Curriculum for

Diploma Programme in

ELECTRICAL ENGINEERING

For the State of Uttar Pradesh

Prepared by:
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National Institute of
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March, 2019

Approved and Implemented by B.T.E,U.P
(Effective from session 2019-20)

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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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Director

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ACKNOWLEDGEMENTS

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

i) Sh. Bhuvnesh Kumar , IAS, Secretary Govt. of UP, Technical Education Department, Secretariat Lucknow.

ii) Sh.R.C. Rajput,Director, Technical Education, UP for taking keen interest in the review of this curriculum.

iii) Sh.ManojKumar, Director, I.R.D.T.,Kanpur for entrusting this project of Curriculum revision to NITTTR, Chandigarh.

iv) Secretary, Board of Technical Education, UP for keen interest for this project of review curriculum.

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

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

vii) Sh. AshokKushwaha,TextBookOfficer/CDCOfficer,IRDT,Kanpur

viii) Faculty/SubjectExperts from U.P. Government polytechnics

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

x) Ramesh Gupta, UDC for her support and secretarial assistance in the conduct of Curriculum workshops at Chandigarh

xi) Amit Kumar Sachdeva, LDC, Curriculum Development Centre for word processing this document

Coordinator

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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**

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.

5.1 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

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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**

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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

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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

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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

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

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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

L	T	P
6	-	-

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

L	T	P
6	-	6

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

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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 (%)
1	14	20
2	18	24
3	08	12
4	08	12
5	10	14
6	12	18
Total	**70**	**100**

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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

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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