of different lamps by measuring power consumption and lumens using lux meter.
3. To measure energy efficiency ratio (EER) of an air conditioner.
4. To measure effect of valve throttling and variable frequency drive (VFD) on energy consumption by centrifugal pump.
5. To measure and calculate energy saving by arresting air leakages in compressor.
6. To measure the effect of blower speed on energy consumed by it.

STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY EFFICIENCY

- Presentations of Case Studies
- Debate competitions
- Poster competitions
- Industrial visits
- Visual Aids

INSTRUCTIONAL STRATEGY

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Teachers are expected to lay considerable stress on understanding the basic concepts in energy conservation, principles and their applications. For this purpose, teachers are expected to give simple problems in the class room so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject must be supplemented by demonstrations and practical work in the laboratory. Visits to industries must be carried out. Expert from industry must be invited to deliver talks on energy conservation to students and faculty.

RECOMMENDED BOOKS

1. Guide book on General Aspects of Energy Management and Energy Audit by Bureau of Energy Efficiency, Government of India. Edition 2015
2. Guide book on Energy Efficiency in Electrical Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
3. Guide book on Energy Efficiency in Thermal Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
4. Handbook on Energy Audit & Environmental Management by Y P Abbi & Shashank Jain published by TERI. Latest Edition

Important Links:

(i) Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India. www.beeindia.gov.in.
(ii) Ministry of New and Renewable Energy (MNRE), Government of India. www.mnre.gov.in.
(iii) Uttar Pradesh New and Renewable Energy Agency (UPNEDA), Government of Uttar Pradesh. www.upneda.org.in.
(iv) **Central Pollution Control Board (CPCB),** Ministry of Environment, Forest and Climate Change, Government of India. www.cpcb.nic.in.
(v) Energy Efficiency Sevices Limited (EESL). www.eeslindia.org.
(vi) Electrical India, Magazine on power and electrical products industry. www.electricalindia.in.

4.7 Universal Human Values

L-T-P
2-0-1

Course Objectives

This introductory course input is intended

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

Course Methodology

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or value prescriptions.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

The syllabus for the lectures is given below:

- After every two lectures of one hour each, there is one hour practice session.
- The assessment for this subject is as follows:
- Sessions Marks (Internal): 20
- Practical Marks (External): 30
- Total Marks: 50

UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and

Experiential Validation- as the mechanism for self-exploration

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material the Body'
2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*

-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. *Understanding Harmony in the family – the basic unit of human interaction*
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
    a. Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship
3. Understanding the meaning of *Vishwas*; Difference between intention and competence
4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
5. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva*as comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj),* Universal Order (*SarvabhaumVyawastha)*- from family to world family!

-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence

-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values

2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:
   a) Ability to utilize the professional competence for augmenting universal human order
   b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
   c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:

a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b) At the level of society: as mutually enriching institutions and organizations

7. To inculcate Human Values among Students:The Role of self ,Parents and Teachers
   -Practice Exercises and Case Studies will be taken up in Practice Sessions.

Practical Session also Includes Different Yogic Exercises and Meditation Session

INSTRUCTONAL STRATEGY

The content of this course is to be taught on conceptual basis with plenty of real world examples.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests,
- Mid-term and end-term written tests
- Practical assessment

Reference Material

The primary resource material for teaching this course consists of

a. The text book (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

b. The teacher's manual (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi.

In addition, the following reference books may be found useful for supplementary reading in connection with different parts of the course:

1. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Purblishers.
3. Sussan George, 1976, *How the Other Half Dies,* Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, *Energy & Equity,* The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.

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6. Subhas Palekar, 2000, *How to practice Natural Farming,*Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, *Jeevan Vidya ekParichay,*Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if peoplemattered*, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.

Relevant websites, movies and documentaries

1. Value Education websites, http://uhv.ac.in, http://www.aktu.ac.in
2. Story of Stuff, *http://www.storyofstuff.com*
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA
5. IIT Delhi, *Modern Technology–the Untold Story*
6. Case study Hevade Bazar Movie
7. RC Shekhar , Ethical Contradiction ,Trident New Delhi
8. *Gandhi A., Right Here Right Now, Cyclewala Production*

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	08	20
2	08	20
3	08	20
4	08	20
5	10	20
Total	**42**	**100**

INDUSTRIAL TRAINING

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 4 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. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An external assessment of 50 marks has 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)	Presentation and VIVA	15%.
d)	Industrial training report	55%

5.1 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

L	T	P
5	-	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. It may be further added that an entrepreneurial mindset with managerial skills helps the student in the job market. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

LEARNING OUTCOMES

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

- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- Explain the principles of management including its functions in an organisation.
- Have insight into different types of organizations and their structures.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organisation.
- Use marketing skills for the benefit of the organization.
- Maintain books of accounts and take financial decisions.
- Undertake store management.
- Use modern concepts like TQM, JIT and CRM.

DETAILED CONTENTS

SECTION – A

ENTREPRENEURSHIP

1. Introduction (04 Periods)

    1.1 Concept /Meaning and its need
    1.2 Qualities and functions of entrepreneur and barriers in entrepreneurship

1.3 Sole proprietorship and partnership forms and other forms of business organisations

1.4 Schemes of assistance by entrepreneurial support agencies at National, State, District –level, organisation: NSIC, NRDC, DC, MSME, SIDBI, NABARD, NIESBUD, HARDICON Ltd., Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks

2. Market Survey and Opportunity Identification/Ideation (04 Periods)

2.1 Scanning of the business environment

2.2 Salient features of National and Haryana State industrial policies and resultant business opportunities

2.3 Types and conduct of market survey

2.4 Assessment of demand and supply in potential areas of growth

2.5 Identifying business opportunity

2.6 Considerations in product selection

2.7 Converting an idea into a business opportunity

3. Project report Preparation (06 Periods)

3.1 Preliminary project report

3.2 Detailed project report including technical, economic and market feasibility

3.3 Common errors in project report preparations

3.4 Exercises on preparation of project report

3.5 Sample project report

SECTION –B

MANAGEMENT

4. Introduction to Management (06 Periods)

4.1 Definitions and importance of management

4.2 Functions of management: Importance and process of planning, organising, staffing, directing and controlling

4.3 Principles of management (Henri Fayol, F.W. Taylor)

4.4 Concept and structure of an organisation

4.5 Types of industrial organisations and their advantages

4.6 Line organisation, staff organisation

4.7 Line and staff organisation

4.8 Functional Organisation

5. Leadership and Motivation (08 Periods)

5.1 Leadership: Definition and Need, Qualities and functions of a leader, Manager Vs leader, Types of leadership, Case studies of great leaders

5.2 Motivation: Definition and characteristics, Importance of self motivation, Factors affecting motivation, Theories of motivation (Maslow, Herzberg, Douglas, McGregor)

6. Management Scope in Different Areas (14 Periods)

6.1 Human Resource Management: Introduction and objective, Introduction to Man power planning, recruitment and selection, Introduction to performance appraisal methods

6.2 Material and Store Management: Introduction functions, and objectives, ABC Analysis and EOQ

6.3 Marketing and sales: Introduction, importance, and its functions, Physical distribution, Introduction to promotion mix, Sales promotion

6.4 Financial Management: Introductions, importance and its functions, knowledge of income tax, sales tax, excise duty, custom duty, VAT, GST

7. Work Culture (08 Periods)

7.1 Introduction and importance of Healthy Work Culture in organization

7.2 Components of Culture

7.3 Importance of attitude, values and behavior

7.4 Behavioural Science – Individual and group behavior.

7.5 Professional ethics – Concept and need of Professional Ethics and human values.

8. Basic of Accounting and Finance (10 Periods)

8.1 Basic of Accounting: Meaning and definition of accounting, Double entry system of book keeping, Trading account, PLA account and balance sheet of a company

8.2 Objectives of Financial Management: Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics (10 Periods)

9.1 Total Quality Management (TQM): Statistical process control, Total employees Involvement, Just in time (JIT)

9.2 Intellectual Property Right (IPR) : Introduction, definition and its importance, Infringement related to patents, copy right, trade mark

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition,

expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/Prototype making.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development and Management by J.S.Narang; Dhanpat Rai & Sons, Delhi.
3. Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
4. Handbook of Small Scale Industry by PM Bhandari
5. Entrepreneurship Development and Management by MK Garg
6. E-books/e-tools/relevant software to be used as recommended by AICTE/ NITTTR, Chandigarh.

Websites for Reference:
http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	06
2	04	06

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3	06	08
4	06	08
5	08	12
6	14	20
7	08	12
8	10	14
9	10	14
Total	**70**	**100**

5.2 SWITCHGEAR AND PROTECTION

L	T	P
5	1	-

RATIONALE

In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma passouts 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 develop understanding of the principles and working of protective switchgear so that one can handle, install and maintain them and also take decisions at his level in different situations.

This subject teaching requires reinforcement from visits to substations, power stations and well designed laboratory experiences. A practical orientation to the teaching of this subject is suggested.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- assess type of fault diagnosis
- know circuit breaker operation
- know relay operation
- know read about protection schemes
- Know about different types of substations and read single line diagrams

DETAILED CONTENTS

1. Faults (15 Periods)

   Types of faults, three phase symeterical faults, effects of faults on system reliability and stability, abnormalities, short circuits and their effects, representation of fault conditions through single line diagrams

2. Switchgear (24 Periods)

   2.1 Purpose of protective gear, characteristics of a protection system.

   2.2 Classification of fuses H.V. Fuses, application and working, grading and co-ordination L.V. fuses, selection of fuses, characteristics

   2.3 Isolators and switches, outdoor isolators, functions, air break switches, braking capacity of switches.

   2.4 Circuit breakers :- requirements of circuit breakers, definition of terms associated with circuit-breakers, reasons for arc formation, principles of arc

extinction, types of circuit-breakers, comparison with oil circuit breaker, classification, rating of circuit breakers, working of different types of air and oil circuit breakers, specification of circuit breakers, maintenance schedule, SF-6 and Vacuum circuit breakers.

2.5 Relays:Requirement of relays, operation principles, induction type over current, directional over current, differential, percentage differential relays working, applications and characteristics, basic principles of static relays. Introduction too distance relay.

3. Protective Schemes (15 Periods)

3.1 Protection of alternators, stator faults, rotor faults, mechanical conditions, external faults - their reasons, effect and protections used.

3.2 Protection of power transformer: types of faults, its effects, types of proective schemes over current, earth fault, differential protection, Buckholtz devices, winding temp. protection.

3.3 Motor protection: types of faults and protection in motors, thermal relays, protection of small motors, under voltage protection.

3.4 Protection of feeders: radial, parallel and ring feeders protection, directional time and current graded schemes, differential protection.

4. Protection Against Over Voltages (15 Periods)

Causes of over voltages, travelling waves earth wire, protective zone, lightening arrestors, space-gap and electrolytic arrestors, surge absorber, location and rating of lighening arrestors. Thyrite lightening arrestor.

5. Different Type of Sub-stations (15 Periods)

5.1 Layout, single line diagram, busbar arrangement, equipment, their fuctions, accessories, study of protective schemes, batteries and their maintenance, operation of small sub-stations.

5.2 Reactors: types of reactors, busbar reactor, tuning reactor, arc-supression reactor, connection of reactors in power stations, uses of reactors.

