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**

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

FIRST SEMESTER

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

* Common with other diploma programmes

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

SECOND SEMESTER

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

* Common with other diploma programmes

** Common with diploma in Chemical Engg.

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

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THIRD SEMESTER

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

* Common with other diploma programmes

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

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FOURTH SEMESTER

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

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

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

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FIFTH SEMESTER

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

* Common with other diploma programmes

** Elective (Any one out of the following)

5.5.1 Renewable Sources of Energy

5.5.2 Electric Traction

5.5.3 Control of Electrical Machine

5.5.4 Energy Management

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

SIXTH SEMESTER

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

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

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

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

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

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

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

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

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

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

3.1 APPLIED MATHEMATICS –III

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Matrices (16 Periods)

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

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

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

1.4 Eigen Pairs, Cayley-Hamilton Theorem

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

2. Differential Calculus (15 Periods)

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

2.2 Partial Differentiation

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

2.3 Vector Calculus

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

3. Differential Equation (15 Periods)

3.1 Formation, Order, Degree, Types, Solution

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

3.2 First Order Equations

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

3.3 Higher Order Linear Equation :

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

3.4 Simple Applications

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

4. Integral Calculus-II (12 Periods)

4.1 Beta and Gamma Functions

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

4.2 Fourier Series

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

4.3 Laplace Transform

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

5. Probability and Statistics (12 Periods)

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

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

INSTRUCTONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

3.2 ELECTRICAL INSTRUMENTATION AND MEASUREMENT

L	T	P
6	-	4

RATIONALE

Diploma holders in Electrical Engineering have to work on various jobs in the field as well as in testing laboratories and on control panels, where he performs the duties of installation, operation, maintenance and testing by measuring instruments. Persons working on control panels in power plants, substations and in industries will come across the use of various types of instruments and have to take measurements.

Instruments used to read and observe the general electrical quantities like current, voltage, power, energy, frequency, resistance etc and their wave shapes, have been incorporated in this subject. So the technician will know the construction and use of various types of electrical instruments.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

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

DETAILED CONTENTS

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

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

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

   2.1 Concept of ammeter and voltmeters and difference between them
   2.2 Construction and working principles of moving Iron and moving coil instruments
   2.3 Merits and demerits, sources of error and application of these instruments

3. Wattmeters (Dynamometer Type) (06 Periods)

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

4. Energymeter (10 Periods)

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

   4.5 Digital energy meter (diagram, construction and application)

5. Miscellaneous Measuring Instruments: (18 Periods)

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

b) PT

6. Electronic Instruments: (06 Periods)

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

7. LCR meters. (04 Periods)

Study of LCR meters and their applications

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

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

9. Transducers (10 Periods)

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

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

10. Measurement of Temperature (09 Periods)

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

11. Smart Metering System (06 Periods)

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

LIST OF PRACTICALS

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

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

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Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

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3.3 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

L	T	P
6	-	-

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Classification (10 Periods)

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

2. Conducting Materials (12 Periods)

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

corrosion, contact resistance. Application in the field of electrical engineering.

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

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

2.3.4 Introduction to bundle conductors and its applications.

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

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

2.5 High resistivity materials and their applications e.g., manganin, constantan, Nichrome, mercury, platinum, carbon and tungsten

2.6 Superconductors and their applications

3. Review of Semi-conducting Materials (12 Periods)

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

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

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

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

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

4.4 Chemical Properties:
Solubility, chemical resistance, weatherability

4.5 Mechanical properties, mechanical structure, tensile structure

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

5.1 Plastics

5.1.1 Definition and classification

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

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

5.2 Natural insulating materials, properties and their applications

- Mica and Mica products
- Asbestos and asbestos products
- Ceramic materials (porcelain and steatite)
- Glass and glass products
- Cotton
- Silk
- Jute
- Paper (dry and impregnated)
- Rubber, Bitumen
- Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
- Enamels for winding wires
- Glass fibre sleeves

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

6. Magnetic Materials: (10 Periods)

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

6.2 Soft Magnetic Materials:

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

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

6.2.3 Nickel-iron alloys

6.2.4 Soft Ferrites

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

7. Special Materials (10 Periods)

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

8. Materials for Electrical Machines (10 Periods)

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

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http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

3.4 DIGITAL ELECTRONICS

L	T	P
5	-	4

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Number Systems (10 Periods)

