

CURRICULUM FOR THREE YEAR
(SIX SEMESTER)
DIPLOMA COURSE IN

=====
: ELECTRICAL ENGINEERING :
: Effective from Session :
=====

=====
:Semester System :
=====

Prepared By

=====
: Curriculum Development Cell :
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INSTITUTE OF RESEARCH DEVELOPMENT
& TRAINING, U.P., KANPUR

APPROVED BY

=====
: BOARD OF TECHNICAL EDUCATION :
: U.P. LUCKNOW, :
:CORRECTED AS SYLLABUS COMMITTEE OF:
: B.T.E. MEETING HELD ON 17.08.2016:
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STUDY AND EVALUATION SCHEME FOR
1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
(Effective From)

I Semester

Curriculum						Scheme of Examination									
Periods Per Week						Theory				Practical				Grand Total	
Le	Tut	Dr	Lab	Work	Tot	Examination	Sess.	Total	Examination	Sess.	Total	Total			
c.	ori	aw	Shop	al		Dur.	Marks	Marks	Marks	Dur.	Marks	Marks	Marks		
4	-	-	-	-	4	1.1 Foundational Communicaton	2.5	50	20	70	-	-	-	70	
3	1	-	-	-	4	1.2 Applied Mathematics-I(A)	2.5	50	20	70	-	-	-	70	
3	1	-	-	-	4	1.3 Applied Physics-I	2.5	50	20	70	-	-	-	70	
6	-	-	4	-	10	1.4 Applied Chemistry	2.5	50	20	70	3	40	20	60	
5	-	-	-	-	5	1.5 Electrical & Electronics Engineering Material	2.5	50	20	70	-	-	-	70	
-	-	-	-	14	14	1.6 Workshop Practice	-	-	-	-	4	60	30	90	
21	2	-	4	14	41	<-----TOTAL----->	-	250	100	350	-	100	50	150	
													Games/NCC/Social and Cultural Activities + Discipline (15 + 10)		25
													TOTAL		525

II Semester

3	1	-	-	-	4	2.1 Applied Mathematics-I(B)	2.5	50	20	70	-	-	-	70	
3	1	-	4	-	8	2.2 Applied Physics-II	2.5	50	20	70	3	40	20	60	
5	-	-	3	-	8	2.3 Basic Electrical Engg.	2.5	50	20	70	3	40	20	60	
5	-	-	3	-	8	2.4 Electronics - I	2.5	50	20	70	3	60	30	90	
-	-	14	-	-	14	2.5 Engineering Drawing	3.0	50	20	70	-	-	-	70	
16	2	14	10	-	42	<-----TOTAL----->	-	250	100	350	-	140	70	210	
													Games/NCC/Social and Cultural Activities + Discipline (15 + 10)		25
													TOTAL		585

- NOTE:-
- (1) Each period will be 50 minutes duration.
 - (2) Each session will be of 16 weeks.
 - (3) Effective teaching will be at least 14 weeks.
 - (4) Remaining periods will be utilised for revision etc.

STUDY AND EVALUATION SCHEME FOR
 1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
 2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
 (Effective From)