5.3 Neutralgrounding:- types of grounding solid grounding, reactance grounding, arc suppression, coil grounding, choice of method of neutral earthing, grounding of sub-stations, grounding of line structure and substation equipment.

5.4 Concept of G.I.S. (Gas Insulated Substation)

RECOMMENDED BOOKS

1. Switchgear and Protection by NagrathKathan; TMH
2. Switchgear and Protection by Soni Gupta &Bhatnagar; Dhanpat Rai & Sons

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3. Switchgear and Protection by Sunil S. Rao; Dhanpat Rai & Sons
4. Switchgear and Protection by HarnoonAsfaqHussain; Khanna Publications
5. Switchgear and Protection by J.B. Gupta; Kataria& Sons
6. Switchgear and Protection by U.A Bakshi; Technical Publications, Pune

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1	15	16
2	24	30
3	15	18
4	15	18
5	15	18
Total	**84**	**100**

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5.3 PLC, MICRO CONTROLLER & SCADA

L	T	P
6	-	6

RATIONALE

A diploma holder, employed in automated industrial process controls or in automated power station, will be required to know the basic of programmable logic controllers, their working and their programming. In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation system was mechanical in design, timing and sequencing being effected by gears and cams. Now this design concept was replaced by programmable logic controllers (PLC). A PLC is a solid state device. PLCs are widely used in all industries for efficient control operations. Looking at the industrial applications of PLCs in the industry, this subject finds its usefulness in present curriculum.

Microcontrollers and SCADA have also assumed great significance in the field of electronics, power system, large industry and engineering field. This subject aims to expose the diploma students to both of these and give them adequate knowledge of these topics.

DETAILED CONTENTS

1. Introduction (24 Periods)

Concept of PLC, building block of PLC, function of various blocks, limitation of relays, advantage of PLC over electromagnetic relays, different programming languages, PLC manufacturer, working of PLC, basic operation and principles of PLC, architectural details.

2. Instruction Set (20 Periods)

2.1 Basic instructions like latch, master control self holding relays, timer instruction like retentive timers, resetting of timers, counter instructions like up counter, resetting of counters.

2.2 LadderDiagram Programming : programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.

3. Microcontroller series (MCS)-51 over view (20 Periods)

Pin details, I/O ports structure, memory organisation, special function registers instruction set, addressing modes, timers operation, serial port operation, interrupts.

4. Assembly language programming (10 Periods)

Assemblers and Compilers, assembler directives, design and interface.
Examples like: keypad interface, 7- segment interface, LCD, Stepper motor , A/D, D/A , RTC interface, introduction of PIC microcontrollers.

5. SCADA (10 Periods)

Introduction, role of SCADA in dispatch centre, operator console, VDUs, types of communication channels in SCADA systems, RTUs, MTUs, data loggers, report generation, report analysis and actions.

LIST OF PRACTICALS

PLCs

1. Components / sub components of aPLC, learning functions of different modules of a PLCs
2. Practical steps in programming a PLC (a) using hand held programmer (b) using computer interface.
3. Introduction to step programming language, ladder diagram concepts, instruction list syntax.
4. Basic logic operations, AND, NOT, OR functions
5. Use of PLC for an application
   Car parking, doorbell operation, traffic light control, washing machine, motor in forward and reverse direction
   Microcontrollers
6. Familiarization of micro controllers (8051) kit
7. Testing of general input/ output on micro controller board
8. Use of micro controller liken in relays, buzzer of working machine, oven

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with applications of PLCs, micro controller and SCADA. The inputs start with theoretical inputs to architecture, instruction set , assembly language programming, small projects may identified, PLC ladder diagram and programming should be supplemented with visits to industry.

RECOMMENDED BOOKS

1. Introduction to PLCs by Gary Dunning , McGraw Hill

2. Module on PLCs and their applications by Rajesh Kumar, NITTTR Chandigarh
3. Micro controller by Ayala, Penram International
4. Power system SCADA and smart Grids by Mini S. Thomas and John D. McDonald

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocations (%)
1	24	26
2	20	24
3	20	24
4	10	13
5	10	13
Total	**84**	**100**

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5.4 ELECTRICAL MACHINES - II

L T P
6 1 6

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:

- Demonstrate the constructional features of a synchronous machine and its working as a synchronous motor
- Operate the synchronous motor as synchronous condenser
- Use 3-ϕ induction motor in the industry for various operations
- Operate and maintain three phase squirrel cage and three phase slip ring induction motors.
- Start and reverse the direction of rotation of three phase induction motors using different types of starters.
- Conduct speed control of three phase induction motor.
- Operate and maintain double cage induction motors.
- Recognize the condition of cogging and crawling in three phase induction motors.
- Operate different types of single phase induction motors.
- Operate different types of special purpose motors

DETAILED CONTENTS

1. 3 Phase Induction Motors (25 Periods)

    1.1 Production of rotating magnetic field in 3 phase winding.
    1.2 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
    1.3 Principle of operation, slip and its significance

1.4 Locking of rotor and stator fields
1.5 Rotor resistance, inductance, emf and current
1.6 Relationship between rotor copper losses, slip and rotor input power.
1.7 Power flow diagram of an induction motor
1.8 Factors determining the torque
1.9 Torque-slip curve, stable and unstable zones
1.10 Effect of rotor resistance upon the torque slip curve
1.11 Double cage rotor motor and its applications
1.12 Starting of 3-phase induction motors, DOL, star-delta, auto transformer starter.
1.13 Causes of low power factor of induction motors
1.14 Testing of 3-phase motor on no load and blocked rotor test and to find efficiency
1.15 Method of Speed control of induction motor
1.16 Harmonics and its effects, cogging and crawling in Induction Motors.
1.17 Specifications and ratings of induction motors.

2. Single Phase Motors (18 Periods)

2.1 Single phase induction motors; Construction characteristics, specifications and applications.
2.2 Nature of field produced in single phase induction motor-double revolving field theory.
2.3 Split phase induction motor
2.3.1 Capacitor start, capacitor run, capacitor start and run motor
2.3.2 Shaded pole motor
2.4 Alternating current series motor and universal motors, construction,working principle and operation, application.
2.5 Single phase synchronous motor
2.5.1 Reluctance motor
2.5.2 Hysteresis motor

3 Synchronous Machines (25 periods)

3.1 Main constructional features of synchronous machine including commutator and brushless excitation system
3.2 Generation of three phase emf
3.3 Concept of distribution factor and coil span factor and emf equationArmature reaction at unity, lag and lead power factor
3.4 Equivalent circuit diagram of synchronous machine
3.5 Concept of voltage regulation. Determination of voltage regulation by synchronous impedance method.

3.6 Operation of single synchronous machine independently supplying a load.
3.7 Concept of infinite bus bar. Need and necessary conditions of parallel operation of alternators, synchronizing an alternator (Synchroscope method) with the bus bars
3.8 Operation of synchronous machine as a motor –its starting methods
3.9 Effect of change in excitation of a synchronous motor, V curve, Concept of synchronous condenser.
3.10 Concept and cause of hunting and its prevention
3.11 Specification, rating and cooling of synchronous machines
3.12 Applications of synchronous machines

4. Special Purpose Machines (16 periods)

Construction, working principle and application of linear induction motor, stepper motor, AC Servomotor, Submersible Motor,

LIST OF PRACTICALS

1. Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer BIS code)
2. Determination of effect of rotor resistance on torque speed curve of an induction motor Observe the performance of a ceiling fan (I-ϕ) induction motor) without capacitor
3. Determine the effect of change in capacitor on the performance of 1-phase induction motor and reverse the direction of motor.
4. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
5. Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
6. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
7. Determination of the effect of variation of excitation on performance of a synchronous 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

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1. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi
2. Electrical Machine by B.L.Thareja; S.ChandPublicaion, New Delhi
3. Electrical Machines by SK Sahdev; Uneek Publications, Jalandhar
4. Electrical Machines by Nagrath and Kothari; Tata McGraw Hill, New Delhi
5. Electrical Engineering by JB Gupta; SK Kataria and sons, New Delhi
6. Electrical Machines by Samarjit Ghosh; Pearson Education (Singapore) Pvt, Ltd. Delhi
7. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1	25	30
2	18	22
3	25	30
4	16	18
Total	**84**	**100**

5.5.1 RENEWABLE SOURCES OF ENERGY

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RATIONALE

Since the conventional energy resources are under fast depletion, it is high time to tap the non-conventional energy sources also. So, the solution primarily lies in tapping all possible energy generation sources but efficient use of available energy is also important. The electrical diploma holder must be made aware about saving and conserving Electrical Energy and tackle the problems of environmental pollution as they will have to face this challenge in future life. Hence the subject.

LEARNING OUTCOMES

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

- Explain the importance of non-conventional energy sources for the present energy scenario.
- Classify various non-conventional sources of energy
- Explain principle of solar photovoltaic energy conversion and the applications of solar energy in different fields.
- Explain basic conversion technologies of biomass, wind energy, geo-thermal, tidal energy, hydro energy and its applications.
- Explain direct energy conversion systems like magneto hydrodynamics and fuel cells and its applications.

DETAILED CONTENTS

1. Basic of Energy (06 periods)

Classification of Energy-primary and secondary energy, commercial and non-commercial energy, importance of non conventional energy sources, present scenario,future prospectus, energy scenario in India,sector-wise energy consumption(domestic, industrial, agriculture etc.), comparison between renewable andnon renewable energy resources

2. Solar Energy (20 periods)

Principle of conversion of solar radiation into heat, using different types of solar collectors, photo-voltaic cell, electricity generation, application of solar energy like solar water heaters, solar furnaces, solar cookers, solar lighting, solar pumping, installation & maintenance of solar power plant

3. Bio-energy (14 periods)

Bio-mass conversion technologies& their types- wet and dry processes. Methods for obtaining energy from biomass. Power generation by using gasifiers

4. Wind Energy (12 periods)

Wind energy conversion, windmills, electricity generation from wind- types of wind mills, local control, energy storage

5. Geo-thermal and Tidal Energy (16 periods)

Geo-thermal sources, Ocean thermal electric conversion, open and closed cycles, hybrid cycles. Prime movers for geo-thermal energy conversion. Steam Generation and electricity generation. Different types of tidal energy systems

6. Magneto Hydro Dynamic (MHD) Power Generation (04 periods)

7. Fuel Cell (10 periods)

Concept, types of fuel cells, operating principles of a fuel cell, conversion efficiency, work output and e.m.f of fuel cells, applications.

8. Hydro Energy (06 periods)

Mini & Micro hydro plants

INSTRUCTIONAL STRATEGY

The teacher should make the student s aware about the depletion of energy sources and the availability of alternate sources of energy their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. While explaining the need and energy management, the teacher should give students home assignments bases on energy conservation. The students should be made familiar with the energy efficient devices, various approaches to conserve energy, energy auditing procedure etc. Teacher must give practical application of these energy sources in nearby surrounding areas.