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

2. Gates (08 Periods)

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

3. Boolean Algebra (12 Periods)

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

4. Combinational Circuits (12 Periods)

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

5. Flip-Flops (09 Periods)

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

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

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

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

8. Semi-conductor Memories (05 Periods)

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

LIST OF PRACTICALS

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

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

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3.5 ELECTRICAL MACHINES - I

L	T	P
6	-	4

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Introduction to Electrical Machines (20 Periods)

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

2. DC Machines (25 Periods)

2.1 Main constructional features, Types of armature winding
2.2 Function of the commutator for motoring and generation action
2.3 Factors determining induced emf
2.4 Factors determining the electromagnetic torque
2.5 Various types of DC generators
2.6 Significance of back e.m.f., the relation between back emf and Terminal voltage
2.7 Armature Reaction
2.8 Methods to improve commutation
2.9 Performance and characteristics of different types of DC motors
2.10 Speed control of dc shunt/series motors
2.11 Need of starter, three point dc shunt motor starter and 4 point starter
2.12 Electric Braking
2.13 Applications of DC motors
2.14 Faults in dc machines and their retrospective
2.15 Losses in a DC machine
2.16 Determination of losses by Swinburne's test
2.17 Rating and Specifications of DC machines

3. Single Phase Transformer (25 Periods)

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

4. Three Phase Transformer (14 Periods)

4.1 Construction of three phase transformers and accessories of transformers such as Conservator, breather, Buchholtz Relay, Tap Changer (off load and on load) (Brief idea)
4.2 Types of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star
4.3 Star delta connections (relationship between phase and line voltage, phase and line current)
4.4 Conditions for parallel operation (only conditions are to be studied)
4.5 On load tap changer
4.6 Difference between power and distribution transformer
4.7 Cooling of transformer
4.8 Rating and Specifications of three phase transformers

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

Electrical machines being a core subject of electrical diploma curriculum, where a student will deal with various types of electrical machines which are employed in industry, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Special care has to be taken on conceptual understanding of concepts and principles in the subject. For this purpose exposure to industry, work places, and utilization of various types of electrical machine for different applications may be emphasized. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1.	20	10
2.	25	35
3.	25	35
4.	14	20
Total	**84**	**100**

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3.6 ENVIRONMENTAL STUDIES

L	T	P
3	-	2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (04 Periods)

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

2. Air Pollution (04 Periods)

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

3. Water Pollution (08 Periods)

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

4. Soil Pollution (06 Periods)

   4.1 Sources of soil pollution

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

5. Noise pollution (06 Periods)

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

6. Environmental Legislation (08 Periods)

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

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

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

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

4.1 COMMUNICATION SKILLS – II

L	T	P
4	-	2

RATIONALE

Knowledge of English Language plays an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills as parts of Communication Skill.

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

2 Reading (16 periods)

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

3 Writing Skill (24 periods)

- 3.1 Correspondence

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

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

LIST OF PRACTICALS

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

Speaking and Listening Skills

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

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Websites for Reference:

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

SUGGESTED DISTRIBUTION OF MARKS

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

4.2 INDUSTRIAL ELECTRONICS AND CONTROL

L	T	P
5		14

RATIONALE

Industrial electronics plays a very vital role in the field of Control Engineering specifically in the modern industries as they mostly use electronic controls, which are more efficient, effective and precise as compare to the conventional methods. The old magnetic and electrical control schemes have all become obsolete. Electrical Engineering diploma holder, many times, has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance of this subject, it has been incorporated in the curriculum.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Introduction to SCR (18 Periods)

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

2. Controlled Rectifiers (12 Periods)

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

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

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

4. Thyristor Control of Electric Drives (18 Periods)

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

5 Uninterrupted power supplies (12 Periods)

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

LIST OF PRACTICALS

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

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

BOOKS RECOMMENDED

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

Websites for Reference:

http://swayam.gov.in

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SUGGESTED DISTRIBUTION OF MARKS

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

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4.3 ELECTRICAL DESIGN, DRAWING AND ESTIMATING - I

L	T	P
3	-	8

RATIONALE

A diploma holder in Electrical Engineering is supposed to have ability to read, understand and interpret engineering drawings and communicate through sketches and drawings. He is also expected to prepare working drawings of panels, transmission and distribution. The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Recognize various electrical devices and their symbols
- Recognize various electrical devices placed on the panels/distribution boards and to design the panels
- Recognize the internal details of various electrical machines and devices
- Read schematic and wiring diagrams of electrical devices
- Read and interpret electrical installation plan
- Communicate about circuits and devices through sketches and drawings
- Determine various types of wiring systems and their use
- Practice and execute any type of wiring
- Estimate and determine the cost of wiring installation
- Estimate the material required for HT and LT lines
- Prepare a tender document for a particular job
- Estimate the material required for pole-mounted sub-stations