III Semester

Curriculum						S U B J E C T	Scheme of Examination								
Periods Per Week							Theory				Practical				Grand Total
Le	Tut	Dr	Lab	Work	Tot		Examination	Sess.	Total	Examination	Sess.	Total	Dur.	Marks	
c.	ori	aw		Shop	al	Dur.	Marks	Marks	Dur.	Marks	Marks	Marks			Marks
COMMON SUBJECTS															
4	-	-	-	-	4	3.1 Functional Communication	2.5	50	20	70	--	--	--	--	70
5	2	-	-	-	7	3.2 Applied Mathematics-II	2.5	50	20	70	--	--	--	--	70
5	1	-	4	-	10	3.3 Electrical Instruments & Measurements.	2.5	50	20	70	3	40	20	60	130
2	-	-	5	-	7	3.4 Introduction To Computer SUBJECTS FOR ELECTRICAL ENGG.	--	--	--	--	3	60	30	90	90
5	1	-	3	-	9	3.5 Elementary Mechanical & Civil Engineering.	2.5	50	20	70	3	40	20	60	130
5	1	-	4	-	10	3.6 Electrical M/c-I	2.5	50	20	70	3	40	20	60	130
26	5	-	16	-	47	<-----TOTAL----->	--	200	80	280	--	180	90	270	620
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL															
6	1	-	7	-	14	3.7 Electrical M/c	2.5	50	20	70	3	40	20	60	130
22	4	-	16	-	42	<-----TOTAL----->	--	200	80	280	--	140	70	210	490
															25
Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10)															25
TOTAL FOR ELECT. ENGG.-620+25=645															TOTAL FOR ELECT. ENGG. (INDUST. CONTROL) --490+25= 515

IV Semester

COMMON SUBJECTS															
5	-	-	3	-	8	4.1 Electronics-II	2.5	50	20	70	3	40	20	60	130
4	-	8	2	-	14	4.2 Electrical Design, Drawing and Estimating-I	3.0	50	20	70	4	40	20	60	130
5	1	-	-	-	6	4.3 Power Plant Engg.	2.5	50	20	70	-	--	--	--	70
4	1	-	-	-	5	4.4 Trans. & Distri of Elect	2.5	50	20	70	-	--	--	--	70
18	2	8	5	-	33	<-----TOTAL----->	--	200	80	280	--	80	40	120	400
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL															
4	1	-	3	-	8	4.5 Power Electronics	2.5	50	20	70	3	35	15	50	120
22	3	8	8	-	41	<-----TOTAL----->	--	250	100	350	--	115	55	170	520
															25
Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10)															25
TOTAL FOR ELECT. ENGG.-400+25=425															TOTAL FOR ELECT. ENGG. (INDUST. CONTROL) --520+25= 545

NOTE:- (1) Each period will be of 50 minutes duration.
 (2) Each session will be of 16 weeks.
 (3) Effective teaching will be at least 14 weeks.
 (4) Remaining periods will be utilised for revision etc.
 (5) 4 weeks structured & supervised branch specific task oriented industry/field exposure to be organised during summer vacation.

STUDY AND EVALUATION SCHEME FOR
 1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
 2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
 (Effective From)

V Semester

Curriculum						Scheme of Examination									
Periods Per Week						Theory				Practical			Grand		
Le c.	Tut ori al	Dr aw	Lab	Work Shop	Tot al	S U B J E C T	Examination		Sess. Marks	Total Marks	Examination		Sess. Marks	Total Marks	Tot al
							Dur.	Marks			Dur.	Marks			
COMMON SUBJECTS															
-	-	-	4	-	4	5.1 Integrative Communication	--	--	--	70	-	40	20	60	60
6	2	-	-	-	8	5.2 Industrial Management and Entrepreneurship Development	2.5	50	20	70	--	--	--	--	70
4	1	-	-	-	5	5.3 Switch Gear & Protection	2.5	50	20	70	-	--	--	--	70
						5.4 Field Exposure	--	--	--	--	-	40	15	55	55
SUBJECTS FOR ELECTRICAL ENGG.															
4	1	-	4	-	9	5.5 Industrial Elex. & Control	2.5	50	20	70	3	70	35	105	175
4	1	-	4	-	9	5.6 Electrical Machine II	2.5	50	20	70	3	70	35	105	175
5	1	-	-	-	6	5.7 ELECTIVE (Any One)	2.5	50	20	70	-	--	--	--	70
						a. Control of Electrical Machine									
						b. Process Control Instrumentation									
						c. Electric Traction									
						d. Renewable Sources of Energy									
						e. High Voltage Engineering									
						f. Energy Management									
23	6	-	12	-	41	<-----TOTAL----->	--	250	100	350	--	220	105	325	675
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL															
5	1	-	4	-	10	5.7 Industrial Control I	2.5	50	20	70	3	60	30	90	160
5	1	-	4	-	10	5.8 Micro processor Develop. Systems	2.5	50	20	70	3	40	25	65	135
5	1	-	4	-	10	5.9 Electrical & Electronics Instrumentation	2.5	50	20	70	3	60	30	90	160
25	6	-	12	-	43	<-----TOTAL----->	--	250	100	350	--	240	120	360	710
															Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10) 25