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MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS :

1. Non-Conventional Energy Resources by RK Singal; SK Kataria and Sons, New Delhi
2. Solar Energy Utilization; GD Rai; Khanna Publishers, New Delhi.
3. Reviews of Renewable Energy Sources, Vol. 3, Edited by MS Sodha, S.S. Mathur, MAS Malik, TC Kandpal ; Wiley Eastern Limited, New Delhi.
4. Renewable Energy Sources and Conversion Technology by NK Bansal, Manfred Kleemann, Michael Meliss; Tata McGraw Hill Publishing Co. Ltd New Delhi.
5. Energy Today and Tomorrow; Maheshwar Dayal; Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.
6. Energy Technology (Nnon-Conventional, Renewable and Conventional) by S Rao and BB Parulekar; Khanna Publishers, New Delhi
7. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allocation (%)
1.	06	8
2.	16	20
3.	14	16
4.	12	14
5.	16	20
6.	04	05
7.	10	12
8.	06	08
Total	**84**	**100**

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5.5.2 ELECTRIC TRACTION

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RATIONALE

Nowadays, electrical energy finds major application in electric traction besides steam and diesel locomotives. Therefore, a diploma holder is required to have elementary knowledge of electric drives used in traction, accelerating and breaking arrangements at the control panel.

LEARNING OUTCOMES

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

- The utilization of electric machines in railway
- Utilize electric circuits in locomotive on rail tract
- Explain arrangement of the power supply system used in electric traction.

DETAILED CONTENTS

1. Introduction (05 periods)

Electric traction system and its advantages over other systems, types of electric traction systems. Traction systems for India.

2. Electric Traction drives (9 periods)

Suitability of electric traction drives- D.C. series motor, A.C. series motor, 3 phase induction motor, characteristics of electric traction drives, special design requirements, methods of starting and speed control, different methods of braking, plugging, rheostatic, regenerative.

3. Power Supply of Electric Traction (10 periods)

Different systems of power supplies, their chronological evaluation, power supply arrangement i.e. traction substation major equipment, transformer, circuit breaker, interuptor, protection system, remote control system.Design consideration.

4. Mechanics of traction: (10 periods)

System of units, speed time curves, their construction, simplification and interpretation for main line, suburban routes, tractive effort, specific energy consumption and factors effecting it. Weight transfer due to torque coefficient of adhesion.

5. Rectification equipment: (7 periods)

Equipments required for rectification, their brief theory and working.

6. Overhead equipment (7 periods)

Design aspects of overhead equipments catenary and its types, practical aspects of working, maintenance of overhead equipments, current collection system, their requirements.

7. Track Circuits (12 periods)

D.C. and A.C. track circuits, signals for traffic control.

8. Supervisory Remote Control (12 periods)

System of remote control, its advantages, mimic diagram, remote control system and network remote control centre (R.C.C.)

9. Rail and Return Path (12 periods)

Earth return protection of underground equipment, Negative booster, voltage distribution on rails.

RECOMMENDED BOOKS

1. Electric Traction by J. Upadhya;Allied Publisher Limited, New Delhi
2. Modern Electric Traction by H. Pratap; Dhanpat Rai & Sons, New Delhi
3. Electric Traction by A.T. Dover; McmillanDhanpat Rai & Sons, New Delhi
4. Electric Traction Handbook by R.B. Brooks; Sir Isaac Pitman and Sons Ltd., London.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allocation (%)
1.	05	06
2.	09	12
3.	10	12
4.	10	12
5.	07	08
6.	07	08
7.	12	14
8.	12	14

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9.	12	14
Total	**84**	**100**

5.5.3 CONTROL OF ELECTRICAL MACHINES

L T P
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RATIONALE

Control systems for electric motors have become very important particularly with reference to their performance and protection. These control systems may range from starting and stopping of electric motors to that of directing the energy flow in a completely automated factory. The arrangement in general, may involve one or more of such functions as rapid stopping (braking), reversing, speed changing, travel limits of mechanical equipment, timing of multimotor drives and the regulation of current torque, speed, acceleration and deceleration. The subject has become an important part of Electrical Engineering.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Select suitable supporting structure, contactors and relay
- Prepare layout plan for open loop control of AC motor
- Prepare layout plan for closed loop control of AC motor
- Operate and maintain parts of drives
- Assess and compare the result of various timing relays

DETAILED CONTENTS

1. Control Components (12 Periods)

1.1. Fuses and combination fuse switch units
1.2 Miniature circuit breaker
1.3 Contactors-Solenoid type, Clapper type
1.4 Over-load relays-Thermal over-load relay, Ratchet type over load relay, Magnetic over load relay, Dash pot type oil filled relay
1.5 Timing relays

1.5.1 Thermal time delay relay
1.5.2 Pneumatic time delay relay
1.5.3 Synchronous motor-driven timer
1.5.4 Solid state timer

1.6 Phase failure relay
1.7 Push buttons
1.8 Selector switches- Two position, Three position
1.9 Limit switches- Single side actuation type, Double side actuation type, Rotary cam type, Heavy duty limit switch
1.10 Proximity switches
1.11 Solenoid valves
1.12 Master controllers & drum switches
1.13 Pressure switches
1.14 Temperature controller (Thermostat)
1.15 Float switches
1.16 Mechanical brakes for motors
1.17 Control transformer
1.18 Rectifiers
1.19 Reactors
1.20 Capacitors
1.21 Symbols for various components
1.22 Control diagram- Two wire control circuit, Three wire control circuit

2. A.C. Control Circuits (12 Periods)

2.1 Forward/reversing of 3 phase motors-With push button inter-locking, with Auxillary contact inter-locking
2.2 Sequence starting of motors
2.3 Starting multispeed squirrel cage motor
2.4 Dynamic braking of squirrel cage induction motor
2.5 Plugging of squirrel cage induction motor
2.6 Over-load protection of motors
2.7 Single phase protection
2.8 Over-temperature protection
2.9 Voltage stabilizer for 3 phase and single phase motors

3. Control of Synchronous Motors (13 Periods)

3.1 Principle of acceleration
3.2 Motor starter with field application by definite time relay
3.3 Motor starter with field control by polarized field frequency control

3.4 Motor starter with field application by slip frequency relay
3.5 Over-load protection scheme

4. Control of Single Phase Motors (14 Periods)

4.1 Across the line starter
4.2 Reversal of universal motor
4.3 Speed control of universal motor
4.4 Starter for capacitor type split phase motor
4.5 Dynamic braking

5. Industrial Control Circuits (14 Periods)

5.1 Heater control
5.2 Compressor motor control
5.3 Skip hoist control
5.4 Walking beam
5.5 Battery operated truck
5.6 Conveyor system control
5.7 Life circuit

6. Trouble Shooting in Control Circuits (12 Periods)

6.1 Analysing the problems
6.2 Major trouble spots- Fuse base, Loose connections, Faulty contacts, Incorrect wire markers, Combination problems, Low-voltage, Grounds
6.3 Procedure used in trouble-shooting

7. Programmable Logic Controller (PLC) (7 Periods)

Introduction, Principle of operation, Architecture of programmable, controller, Programming the programmable controller, Application of programmable controller.

INSTRUCTIONAL STRATEGY

Control of electrical machines being a industrial requirement,a student will deal with various control methods, parts of control strategy and fundamental equipmentsof control methods. After studying this subject, an electrical diploma holder must be competent to repair and maintain the control panel. For above purpose exposure to industry, work place and utilization of various aspect of control may be emphasized.

RECOMMENDED BOOKS

1. Electric Contacts- Theory and Application by Ragnar Halm; Springer Publication
2. Industrial control Electronics by John Webb, Kevin Greshock; Maxwell; Macmillan International editions
3. Industrial Electronics & Control by S.K. Bhattacharya & S. Chatterji; New Age International Publications(P) Ltd., New Delhi

Websites for Reference

http://www.schneider_electric.us

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1	12	16
2	12	15
3	13	15
4	14	16
5	14	15
6	12	15
7	7	8
Total	**84**	**100**

5.5.4 ENERGY MANAGEMENT

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RATIONALE

The requirement of energy has increased manifolds in last two decades due to rapid urbanization and growth in industrial/service sector. It has become challenging task to meet ever increasing energy demands with limited conventional fuels and natural resources. Due to fast depletion of fossil fuels and a tremendous gap between supply and demand of energy, it is essential to adopt energy conservation techniques in almost every field like industries, commercial and residential sectors etc. Energy conservation has attained priority as it is regarded as additional energy resource. Energy saved is energy produced. This course covers the concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in general industry and details out energy audit methodology and energy audit instruments.

LEARNING OUTCOMES

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

- Define principles and objectives of energy management and energy audit.
- Understand various forms & elements of energy.
- Identify electrical and thermal utilities. Understand their basic principle of operation and assess performance of various equipment.
- Identify areas of energy conservation and adopt conservation methods in various systems.
- Evaluate the techno economic feasibility of the energy conservation technique adopted.

DETAILED CONTENTS

4. Introduction (15 periods)

1.1 Energy management
1.2 Environmental aspects, need for energy conservation with brief description of oil & coal crisis.
1.3 Energy efficiency & its significance
1.4 Energy efficient practices in lighting
1.5 Tips for energy saving in building - New Building, Existing Building
1.6 Energy conservation opportunity & measures
1.7 Macro level approach at design stage

5. Energy Conservation in Various Sectors (14 periods)

5.1 Energy conversation in domestic sector-lighting, home applications
5.2 Energy conservation in industrial sector-industrial lighting, distribution system, motors, pumps blowers etc.
5.3 Energy conservation in agricultural sector-Tube well pump, D.G. sets, standby energy source

6. Energy Audit (08 periods)

6.1 Types and methodology
6.2 Energy auditing reporting format
6.3 Energy audit instruments
6.4 Specific energy consumption-three pronged approach, fine tuning, technical upgradation; avoidable losses

7. Electrical Supply System and Motors (20 periods)

7.1 Transformer loading
7.2 Tips for energy savings in transformers
7.3 Motor Loading
7.4 Variation in efficiency and power factor with loading
7.5 Tips for energy savings in motors
7.6 BIS standard for energy efficient motors, design features
7.7 Need for energy efficient motors
7.8 Various constructional features of EEMs
7.9 EEM as compared to standard motors
7.10 Distribution system- optimum cable size, amorphous core transformers, location of capacitors

8. Efficient devices (17 periods)

8.1 Energy efficient technology- An overview
8.2 Need for energy efficient devices
8.3 Initial cost vs. life cycle, cost analysis on life cycle basis
8.4 Energy efficient motor as compared to standard motors
8.5 Energy efficient lighting system, different sources-lumens/watt, LED, Role of voltage and efficiency.