DETAILED CONTENTS (To make 16 Sheets)

1. Symbols and Signs Conventions (2 Sheets)

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

2. Wiring Diagram

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

3. Panels/Distribution Boards (6 Sheets)

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

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

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

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

6. Introduction to Estimating & Costing (04 periods)

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

7. Types of Wiring (04 periods)

Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial). Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables (to be prepared/arranged)

8. Estimating and Costing (18 periods)

8.1 Domestic installations; standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load)

8.2 Industrial installations; relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the light load (3-phase supply system)

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

9. Estimating Materials Required (12 Periods)

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

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

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

10. Preparation of Tender Documents (04 Periods)

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

LIST OF PRACTICALS

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

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

4.4 POWER PLANT ENGINEERING

L	T	P
5	-	-

RATIONALE

The majority of the diploma passouts who get employment in State Electricity Boards have to perform various activities in the field of generation, transmission and distribution of electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, transmission and distribution networks in addition to administrative jobs including public relations. They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in transmission and distribution of electrical power.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Distinguish and select suitable resource of energy required for a particular area and environment
- Calculate effective cost generation
- Explain the working of various plants for power generation

DETAILED CONTENTS

1. Power Generation (06 Periods)

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

2. Thermal Station (10 Periods)

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

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3. Hydro-Electric Plant (8 Periods)

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

4. Nuclear Power Plant (9 Periods)

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

5. Diesel Power Plant (6 Periods)

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

6. Gas Turbine Plant (9 Periods)

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

7. Combined Working of Power Plant (10 Periods)

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

8. Economics of Generation (12 Periods)

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

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

9. Non Conventional Source of Energy (5 Periods)

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

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INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

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

SUGGESTED DISTRIBUTION OF MARKS

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

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

4.5 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

L	T	P
6	1	-

RATIONALE

The majority of the diploma passouts who get employment in State Electricity Boards have to perform various activities in the field of transmission and distribution of electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in transmission and distribution networks in addition to administrative jobs including public relations. They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in transmission and distribution of electrical power.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Transmission Systems (28 Periods)

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

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

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

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

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

   1.6 Transmission Losses

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

2. Distribution System (21 Periods)

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

3. Substations: (21 Periods)

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

4. Power Factor: (14 Periods)

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

5. Revenue and Energy loss (14 Periods)

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

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

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Total	**98**	**100**

4.6 ENERGY CONSERVATION

L	T	P
3	-	2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Basics of Energy

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

2. Energy Conservation and EC Act 2001

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

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

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

3. Electrical Supply System and Motors

3.1 Types of electrical supply system

3.2 Single line diagram

3.3 Losses in electrical power distribution system

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

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

3.6 Electric Motors

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

4. Energy Efficiency in Electrical Utilities

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

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

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

5. Lighting and DG Systems

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

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

6. Energy Efficiency in Thermal Utilities

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

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

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

6.4 Efficient Steam Utilization

7. Energy Conservation Building Code (ECBC)

7.1 ECBC and its salient features

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

8. Waste Heat Recovery and Co-Generation

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

9. General Energy Saving Tips
Energy saving tips in:

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

10. Energy Audit

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

PRACTICAL EXERCISES

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

STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY EFFICIENCY

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

Important Links:

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

4.7 Universal Human Values

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Course Objectives

This introductory course input is intended

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

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

Course Methodology

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

The syllabus for the lectures is given below:

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

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

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

Experiential Validation- as the mechanism for self-exploration

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

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

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

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

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

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

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

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

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

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

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

1. Natural acceptance of human values

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

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

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

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

Practical Session also Includes Different Yogic Exercises and Meditation Session

INSTRUCTONAL STRATEGY

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

MEANS OF ASSESSMENT

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

Reference Material

The primary resource material for teaching this course consists of

a. The text book (Latest Edition)

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

b. The teacher's manual (Latest Edition)

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

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

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

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

Relevant websites, movies and documentaries

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

SUGGESTED DISTRIBUTION OF MARKS

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

INDUSTRIAL TRAINING

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

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

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

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

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

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

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Presentation and VIVA	15%.
d)	Industrial training report	55%