TOTAL FOR ELECT. ENGG.-675+25=700

TOTAL FOR ELECT. ENGG. (INDUST. CONTROL) --710+25= 735

- NOTE:-
- (1) Each period will be of 50 minutes duration.
 - (2) Each session will be of 16 weeks.
 - (3) Effective teaching will be at least 14 weeks.
 - (4) Remaining periods will be utilised for revision etc.

STUDY AND EVALUATION SCHEME FOR
1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
(Effective From)

VI Semester

Curriculum						S U B J E C T	Scheme of Examination								
Periods Per Week							Theory				Practical				Grand Total
Le	Tut	Dr	Lab	Work	Tot		Examination	Sess.	Total	Examination	Sess.	Total	Dur.	Marks	
c.	ori	aw	Shop	al		Dur.	Marks	Marks	Dur.	Marks	Marks	Marks			Marks
COMMON SUBJECTS															
4	-	-	-	-	4	6.1 Environmental Education & Disaster Management	2.5	50	--	--	--	--	--	--	
4	1	-	4	-	9	6.2 Installation, Maintenance & Repair of Elect. Machines	2.5	50	20	70	3	70	35	105	
-	-	-	-	6	6	6.3 Project -i. Problem	--	--	--	--	3	100	50	150	
SUBJECTS FOR ELECTRICAL ENGG.															
4	1	-	-	8	13	6.4 Electrical Design, Drawing & Estimating II	3.0	100	40	140	-	--	--	140	
4	1	-	-	-	5	6.5 Utilisation of Elect. Energy	2.5	50	20	70	-	--	--	70	
16	3	-	4	14	37	<-----TOTAL----->	--	200	80	280	--	170	85	255	
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL															
5	1	-	-	-	6	6.6 Industrial Control II	2.5	50	20	70	-	--	--	70	
5	1	-	-	-	6	6.7 Control System & Process Application	2.5	50	20	70	-	--	--	70	
18	3	-	-	10	31	<-----Total ----->	-	150	60	210	-	170	85	255	
Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10)														25	
Total Marks for Electrical Engg.						Total Marks for Electrical Engg.(Industrial Control)									
100% V & VI SEM. 1260						100% V & VI Sem. 1225									
30 % Carry Over I & II Sem. 333						30% Carry Over of I & II Sem. 333									
70 % Carry Over III & IV Sem. 749						70% Carry Over of III & IV Sem. 742									
Total 2342						Total 2200									

- NOTE:-
- (1) Each period will be of 50 minutes duration.
 - (2) Each session will be of 16 weeks.
 - (3) Effective teaching will be at least 14 weeks.
 - (4) Remaining periods will be utilised for revision etc.
 - (5) Field visit and extension lectures are to be organised and managed well in advance at institute level as per need.
 - (6) Field exposure will be treated as the part of project 40 marks will awarded on the basis of field exposure report and viva by project examiner.
 - (7) The exology and environment awareness (4 extension lectures).
 - (8) (*) It is compulsory to appear & to pass in examination, But marks will not be included for division and percentage of obtained marks.