9. Environmental Impact assessment (10 periods)

9.1 Need for environmental impact assessment

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9.2 Standard format for assessment & its completion
9.3 Evaluation of assessment

10. Energy Conservation Building Code (10 periods)

10.1 ECBC and its salient features including thermal behavior of buildings
10.2 ECBC Guidelines on Building Envelope
10.3 ECBC Prescriptive Requirements for Building Envelope
10.4 ECBC Guidelines on Heating, Ventilation and Air Conditioning
10.5 ECBC Guidelines on Service Hot Water and Pumping
10.6 ECBC Guidelines on Lighting
10.7 ECBC Guidelines on Electrical Power
10.8 ECBC Guidelines on Star Labelling and Minimum Star rating

STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY EFFICIENCY

1. Presentations of Case Studies
2. Debate competitions
3. Poster competitions
4. Industrial visits
5. Visual Aids

INSTRUCTIONAL STRATEGY

Teachers are expected to lay considerable stress on understanding the basic concepts in energy conservation, principles and their applications. For this purpose, teachers are expected to give simple problems in the class room so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject must be supplemented by demonstrations and practical work in the laboratory. Visits to industries must be carried out.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

REFERENCE BOOKS

1. Electric Energy Generation, Utilisation and Conservation by Sivaganaraju, S; Pearson, New Delhi
2. Electrical Power by V.K. Mehta; Khanna and Khanna Publishers, New Delhi

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3. Handbook on Energy Audit & Environmental Management by Y P Abbi & Shashank Jain published by TERI. Latest Edition
4. Guide book on General Aspects of Energy Management and Energy Audit by Bureau of Energy Efficiency, Government of India. Edition 2015
5. Guide book on Energy Efficiency in Electrical Utilities, by Bureau of Energy Efficiency, Government of India.
6. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
9.	12	15
10.	12	15
11.	08	10
12.	16	18
13.	16	18
14.	10	12
15.	10	12
Total	**84**	**100**

6.1 INSTALLATION, MAINTENANCE AND REPAIR OF ELECTRICAL EQUIPMENT

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RATIONALE

In his career as a supervisor, an electrical engineering technician will be called upon to inspect, test and modify the work done by skilled workers or artisans working under him. Many a times, it will become necessary for him to demonstrate the correct method and procedure of doing certain operations. Normally manufacturers of heavy electrical equipment provide service manuals, instructions for installation, maintenance and fault location. Indian Electricity Rules and Indian Standard Specifications also provide enough guidelines. This syllabus has been designed to provide certain guidelines and broad principles regarding the above activities. Appropriate field trips will reinforce the learning.

LEARNING OUTCOMES

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

- Erect/install various electrical equipment as per IE Rules Act by adopting all safety measures.
- Prepare specifications for different items required for transmission lines.
- Design and excavation of cable trenches.
- Lay underground cables
- Test cables and their termination.
- Check HT/LT circuit breakers, transformers and related equipment in a substation
- Carry out earthing, make earth pits and measure earth resistance values.
- Find fault in a transmission/distribution system.
- Carry out preventive maintenance to minimize breakdowns.

DETAILED CONTENTS

1. Tools and Accessories (14 Periods)

   Tools, accessories and instruments required for installation, maintenance and repair work. Knowledge of Indian Electricity rules, safety codes, causes and prevention of accidents, artificial respiration of an electrocuted person, workmen's safety devices

2. Installation (40 Periods)

   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.

Laying of service lines, earthing, provision of service fuses, installation of energy meters

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.

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, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches etc..

2.4 Testing of various electrical equipment such as electrical motor, transformers, cables, and generators, motor control centres, medium voltage distribution panels, power control centres, motor control centres, lighting arrangement, storage, pre-installation checks, connecting and starting, pre-commissioning checks, drying out

2.5 Testing of Transformers: Typetest, oil testing of transformers

3. Maintenance (30 Periods)

3.1 Types of maintenance, maintenance schedules, procedures

3.2 Maintenance of Transmission and Distribution System

Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally, temporary earthing, cancellation of permit and restoration of supply.

Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections;

Location of faults using Meggar, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system, causes of dim and flickering lights.

3.3 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

3.4 Maintenance of Grid Substations

Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers

3.5 Maintenance of Motors

Over hauling of motors, preventive maintenance, trouble shooting of electric motors

3.6 Domestic Installation

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors, continuity or open circuit test

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.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

LIST OF PRACTICALS

1. Testing of Insulation Resistance of PVC in PVC wire, measurement of winding resistance of a motor.
2. Wiring of tube light connection with starter and choke.
3. Oil testing of a transformer and note its breakdown value.
4. Make a alarm circuit.
5. Make ON/OFF control circuit to run an electric induction motor (Single Phase)
6. Make a circuit to run a ceiling fan.

RECOMMENDED BOOKS

1. Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao,Khanna Technical Publication, New Delhi
2. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana
3. Installation and Maintenance of Electrical Equipment by Praveen Kumar, North Publication, Jalandhar
4. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

http://swayam.gov.in

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SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1	14	18
2	40	50
3	30	32
Total	**84**	**100**

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6.2 ELECTRICAL DESIGN, DRAWING AND ESTIMATING - II

L	T	P
5	-	8

RATIONALE

A diploma holder in Electrical Engineering is supposed to have ability to :

i) Read, understand and interpret electrical engineering drawings
ii) Communicate and correlate through sketches and drawings
iii) Prepare working drawings of electrical circuits, motor control, earthing and motor parts

The contents of this subject has 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 contactor and its use in various applications of 3 phase induction motor
- recognize different types of earthing
- name relevant IS specification for earthing
- read and interpret key diagrams
- read and interpret schematic and wiring diagrams
- Prepare estimate of wiring installation.
- Prepare estimate of small sub-station.

DETAILED CONTENTS

1 Contractor Control Circuits (10 periods)

Design of circuit drawing of schematic diagram and power wiring diagram of following circuits, specification of contactors

1.1 DOL starting of 3-phase induction motor
1.2 3-phase induction motor getting supply from selected feeder
1.3 Forwarding/reversing of a 3-phase induction motor
1.4 Two speed control of 3-phase induction motor
1.5 Limit switch control of a 3-phase induction motor
1.6 Sequential operating of two motors using time delay relay
1.7 Manually generated star delta starter for 3-phase induction motor
1.8 Automatic star delta starter for 3-phase Induction Motor
1.9 Control circuit for cross road signal

2. Earthing (08 periods)

2.1 Concept and purpose of earthing

2.2 Different types of earthing, drawings of plate and pipe earthing
2.3 Procedure of earthing, test of materials required and costing and estimating
2.4 Method of reducing earth resistance
2.5 Relevant IS specifications of earth electrode for earthing a transformer, a high building
2.6 Earthing layout of distribution transformer
2.7 Substation earthing layout and earthing materials
2.8 Line diagram of 11kV, 33kV, 66kV, 132 kV sub-stations

3. Schematic Diagram of lighting system of conference room/Theatre/sports stadium (indoor and outdoor) and Circuits using timers using CAD and, Drawing sheets. (08 periods)

4. Estimation of Internal Wiring Installation (12 periods)

Estimation of wiring installation for commercial and industrial buildings such as multi-storied hotels, hospitals, schools, colleges, cinema, community centers, public library, high rise residential buildings etc. including design of layout, load estimation, Demand factor and diversity factor, power distribution scheme, list of material with specifications estimation of cost preparing relevant electrical schedule or rate (CPWD or PWD) using latest practices, materials and accessories.

5. Estimation of Power Wiring (08 periods)

I.S. specifications and I.E. rules, calculation of current for single and three phase motors. Determination of sizes of cables, conductors distribution board, main switches and starters for power circuits. Cost of equipments and accessories and schedule of material. Estimation and cost of material and work for motors up to 20 H.P., pumpsets and small workshops.

6. Estimation of Overhead and Underground Distribution Lines (08 periods)

Main components of overhead lines-line supports, cross-arm, clamps, conductors and staysets, lightening arrestors, danger plates, anti climbing devices, bird guards, jumpers etc., concerting of poles, earthing of transmission line, formation of lines, specification of materials for O.H. lines, I.S, specification and I.E. rules. Cost of material and work for overhead and undergoing lines up to 11 KV only.

7. Estimation of Service Connections (08 periods)

Service connection, types of service connections-overhead and underground for single story and double story buildings, estimate of materials required for giving service connection to domestic consumers, commercial consumers and industrial consumers at L.T. and H.T. costing of material and work in above cases.

8. Estimation of Small Sub-Station (08 periods)

Main equipments and auxiliaries installed on the substation. Estimation of materials required for a small distribution substation (indoor and outdoor type-platform and pole mounted). Costing of material and work of above substations.

Note: Draw various schematic and wiring diagrams using graphic package(preferably CAD)

LIST OF PRACTICALS

1. Earthing
2. Commercial and industrial buildings
3. Power wiring layout and circuits
4. Stays, line crossings, line earthing, end poles and terminal poles, junction poles/towers and transposition pole/towers.
5. Service connection domestic, industrial and agriculture.
6. Substation layout and bus bar arrangements
7. Machine drawings-induction and synchronous machines.
8. Winding of induction machine, 3phase; 1phase.
9. Reading and interpreting practical drawing of wiring installation and control circuits.
10. Winding of synchronous machine 3 phase. (alternator and synchronous motor)

MEANS OF ASSESSMENT

- Design and drawing
- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1. Electrical Design and Drawings by Raina & Bhattacharya
2. Electrical Design & Drawings by Sarabjeet Singh
3. IEEE Guide 80 for Earthing, IEEE Publication, New York
4. Electrical Design and Drawing by Surjit Singh, North Publication, Jalandhar
5. BIS for Electrical Earthing
6. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1.	10	15
2.	08	10
3.	08	10
4.	12	25
5.	08	10
6.	08	10
7.	08	10
8.	08	10
Total	**70**	**100**

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6.3 UTILIZATION OF ELECTRICAL ENERGY

L	T	P
5	-	-

RATIONALE

This subject assumes importance in view of the fact that 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 him 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:

- Explain different methods of illumination
- 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
- Handle and maintain electrolytic plant
- Find faults in electric circuits of refrigerators
- Suggest electric drives as per need
- Maintain electric traction lines and track

DETAILED CONTENTS

1. Illumination (14 Periods)

1.1 Nature of light, visibility spectrum curve of relative sensitivity of Human eye and wave length of light.

1.2 Definition: Luminous flux, solid angle, intensity, luminous efficiency. Space to height ratio, reflection factor, lux, shadow .

1.3 Different types of lamps, construction and working of incandescent and discharge lamps. Fitting required for filament lamp,mercury vapor, sodium lamp, halogen lamp, CFL, LED lamp.

1.4 Calculation of number of light points for interior illumination calculation of indoor and outdoor illumination levels at different points..

1.5 Time switches, street lighting, flood lighting and its characteristics.

2. Electric Heating and Welding (18 Periods)

2.1 Advantages of electrical heating

2.2 Heating methods

2.2.1 Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit

2.2.2 Induction heating; principle of core type and coreless induction furnace, their construction and applications

2.2.3 Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace

2.2.4 Dielectric heating, applications in various industrial fields

2.2.5 Infra-red heating and its applications (construction and working of two appliances)

2.2.6. Microwave heating and its applications (construction and working of two appliances)

2.2.7 Solar Heating

2.3 Calculation of resistance heating elements (simple problems)

2.4 Electric Welding

2.4.1 Advantages of electric welding

2.4.2 Welding methods

2.4.3 Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment

2.4.4 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply requirement. Advantages of using coated electrodes,comparison between AC and DC arc welding, welding control circuits,welding of aluminum and copper

3. Electrolytic Processes (08 Periods)

3.1 Need of electro-deposition

3.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing

3.3. Equipment and accessories for electroplating

3.4. Factors affecting electro-deposition
3.5. Principle of galvanizing and its applications
3.6 Principles of anodizing and its applications
3.7 Electroplating of non-conducting materials
3.8 Manufacture of chemicals by electrolytic process

4. Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers (08 Periods)

4.1 Principle of air conditioning
4.2 Description of Electrical circuit used in
a) Refrigerator,
b) Air-conditioner, and
c) Water cooler

5. Electric Drives (10 Periods)

5.1 Advantages of electric drives
5.2. Characteristics of different mechanical loads
5.3. Types of motors used as electric drive
5.4. General idea about the methods of power transfer by direct coupling by using devices like belt drive, gears, chain drives etc.
5.5 Examples of selection of motors for different types of domestic loads
5.6 Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.
5.7 Selection of motors for Domestic Appliances

6. Electric Traction (12 Periods)

6.1 Advantages of electric traction
6.2 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 Different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector-pentagraph
6.4 Factors affecting scheduled speed
6.5. Electrical block diagram of an electric locomotive with description of various equipment and accessories used.
6.6 Types of motors used for electric traction
6.7 Power supply arrangements
6.8 Starting and braking of electric locomotives
6.9 Introduction to EMU and metro railways
6.10 Train Lighting Scheme

Note: Students should be taken for visits to nearest electrified railway track and railway station to study the electric traction system. Also visit should be made to show electric illumination in building.

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.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce
- Software installation, operation, development

RECOMMENDED BOOKS

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai & Sons, Delhi
2. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana
3. Utilization of Electrical Energy by Sahdev, Uneek Publication, Jalandhar
4. A Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
5. Modern Electric Traction by H Partap,Dhanpat Rai & Sons, Delhi
6. Utilization of Electrical Energy by D.R. Arora, North Publication, Jalandhar
7. Generation, Distribution and Utilization if Electrical Power by CL Wadhwa,Wiley Eastern Ltd., New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
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5	10	14
6	12	18
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6.4 APPLICATIONS OF COMPUTER SOFTWARE IN ELECTRICAL ENGINEERING

L	T	P
-	-	2

RATIONALE

All equipment, installations, circuits and other electrical and electronic systems in commercial, power and industrial sector need drawings for their manufacturing, installation, operation and maintenance. A diploma holder in Electrical Engineering must possess the skill of reading, interpreting different drawings and simulating electrical and electronics circuits for most of the activities. With the evolution of various computer softwares, the conventional role of draftsman has been is now taken over by Computer software. Computer Aided Drawing (CAD) and simulation (MATLAB/SIMULINK) software will be used to perform various practical exercises in this course. This will enable the students to become competent to function in the fast growing information technology environment by enhancing their computer aided drawing, designing and simulating skills in the field of electrical and electronics engineering.

LEARNING OUTCOMES

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

- Use various symbols and notations in electrical and electronics engineering drawings.
- Interpret drawings and draw interferences.
- Draw various electrical and electronics circuits using CAD software.
- Simulate simple electrical and electronics circuits using simulation software

LIST OF PRACTICALS

1. Draw different types of following rectifier circuits using MATLAB/Simulink/Open Source Software and take print out of
   (a)Single phase half wave
   (b)Single phase full wave
2. Simulate three resistances in series circuit and find out voltage and current in each resistance .
3. Simulate the following circuits and find out voltage and current in each resistance
   (a)Two resistances in parallel
   (b)Resistance and inductor in parallel
4. Simulate R-L series circuit and observe voltage wave forms across each component.
5. Simulate R-C series circuit and observe voltage wave forms across each component.
6. Simulate R-L-C series circuit and observe voltage wave forms across each component.
7. Simulate R-L-C parallel circuit and observe current wave forms across each component.

8. Simulate star connection using resistors and observe voltage current relation of line and phase.
9. Simulate delta connection using resistors and observe voltage current relation of line and phase.
10. Simulate single phase half-wave rectifier circuit.
11. Simulate single phase full-wave rectifier circuit.
12. Simulate single phase bridge rectifier circuit.

LIST OF RECOMMENDED BOOKS

1. Computer Aided Electrical Drawing by M. Yogesh, B.S. Nagaraja, N. Nandan, Prentice Hall of India.
2. Mastering electronics workbench: Version 5 and Multisim Version 6 by John Adams, McGraw-Hill, New Delhi
3. Electrical Drafting by S.F. Divalapur, Eastern Book Promoters, Belgaum.
4. Getting Started with MATLAB by Rudra Pratap

6.5 PROJECT WORK

L	T	P
-	-	12

RATIONALE

Major 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 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 or by undertaking a project. In addition, the project work is intended to place the learner for project oriented practical training in actual work situation for the stipulated period with a view to:

- 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 firsthand 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 (say at the end of second year). Students should be allotted a problem of interest to him/her as a major 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. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

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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.

Some of the project activities 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.
- Projects related to design, fabrication, testing and application of simple digital circuits and components.
- Projects related to microprocessor/microcontroller based circuits/ instruments.

A suggestive list of project is given below:-

1. Design and fabrication of control panel for various applications in the field of electrical engineering.
2. Rewinding of a single phase/three phase induction motor
3. Fabrication of working model of a solar thermal power plant.
4. Design and fabrication of automated car parking system.
5. Design and fabrication of automated gate control of railway crossing.
6. Design and fabrication of electrical resistive/inductive/capacitive loads.
7. Design and fabrication of remote control of various domestic electrical appliances.
8. Design and fabrication of microcontroller based DC drive system.
9. Design and fabrication of automatic water level control system.
10. Design and fabrication of automatic solar battery charger.
11. Fabrication of automatic star-delta starter.
12. Fabrication of working model of hydro electric power plant.
13. Fabrication of sine wave inverter up to 500VA.
14. Fabrication of water level indicator.
15. Fabrication of rain/fire/ smoke/burglar detector.
16. Fabrication of automatic solar panel based street lights.
17. Fabrication of automatic solar panel based traffic lights
18. Fabrication of automatic voltage stabilizer up to 1 KVA.
19. Fabrication of working model of wind power plant.
20. Fabrication of heat convector blower with humidifier.
21. Fabrication of oil based radiation type room heater.
22. Fabrication of small 1- phase transformer up to 1KVA.
23. Fabrication of UPS up to 500VA.

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24. Fabrication of a distribution board as per requirement.
25. Fabrication of Direct-On-Line (DOL) starter.
26. Fabrication of solar tracking system.
27. Fabrication of automatic power factor corrector.
28. Fabrication of desert cooler/ room cooler.
29. Fabrication of electric/solar water heater.
30. Erection, installation & commissioning of electrical equipments.
31. Fault detection & repair of electrical/ electronic instruments.
32. Drawing, estimating and costing of electrical installation of the institution from supplier's pole to the institution distribution board.
33. Drawing, estimating and costing of electrical installation of a workshop having a given number of electrically operated appliances/machines.
34. To study the laying out of underground distribution cable for a small colony starting from main distribution pole.
35. To study the erection of a 5 pole span over head line for a small distance for distribution of electrical energy and to prepare list of material required.
36. Energy audit for the workshop of your institution & to suggest remedies to reduce electricity bills.
37. Estimate the material required to provide a service connection to a consumer's premises for domestic purposes.
38. To survey the load of a given area in a village, small colony, calculate the effective load and find out the sizes of cables/conductors for the proposed distribution system.
39. Designing of light and fan scheme for an institutional or commercial building.
40. To study and estimate the material required during augmentation of a nearby pole mounted sub-station.
41. To study and estimate the material required during augmentation of a nearby in door sub-station.
42. To study and estimate the material required for a solar power station up to 100KW after visiting the actual site
43. To prepare a proposal for substation of your institution , calculating the total load (estimating and costing)
44. Installation of home security system
45. Detection of electricity theft control system with wireless indication system
46. Fabrication of cyclo-converter (frequency changer)
47. Design and fabrication of panel for automatic switching of DG set with supply system
48. Design and fabrication of wireless AC Power transmission.
49. Design and fabrication of solar energy bored projects like solar cooker, solar dryer, solar street light, solar inverter, solar pump, solar emergency light etc.

NOTE: The project should be preferably undertaken by a group of students depending upon cost and time involved.
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 the external (person from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance Criteria	Max. Marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9	Viva voce	10%	10	8	6	4	2
Total marks		**100**	**100**	**80**	**60**	**40**	**20**

The overall grading of the practical training shall be made as per following table.

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared "not eligible to receive diploma". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

	Range of maximum marks	Overall grade
i)	More than 80	Excellent
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

Important Notes

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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 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work

10. RESOURCE REQUIREMENT

10.1 PHYSICAL RESOURCES

(A) Space requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) are to 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.

(B) Equipment requirement:

Following Laboratories are required for Diploma Programme in Electrical Engineering:

- Communication Laboratory
- Applied Physics Laboratory
- Applied Chemistry Laboratory
- Engineering Drawing
- Electrical Engineering Laboratory
- Basics of IT/Computer Laboratory
- Carpentry Shop
- Painting and Polishing Shop
- Electrical Shop
- Welding Shop
- Fitting and Plumbing Shop
- Sheet Metal Shop
- Mason Shop
- Machine Shop
- Measurement and Instrumentation Laboratory
- Electrical Machines Laboratory
- Installation, Maintenance & Repair Laboratory
- Environment Engineering Lab

- Energy Conservation Lab

EQUIPMENT REQUIRED FOR CIVIL ENGINEERING

Sr. No.	Description	Qty	Total Price (Rs)
COMMUNICATION LABORATORY			
1.	Stools	40	10,000
2.	Display Board/Screen	2	6,000
3.	Sound recording and playing system	1	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	1	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	1 each	20,000
8.	English spoken course	1	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	1	30,000
10.	**Miscellaneous**	**LS**	**1,500**
APPLIED PHYSICS LABORATORY			
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12	2,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12	2,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12	2,000
4.	Mirrors (convex, concave)	5 Each	1,500
5.	Pendulum Setup	02	4,000

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6.	Gravesand's Apparatus	02	3,000
7.	Inclined Plane Setup	02	2,000
8.	Flywheel Setup	02	4,000
9.	Prism	05	1,500
10.	Spectrometer	02	25,000
11.	DC Ammeters Moving coil weston-type ammeter with ebonite stand	10	3,500
12.	DC Miliammeters	2	1,000
13.	DC Microammeters	2	700
14.	DC voltmeters	10	700
15.	DC Millivoltmeters	10	2,000

Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
16.	Sensitivity Galvanometer	2	800
17	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	2	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	2	1,000
20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	8	8,000
21.	Resistance boxes (dial type) assorted	8	8,000
22.	Rheostats	10	4.000
23.	Miscellaneous items (Spring, Pan, Glycerine, Optic fibre,	LS	2,000

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	Ferromagnetic material)		
24.	Fortin's Barometer (Wall type)	2	20,000
25.	Stoke's Apparatus	2	10,000
26.	Gumther's Apparatus	2	16,000
27.	Resonance Tube Apparatus with accessories and Tuning fork set	2	14,000
28.	Sodium Lamp setup with Biprism	2	10,000
29.	Ohmic resistance coil	10	5,00
30.	Slide wire bridge	2	8,000
31.	PN Junction diode Apparatus	2	10,000
32.	Laser (as per requirement)	1	1,00,000
33.	Numerical aperture setup	1	25,000
34.	**Miscellaneous**	**LS**	**3,000**

APPLIED CHEMISTRY LABORATORY			
	Digital Balance	**1**	80,000
	Burette 50ml	30	3,000
	Pipette 25ml	60	4,000
	Beakers 100ml	60	4,000
	Burette stand	30	30,000
	Glazed tile	30	1,000
	Conical flask 50ml (Titration flask)	**60**	4,000
	Standard (Measuring) flask (to prepare standard solution) 250ml/100ml	30	6,000
	Able's Flash Point apparatus	2	10,000
	(1/10)°C thermometer	06	6,000

Sr. No.	Description	Qty	Total Price (Rs)
	Candles	20	100
	Crucible with lid	06	2,000
	Muffle furnace	1	18,000
	Decicators	06	8,000
	Pair of tongue (small and big)	24 (small) 2 (big)	2,000
	Chemicals EDTA-1 kg Eriochrome Black-T(solochrome black T)-200g Buffer solution (NH_3 - 2.5 ltr, NH_4Cl – 1 kg) Zinc sulphate- 500g H_2SO_4- 2.5 ltr Phenolphthalein indicator (as per requirement) Methyl orange indicator (as per requirement) Charcoal (as per requirement) Kerosene- 1 ltr	LS	20,000
	Miscellaneous	**LS**	**2,000**
ENGINEERING DRAWING			
1.	**Drawing Boards (700 x 500mm)**	**60**	**25,000**
2.	**Draughtsman Tables**	**60**	**1,80,000**
3.	**Draughtsman Stools**	**60**	**40,000**
4.	**Computer Aided Drawing (CAD) Software**	**30 User**	**5,00,000**

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5.	**Model of different wooder joints**	**1**	**1,000**
6.	**Model of different screw threads**	**1**	**1,000**
7.	**Model of various locking devices**	**1**	**1,000**
8.	**Model of various joints**	**1**	**1,000**
9.	**Cut section Model of various couplings**	**1**	**3,000**
10.	**Miscellaneous**	**LS**	**5,000**
ELECTRICAL ENGINEERING LABORTORY			
1.	Voltmeter	5	7,500
2.	Ammeter	5	10,000
3.	CRO	1	15,000
4.	Wattmeter	5	10,000
5.	Multimeter	1	4,000
Sr. No.	Description	**Qty**	**Total Price (Rs)**
6.	Resistive load	1	4,000
7.	Regulated supply	1	8,000
8.	Signal generator	1	5,000
9.	Rheostat	2	2,500
10.	Lead acid battery	1	4,000
11.	Cables, Coils, Lamp (as per requirements)	LS	1,500
12.	Resistance, Inductor, Capacitor (as per requirements)	LS	1,500
13.	**Miscellaneous**	**LS**	**1,500**
BASICS OF IT LABORATORY/COMPUTER LABORATORY			
	Computer System with latest configuration	30	8,00,000
	Printer (MFP)	1	25,000

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	Printer (Laser)	1	35,000
	Plotter	1	75,000
	Digitiser	1	50,000
	Antivirus Software	LS	10,000
	Internet Facility on Computers	LS	2,00,000
	LCD Projector	1	35,000
	UPS	60	1,20,000
	Software (latest windows, latest MS Office)	1	1,00,000
	Scanner	1	10,000
	Auto CAD	L.S.	
	Auto Civil	L.S.	
	STAAD Pro	L.S.	
	Primavera/MS Project	L.S.	
	Revit	L.S.	
	BIM	L.S.	
	Miscellaneous	**LS**	**5,000**
CARPENTRY SHOP			
1	Work benches fitted with carpenter vices	5	20,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000
4.	Bench grinder	1	5,000
5.	Drilling machine	1	8,000
6.	Wood turning lathe	1	40,000
7.	Wood Planner	1	20,000

8.	Tool accessories measuring and marking Instruments	25	25,000
9.	Band saw blade brazing unit	1	10,000
10.	**Miscellaneous**	**LS**	**1,500**
Sr. No.	Description	**Qty**	**Total Price (Rs)**
PAINTING AND POLISHING SHOP			
1.	**Spray gun with hose pipe**	**1**	**1,000**
2.	**Paint brushes**	**20**	**2,000**
3.	**Paint/Varnish**	**LS**	**2,000**
4.	**Air Compressor with 2 hp motor**	**1 set**	**10,000**
5.	**Miscellaneous**	**LS**	**2,000**
ELECTRICAL SHOP			
	Tool kit (Plier, Srew driver, Knife, Steel rule, hammer, sciber, pincer steel tape etc.)	20	20,000
	Fuses, Switches, Plugs, Sockets, Ceiling rose, Wires, cleats, Clamps, Test lamp, Tester.(as per requirement)		8,000
	Electric Iron	1	1,500
	Electric kettle	1	1,500
	Ceiling fan/table fan	1	2,500
	Desert cooler	1	5,000
	Lead acid battery	2	8,000
	Battery Charger	1	6,000
	Miscellaneous		3,000
WELDING SHOP			
1.	Electrical welding transformer set with accessories	3	30,000
2.	Gas Cutting Unit	1	3,000

3.	Work benches with vices	3	5,000
4.	Welding generator set	1	10,000
5.	Oxy acetylene welding set with accessories	1	7,000
6.	Acetylene generating set	1	6,000
7.	Electric welder tool kit	10	10,000
8.	Projection welding machine	1	15,000
9.	Brazing equipment with accessories	1	10,000
10.	Soldering irons	3	1,000
11.	Pedestal grinder	1	10,000
12.	Metal spraying gun	1	10,000
13.	Spot welder	1	25,000
14.	TIG welding set	1	1,00,000
15.	MIG welding set	1	1,00,000
16.	Welding Partition Screen	5	2,500
17.	**Miscellaneous**	**LS**	**3,000**

Sr. No.	Description	**Qty**	**Total Price (Rs)**
FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribers	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribers	25	50,000
5.	Tool kits – taps, dies, drills	25	40,000

6.	Tool kits – chiesels, hammers, files, hacksaw	25	25,000
7.	Drilling machine	2	12,000
8.	Pipe vice	4	1,000
9.	Chain wrenches	5	1,250
10.	Ring spanner set	5	600
11.	Pipe die set 2”	2 set	1,000
12.	Pipe bending device	1	5,000
13.	Various plumbing fittings	LS	2,000
14.	**Miscellaneous**	**LS**	**1,500**
SHEET METAL SHOP			
1.	Hammers	8	3,000
2.	Mallets (Hard & Soft)	5	2,000
3.	Sheet and wire Ganges	LS	8,00
4.	Shearing Machine	1	20,000
5.	Bar folding Machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminium)	1 Each	1,000
8.	Hand Shears/Snippers	4	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	5,00
10.	**Miscellaneous**	**LS**	**1,000**
MASON SHOP			
	Mason Trowel	**10**	**1,000**
	Concrete Finishing Trowel	**10**	**1,000**
	Gauging Trowel	**10**	**1,000**

	Margin Trowel	**10**	**1,000**
	Pointing Trowel	**10**	**1,000**
	Round Trowel	**10**	**1,000**
	Mason/Brick Hammer	**10**	**3,000**
	Comb hammer	10	3,000
Sr. No.	Description	**Qty**	**Total Price (Rs)**
	Blocking chisel	10	1,000
	Plumb bob	10	500
	Spirit level	10	1,000
	Straight Edge	10	1,000
	Jointer	10	1,000
	Masonry Pan	10	1,500
	Steel Measuring Tape	10	500
	Miscellaneous (Bricks, Blocks, Stones, Sand, Cement)	10	3,000
MACHINE SHOP			
1.	Centre lathes	10	6,00,000
2.	Grinder	1	10,000
3.	Universal milling machine	1	1,25,000
4.	Shaper	2	1,20,000
5.	Plainer	2	1,20,000
6.	Work bench	3	10,000
7.	Precision instruments	1	10,000
8.	Hand tools and accessories	2	8,000

9.	CNC trainer lathe	1	4,00,000
10.	**Miscellaneous**	**LS**	**5,000**

Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
MEASUREMENT AND INSTRUMENTATION 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 b) Ammeter 50 mA , 100 mA, 1000 mA c) Ammeter 0-10 Amp – 20 A d) Ammeter 0 -2.5- 5 Amp e) Voltmeter 0-30 V f) Voltmeter 0-10-15 V, 0-200 – 300 V, 0-200-500 V	 8 6 6 8 8 6	 10,000 7,200 7,200 10,000 10,000 7,200
2.	Stabilized DC Power Supply With maximum 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,0-1.5Aand also with short circuit (0-30 V) and over load protection with measuring devices	8	32,000
3.	Lead Acid Batteries 12 V, 11 plates, 30 amp hour capacity	2	6,000
4.	Battery Charger: SCR based automatic 12 V, AC input voltage 230 V, output dc voltage 0-12 V, 0-2 amp. capacity provided with voltmeter, Ammeter of suitable range	1	3,000
5.	Capacitors: enclosed in a polished hard wood/bakelite box, with four brass terminals	6	1,800

6.	Hydrometer for measuring specific gravity of lead acid battery range 1100 - 1300	6	1,000
7.	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	600
8.	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	1	750
9.	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 $\pm$ 1% FSD, housed in teak wood/ebonite case, with leather case	2	10,000

Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
10.	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	2,000
	b) 0-5-10 amp	8	8,000
	c) 0-2 amp	1	1,000
	d) 0-125-250 volts	5	5,000
	e) 0-250-500 volts	4	4,000
11.	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	7,500
12.	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 olerances $\pm$ 2%		
	a) Single tube 150 ohm – 2 A		
	b) Single tube 300 ohm – 5 A		

	c) Double Tube 500 ohms – 20 A, 30 A d) Double Tube 440 ohms – 3 A e) Double Tube 110 ohms – 10 A	3 3 3 3 3	4,500 5,000 6,000 6,000 6,000
13.	Dimmerstat: Single phase 0-230 V, output 0-270 V, 10A	2	5,000
14.	Inductance: Coil mounted provision for change in value, well polished teak board with terminals fitted with 2.5 Kg variable core	3	7,500
15.	Variable Inductor: Single phase, 250 V, mounted on well polished teak wood frame with terminals, 2.5 kW, continuously variable core type.	1	2,000
16.	Energy meters: a) single phase, induction type, 50 Hz, 5A/10A, 250 V, accuracy± 1% b) 3 phase, Induction type, 4 wire,.440 V, 20-40A, 50 Hz, accuracy ± 1%	3 3	1,500 3,000
17.	Phase Regulator: 10A, 250V,2.5 KVA variable power factor and lagging to leading arrangement indicator	1	5,000
18.	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	2,500
Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
19.	Load: 3 phase variable resistive load, 415 V, 10 KW, trolley mounted tube type provided with switches to vary the load in twenty steps, Continuously variable inductive load, 415 V, 10 kW terminal for end connections	2	10,000
20.	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	4,000
21.	Frequency meter: a) Digital, 4 digit LED display frequency meter suitable for use on 230 V AC main supply range 20-99 Hz b) Vibrating Reed type 230 V, having 21 reed 40-60 Hz. abs Body	1	1,500

	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 1	1,000 1,500
22.	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 (Horizontal) frequency 25 to 50 Hz.	1	500
23.	Thevenin Theorem Module: complete with accessories and the measuring instrument, operated by 6 volt dc supply	1	2,500
24.	Norton theorem Module: Complete with accessories and measuring instruments operated by 6 volt dc supply	1	2,500
25.	Maximum Power transfer theorem module complete with accessories and measuring instruments operated by 6 volt dc supply	1	2,500
26.	Transformer: Single phase, core type, natural air cooled, 230/110 V, 1 KVA, 50Hz	1	2,000
ELECTRICAL MACHINES LABORATORY			
1.	Static Converter: 3-Phase, 415 V, 50 Hz, output 230 V dc 15 KW, regulation + 1%, servo controlled, thyristorised	1	30,000
2.	DC Shunt Motor - DC shunt motor 230 V, 3 hp/3 kW, 1440 rpm complete with appropriate panel board with meters, switches, indicators starter and field regulator.	1	30,000
3.	DC Series motor: DC series motor with interpole/compensating winding, 230 V, kw, 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	8,000
Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
4.	DC Motor-alternator set: DC shunt motor 230 V, 3 kw, 1440 rpm coupled with 3 phase 440 V, 50 Hz alternator having damper winding with exciter complete with appropriate panel board, starter and field regulators	2	25,000
5.	Squirrel Cage Induction Motor: 3-phase squirrel cage induction motor 3 Kw, 415 V, 50 Hz, 1440 rpm all six	1	6,000

	terminals brought out, complete with appropriate panel board, starter etc.		
6.	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	20,000
7.	Single phase Induction Motor(various types): Capacitor start with centrifugal switch 0.5 KW with suitable loading arrangement and appropriate panel board.	1	3,000
8.	Servo motor: 230V, 50 Hz, Servo motor	1	10,000
9.	1-phase transformer: Single phase transformer, 230/115 V, 50 Hz, 3 KVA housed in a metal tank	4	12,000
10.	3-Phase transformer: Three phase transformer, 415/230V,50 Hz, 5 KVA all terminals brought out, housed in a metal tank	2	15,000
11.	Variacs: a) Single phase, 230 V, 50 Hz, 8-A auto transformer continuously valuable, housed in a metal body, portable b) Single phase 230 V, 50 Hz, 15-A transformer continuously valuable, housed in a metal body, portable c) Three phase, 230 V, 50 Hz, 30 A, 415-V transformer continuously valuable housed in a metal body, portable phase	3 2 3	6,000 7,000 30,000
12.	Loading Rheostats: a) Resistance type, single phase, 230V, 15A, each natural air cooled, housed in metal body fitted with switches and mounted on trolleys b) Resistance type, three phase 440V, 15A, natural air cooled, housed in metal body, switches and base wheels, six terminals brought out c) Continuously variable choke type loading coil, coil upto 15A, three phase, 440V, 50Hz, housed in a metal case on wheels (Trolley Aid) d) Capacitor bank, variable in steps through switches, 440V, 3 phase, 15A max. housed in a portable metal case	3 1 2	12,000 6,000 6,000

		1	6,000

Sr. No.	Description	Qty	Total Price (Rs)
13.	AC motor Starters a) DOL starter, suitable for 415V, 3 Phase, 50 Hz, 3kw induction motor b) Auto transformer starter for 3 phase, 415 V, 50 Hz,5 Kw induction motor with facility of tappings c) Star-delta starter suitable for 415V, 3 Phase, 50 Hz, 5 kw induction motor (i) Manual (ii) Automatic	1 1 1 1	2,000 3,000 3,000 3,000
14.	DC Motor starters: DC shunt motor starter, three point suitable for 230V, 3 kw motor	1	3,000
15.	Rheostats: Wire wound Rheostats (Approx. of following rating) 440 Ohm, 3A 110 Ohm 8A	15 10	4,500 3,000
16.	Tachometer: Digital non-contact type tachometers 0-10,000 rpm, 3 1/2 digit	4	8,000
17.	2.17 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 b) Ammeter 0-25 amp c) Ammeter 0-50A	6 6 6	3,000 3,000 3,000
18.	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) 0-15 b) 0-50 c) 0-150 d) 0-300 e) 0-600	 4 2 3 10 1	 3,000 1,500 2,250 7,000 700
19.	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 b) 0-3A c) 0-10A d) 0-20A	 3 3 7 7	 3,000 3,000 8,000 5,000

Sr. No.	Description	Qty	Total Price (Rs)
20.	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 b) 0-15V c) 0-30/60 V d) 0-150/300 V	 3 3 4 10	 2,000 2,000 3,000 7,000
21.	Multimeter: a) Digital/type: 3 1/2 digit LCD display manually operated multimeters with AC/DC 10 A and 10	 2	 2,500

	mega ohm, accuracy± 0.5% for DC and ±1% for AC 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	2,000
22.	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) b) 75/300/600 V and 1.5/20A (UPF) c) 75/150/300 V and 15/30A d) 110/220/440 V and 15/30A	2 2 4 4	4,000 4,000 8,000 8,000
23.	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 b) Portable type 3-phase single element type 110 V/ 240 V, 1 A or 5 A	1 1	2,500 2,500
24.	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 H b) Read type 230 V, range 40-60 Hz and 21 Read c) Digital type. 3 1/2 digit: LED, display frequency meter suitable for use on 230V AC main supply range 20-99Hz	1 1 1	1,500 1,500 1,000

Sr. No.	Description	Qty	Total Price (Rs)
25.	Synchroscope: Suitable for 110V AC, 1-phase, 50 Hz alongwith potential transformer, 230V and 415V on primary and 110V on secondary side	1	2,500
26.	Tong Testing Ammeter: 0-15 A/50A/100A Clip-on type	1	3,000
27.	Current Transformer: 100-50-25-10/5A	2	1,000
INSTALLATION, MAINTENANCE & REPAIR LABORATORY			
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 rpm, 230 V AC single phase, 50 Hz with essential spare	1	10,000
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	5,000
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	3,000
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 $\pm$ 1% AC voltage and current $\pm$ 2%, Ohmmeter + 3% with test leads and carrying case	2	3,000
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	6,000
6.	Fans of various type with one having solid State speed regulator: a) Ceiling fan: 1200 mm, 1500 mm sweep operating at 230V, 50Hz, supply AC b) Table fan: 400 mm sweep operating at 230 V, 50 Hz, supply AC c) Exhaust fan: 375 mm sweep operating at 230 V, 50 Hz, supply AC main 0.25 HP d) Desert cooler, complete with 375 mm sweep, 1400	1	1,000

	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 1 1	1,000 2,000 5,000

Sr. No.	Description	Qty	Total Price (Rs)
7.	Electrical Appliances:		
	1. Electric Kettle: 750 watts, 230V single phase AC, 50Hz, capacity 1 lit.		
	a) Filament type		
	b) Rod type rated 1000 watt.		
	2. a) Electric Iron, 500 watt, 230 V, Ordinary, 50 Hz, 1 Kg weight	3	2,000
	b) Electric Iron, 500 watt, 230 V, Automatic, 50 Hz, 1/2 Kg	3	2,400
	3. Electric Toaster: 500 watt	6	1,800
	4. Geyser 15 lit capacity, 2 Kw, 230 Volts 50 Hz, AC		
	5. Immersion rod: 1000 watt, 230 Volts 50Hz, AC supply operated	6	3,000
	6. Room Heater 1000 watt, 230 V, 50 Hz, AC supply	1	800
	a) Parabolic type	2	6,000
	b) Rod type (single rod/double rod)		
	7. Air convector: 1000 watts, 230 V, 50 Hz, with 2 temperature settings	12	3,600
	8. Mixer cum grinder: 250 watts, 230 volts, 50 Hz, 1 1/2 lit. capacity with various attachments (food processor)	6	2,400
	9. Heater: Wire wound type, 1000 watts, 230 V, 50 Hz supply	6	2,400
	10 Induction plate 2kW, 220V 1 ø A/C	2	3,000
	11. Hot plate: Single/double filament 1500/2000 watts, with control knobs operating at 230 V, 50 Hz, AC supply		
	12. Electrical Oven: 2 KW, with temperature control devices and temperature indicating meters operating at 230 volts, 50 Hz AC supply	1	3,000

	13. Refrigerator 165 litres		
	14. a) Washing Machine: 0.5 HP washing machine to be operated at 230 V 50 Hz, AC 20 lit. cap. round tank type	6	3,000
	b) Washing Machine: 0.5 HP washing machine to be operated at 230 V 50 Hz, AC 6.5 lit. semi-automatic	2	3,000
	15. Electric Shaver: 40-60 watts, to be operated at 230 V, 50 HP supply	4	4,000
	16. Electric Lighter: to be operated at 230 v, 50 Hz Electric/Electronic	1	2,000
		2	14,000
		1	2,500
		1	4,000
		1	1,000
		1	200

Sr. No.	Description	Qty	Total Price (Rs)
8.	Armature Growler: Armature testing growler suitable for finding faults in armature like open circuit, short circuit, ground fault, turn to turn fault and horted commutator etc. Suitable to work on 230V 50 Hz ac supply, Growler should be provided with testing probs and meters to indicate faults	1	2,000

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9.	Digital clip-on meter: Digital Clip-on meter with following specifications: 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	3	3,000
10.	Electric Blower: for cleaning equipment, powerful light weight with flexible hose 2 mts long complete with mains cable, standard Accessories i.e. Suction arrangement, hot air attachment, spray attachment suitable for an electric supply of 230 V 50Hz AC	1	6,000
11.	Miniature Circuit Breakers(MCBs) a) 16, 40 and 60 amps in single phase b) 100 amps 3 phase c) 200 amps 3 phase	 6 each 6 each 6 each	1,200 1,800 1,200 1,800
12.	Oil Testing Set: Oil testing set as per ISI 6792/1972 input voltage 220-250 volt, 50 Hz AC Output voltage 0-50 kv, accuracy +.4% of FSD Rate of rise of voltage automatic 2 Kv/Sec motorised	1	10,000
13.	Electric Lamps: a) Mercury vapour lamp 120 watt, 230v, 50 Hz AC supply complete with choke, lamp holder and power factor capacitor b) Mercury vapour lamp ML type 120/125 watt, 230 v, 50 Hz supply 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. e) Halogen lamps: 1000 watts/1500 watt, 230 v, 50 Hz complete with fittings(Fluorescent tube light) f) LED Tube	 2 2 4 2	 5,000 4,000 8,000 400

		1 50	300 20,000
Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
	g) Filament Lamps - 60 W lamp, 230 V - 60 W lamp, 100 V - 60 W lamp, 230 V - 200 W lamp - 500 W lamp - 100 W – 110 V lamp - 100 W - 150 V lamp h) CFL LAMP i) LED bulb 10W	 100 100 100 100 100 100 100 50 100	 1,000 1,000 1,000 1,500 1,500 1,500 1,500 7,500 10,000
14.	Emergency Light: a) 55 cm long, with 6 volts battery suitable for vertical and horizontal position b) (Fluorescent tube light) portable type twin tube 1"(25.4 mm) long with 6 volts battery for vertical and horizontal position	1 1	500 500
15.	Voltage Stablizer: 500 VA, input 170/260 volts, output 210- 240 volts automatic with voltmeter	2	2,000
16.	Bridge Insulation Tester: Transistorized battery operated bridge insulation tester battery operated push button indications built in wheat stone bridge Varley and Murray loop facilities for finding cable faults bridge suitable for 0.01 m to 11 m available in length of 200-1000 meters	1	5,000
17.	Automobile Electrical Wiring Demonstration working model for automobile Electric wiring	2	6,000

18.	Screw Driver Set: Electrician type round nickel plated steel blade, flat tip with plastic insulated handle following sizes: Blade Sizes 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	6 each	1,000
19.	Combination Pliers: 205 mm length with thick plastic insulated handle Insulated for 500 V (Taparia, PYE make)	8	2,500
20.	Long Nose Pliers: 150 mm insulated for 500 volts	12	1,000
21.	Diagonal Pliers: 150 mm insulated for 500 volts suitable for cutting hard wires	6	600
22.	Adjustable Wrench Chromium plated adjustable wrench lengths 255 mm max. opening 30 mm	6	3,000

Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
23.	a) Flat nose pliers: Rectangular section jaw and smooth gripping surface plastic insulated handles length 130 mm b) Slip Nose Pliers with slim long grains of half round section and smooth gripping surfaces plastic insulated handle length 130 mm c) Round Nose Pliers: With slim long round grains and plastic insulated handles lengths 130 mm	3 each 6 3	300 300 300
24.	Ball Pien Hammer: Ball pein hammer with polished fall and pein wooden handle having wts i) 250 gms ii) 500 gms iii) 800 gms	3 each	500
25.	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 ii) 4 x 75 mm iii) 4 x 100 mm		

		6	400
26.	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	300
27.	Tweezers a) With blunt serrated Jaws stainless steel nickel plated length 160 mm b) Pointed ends serrated jaws stain less steel nickel plated length 130 mm	1 1	50 50
28.	Work shop Scissors Stainless steel, scissors suitable for cutting insulation, paper, plastic etc. length approx. 150 mm	6	300
29.	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	300
30.	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	900
31.	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	800

Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
32.	Bearing Puller Three legs heavy duty bearing puller of size 100 mm/200 mm	1	400
33.	Automatic Centre Punch: Spring loaded action knurled shank centre punch length 115 mm and dia at point 2mm	2	200
34.	Wire Gauge: Suitable upto 0-76 SWG	1	200
35.	Try Square: Engineers try square from stainless steel with stock 90 degrees all sides accurately finished legs 150 x 100 mm	2	100
36.	Measuring tape: Pocket measuring tape of steel spring return device, flexible, clearly graduated in metric	6	200

	readings 2 mts long		
37.	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	1,000
38.	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	100
39.	Screw Driver Mains Voltage Tester: Flat tip screw driver with built in new test lamp transparent plastic handle insulated block, metal pocket clip suitable upto 400 v. AC blade 4 x 100 mm Overall length 180 mm	2	100
40.	Cable Knife: Electrician knife blade made from stainless steel with length 50 mm plastic moulded handle overall length 180 mm	12	100
41.	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	6,000
42.	Rubber Mallet: Soft Rubber with wooden handle approx. 200 gms	6	300
Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
43.	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 Figure Stamp Set for marking made from high grade stainless steel figure height 4mm complete with plastic box	3	300
44.	Letter Stamp Set: Made from high grade steel, character set height 4 mm, full set of alphabets complete with plastic box	2	200

45.	L - End Key Set: a) Metric set of 10 wrenches from 1.5 to 10 mm complete with plastic wallet 4 set b) Imperial set of 7 wrenches from 1/16" to 1/4" complete with plastic set wallet	1 1	100 200
46.	Box Spanner Set: Round shank in chrome vanadium steel Hexagonal socket plastic handle set of nine spanners sizes 3, 4, 5, 6, 7, 8,10, 12 and 14 mm overall length 150 mm	1	200
47.	Open Ended Spanner Set: Double ended chrome vanadium steel jaws, jaw angle 15' oval shank set of 8 spanners. Jaw width 4x5, 5x5, 6x7, 7x8, 9x10, 10x12, 12x14 mm	2	800
48.	Soldering Iron: Soldering iron 35 watts, 65 W, 100 Watts operating at 230 V, 50 Hz supply	2	300
49.	Oil Can: 0.75 lit capacity	2	100
50.	Blow Lamp: 1 Pint kerosene oil capacity blow lamp	3	400
51.	Hand Saw: Hand saw 10" (254) size 10 teeth per inch teak wood handle	6	300
52.	Chisels: Former chisel mode of carbon steel of size 6 mm x 15 mm	3	150
53.	Wrench Set: Set of 5(3/8 to 1 inch) chrome vanadium sets steel, offset type, points, accurately sizes capacity 3/8x7/16, 1/2x9/16, 5/8x1/16, 3/4x7/8 and 15/16x1 inch (in metric sizes)	2	1,000
54.	Pipe Wrench: High tensile steel, drop forged, hardened and tempered app. cap. 6 to 50 mm dia	3	500
55.	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	1,500
56.	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	1,500
57.	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	1,500
Sr. No.	**Description**	**Qty**	**Total Price (Rs)**
58.	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	5,000

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59.	Tube light, 230V, 50HZ, 1-Ø	10	500
60.	Starter, 230V, 50HZ, 1-Ø for Tube Light	10	400
61.	Choke, 230V, 50HZ, 1-Ø for Tube Light	10	1,000
62.	Alarm bell electric, 230V, 50HZ, 1-Ø	6	900
ENVIRONMENT ENGINEERING LABORATORY			
1.	pH Meter	01	500
2.	Turbidity Meter	01	5000
3.	Oven with Temperature Controller and Forced Air Circulation Type	01	20000
4.	B.O.D. Incubator	01	25000
5.	Water Analysis Kit	01	5000
6.	High Volume Sampler	01	40000
7.	Electrical Balance for weighing upto 1/10 of milligram (capacity)	01	1000
ENERGY CONSERVATION LABORATORY			
1	Clamp meter	02	5000
2	Multimeter	02	2000
3	Power Analyser	01	20000
4	Different types of lamps (LS) 60 W lamp, 230 V , 100 V 200 W lamp 500 W lamp 100 W lamp, 110 V, 150 V	10	500
5	Lux meter	02	5000
6	Centrifugal pump, 1 kW	1	15,000

7	Standard window A.C.	01	20000
8	Anemometer	02	5000
9	Thermometer	03	2000
10	Flow meter	02	10000
11	Pumping set with at least two pumps of different capacity.	1 set	10000
12	Pressure gauge fitted on discharge lines	1 set	2000
13	Variable Frequency Drive	02	50000
14	A small compressor with a small network of pipe line fitted with suitable pipeline, pressure gauge, safety valve and loading / unloading pressure switch.	1	3000
15	Stop watch	2	1000
16	Small blower (1.5 kW motor) with inlet and outlet ducts of approximately one meter length on both sides	1	10000
17	Black Box (for checking lamp efficacy including stand and luxmeter)	1	25000

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.

(C) Furniture Requirement

Norms and standards laid down by AICTE be followed for working out furniture requirement for this course.

10.2 Human Resources Development:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, work load norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE.

11. EVALUATION STRATEGY

11.1 INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavor is to ensure the quality of the product which can be assessed through learner's evaluation.

The purpose of student evaluation is to determine the extent to which the general and the specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processes and to get feedback for curriculum improvement. It helps the teachers in determining the level of appropriateness of teaching experiences provided to learners to meet their individual and professional needs. Evaluation also helps in diagnosing learning difficulties of the students. Evaluation is of two types: Formative and Summative (Internal and External Evaluation)

Formative Evaluation

It is an on-going evaluation process. Its purpose is to provide continuous and comprehensive feedback to students and teachers concerning teaching-learning process. It provides corrective steps to be taken to account for curricular as well as co-curricular aspects.

Summative Evaluation

It is carried out at the end of a unit of instruction like topic, subject, semester or year. The main purpose of summative evaluation is to measure achievement for assigning course grades, certification of students and ascertaining accountability of instructional process. The student evaluation has to be done in a comprehensive and systematic manner since any mistake or lacuna is likely to affect the future of students.

In the present educational scenario in India, where summative evaluation plays an important role in educational process, there is a need to improve the standard of summative evaluation with a view to bring validity and reliability in the end-term examination system for achieving objectivity and efficiency in evaluation.

11.2 STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

- Theory
- Practical Work (Laboratory, Workshop, Field Exercises)
- Project Work
- Professional Industrial Training

A. Theory

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

learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional /class-tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section-1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

It should contain short answer/completion items. The weightage to this section should be of the order of 40 percent of the total marks. Again, no choice should be given in section-II

Section-III

It may contain two to three essay type questions. Total weightage to this section should be of the order of 40 percent of the total marks. Some built-in, internal choice of about 50 percent of the questions set, can be given in this section

Table II : Suggested Weightage to be given to different ability levels

Abilities	Weightage to be assigned
Knowledge	10-30 percent
Comprehension	40-60 percent

Application	20-30 percent
Higher than application i.e. Analysis, Synthesis and Evaluation	Upto 10 percent

B. Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals/field exercises) aims at assessing students ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behaviour and it should be followed by viva-voce.

C. Project Work

The purpose of evaluation of project work is to assess students ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

D. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. The formative and summative evaluation may comprise of weightages to performance in testing, general behaviour, quality of report and presentation during viva-voce.

12. RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

This curriculum document is a Plan of Action and has been prepared based on exhaustive exercise of curriculum planning and design. The representative sample comprising selected senior personnel (lecturers and HODs) from various institutions and experts from industry/field have been involved in curriculum design process.

The document so prepared is now ready for its implementation. It is the faculty of polytechnics who have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that a proper mix of different teaching methods in all these places of instruction only can bring the changes in stipulated students behaviour as in the curriculum document. It is important for the teachers to understand curriculum document holistically and further be aware of intricacies of teaching-learning process (T-L) for achieving curriculum objectives. Given below are certain suggestions which may help the teachers in planning and designing learning experiences effectively. These are indicative in nature and teachers using their creativity can further develop/refine them. The designers of the programme suggest every teacher to read them carefully, comprehend and start using them.

(A) Broad Suggestions:

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

2. An academic plan needs to be prepared and made available to all polytechnics well in advance. The Principals have a great role to play in its dissemination and, percolation upto grass-root level. Polytechnics, in turn are supposed to prepare institutional academic plan.

3. HOD of every Programme Department along with HODs and incharges of other departments are required to prepare academic plan at department level referring to institutional academic plan.

4. All lecturers/Senior lecturers are required to prepare course level and class level lesson plans referring departmental academic plan.

(B) Course Level Suggestions

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives.

Polytechnic teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period of time. It is essential for them to use the given time judiciously by planning all above activities properly and ensure execution of the plan effectively.

Following is the gist of suggestions for subject teachers to carry out T-L process effectively:

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

2. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan. They may follow steps for preparing lesson plan e.g. drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver planned subject content, check desired learning outcomes and reinforce learning etc.

3. Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.

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

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

6. There is a dire need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a good beginning to provide lab experiences effectively.

7. Planning of progressive assessment encompasses periodical assessment in a semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive feed back to every student

8. The student centred activities may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.

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

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

12. Students may be given relevant and well thought out project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment.

13. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, research institutes and other relevant field organizations in the state.

13. LIST OF PARTICIPANTS

The following experts participated in workshop for Developing the Curricula Structure and Contents of various Diploma Programmes for UP State on 5-6 April, 2018 at NITTTR, Chandigarh:

1. Sh. Pankaj Yadav, Assistant Director, Directorate of Technical Education, Kanpur
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3. Mohd. Qamruzzaman, Lecturer English, Government Polytechnic, Kanpur
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24. Dr. AB Gupta, HOD, CDC, NITTTR, Chandigarh

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1. Sh. S.K. Govil, Ex Secretary, SIMT, JEEC
2. Dr. Amrita Mishra, Lecturer, Chemistry, Government Polytechnic, Lucknow
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10. Sh. Brijesh Mishra, Softpro India
11. Sh. Ajay Choudhary,,Softpro India
12. Sh. FR Khan, JEEC, UP
13. Sh. K. Ram, Joint Director, (CZ)
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25. Sh. Pravesh Verma, Electrical Engg. Board of Technical Education, Lucknow
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