- STUDY AND EVALUATION SCHEME FOR LATERAL AND ITI PASSED STUDENTS
 1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
 2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
 (Effective From)

III Semester

Curriculum						S U B J E C T	Scheme of Examination							
Periods Per Week							Theory			Practical			Grand Total	
Le	Tut	Dr	Lab	Work	Tot		Examination	Sess.	Total	Examination	Sess.	Total		
c.	ori	aw	Shop	al		Dur.	Marks	Marks	Dur.	Marks	Marks	Marks		
COMMON SUBJECTS														
4	-	-	-	-	4	3.1 Functional Communication	2.5	50	20	70	--	--	--	70
5	2	-	-	-	7	3.2 Applied Mathematics-II	2.5	50	20	70	--	--	--	70
5	1	-	4	-	10	3.3 Electrical Instruments & Measurements.	2.5	50	20	70	3	40	20	60
2	-	-	5	-	7	3.4 Introduction To Computer SUBJECTS FOR ELECTRICAL ENGG.	--	--	--	--	3	60	30	90
5	1	-	3	-	9	3.5 Elementary Mechanical & Civil Engineering.	2.5	50	20	70	3	40	20	60
5	1	-	4	-	10	3.6 Electrical M/c-I	2.5	50	20	70	3	40	20	60
26	5	-	16	-	47	<-----TOTAL----->	--	200	80	280	--	180	90	270
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL														
6	1	-	7	-	14	3.7 Electrical M/c	2.5	50	20	70	3	40	20	60
22	4	-	16	-	42	<-----TOTAL----->	--	200	80	280	--	140	70	210
Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10)												25		
TOTAL FOR ELECT. ENGG.-620+25=645												TOTAL FOR ELECT. ENGG. (INDUST. CONTROL) --490+25= 515		

- A. COMPULSORY SUBJECT OF I & II SEMESTER ELECTRICAL ENGINEERING TO BE TAUGHT IN III & IV SEMESTER TO ITI PASSED STUDENTS OF TRADES ARE AS FOLLOWS :
 I. WIREMAN II. ELECTRICIAN III. ELECTROPLATER IV. ELECTRICAL SECTOR

Curriculum						S U B J E C T	Scheme of Examination							
Periods Per Week							Theory			Practical			Grand Total	
Le	Tut	Dr	Lab	Work	Tot		Examination	Sess.	Total	Examination	Sess.	Total		
c.	ori	aw	Shop	al		Dur.	Marks	Marks	Dur.	Marks	Marks	Marks		
4	-	-	-	-	4	1.1 Foundational Communication (*)	2.5	50	--	50	-	--	-	50
3	1	-	-	-	4	1.2 Applied Mathematics-I(A) (*)	2.5	50	--	50	-	-	-	50
3	1	-	-	-	4	2.1 Applied Mathematics-I(B) (*)	2.5	50	--	50	-	-	-	50
3	1	-	-	-	4	1.3 Applied Physics-I (*)	2.5	50	--	50	-	-	-	50
13	3	-	-	-	16	<-----TOTAL----->	--	200	--	200	--	-	-	200

- NOTE:- (1) (*) It is compulsory to appear & to pass in examination From III Semester To VI Semester, But marks will not be included for division and percentage of obtained marks.
 (2) (*) Four Semester (Two Years) of Extra Time will be given after diploma curriculum period (If Required) to pass the above paper (1.1 To 1.4 and 2.1 to 2.2) examination (As Per G. O. No. 2221/16-Pra. Shi.-3-2009 Dated 28-08-2009) & Revised G.O. No. 2704/16-Pra.Shi.-3-2013-46(8)/2002 Dated 09-01-2013

STUDY AND EVALUATION SCHEME FOR LATERAL AND ITI PASSED STUDENTS
 1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
 2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
 (Effective From)

IV Semester

Curriculum						S U B J E C T	Scheme of Examination								
Periods Per Week							Theory			Practical			Grand Total		
Le	Tut	Dr	Lab	Work	Tot		Examination	Sess.	Total	Examination	Sess.	Total			
c.	ori	aw	Shop	al		Dur.	Marks	Marks	Dur.	Marks	Marks	Marks			
COMMON SUBJECTS															
5	-	-	3	-	8	4.1 Electronics-II	2.5	50	20	70	3	40	20	60	130
4	-	8	2	-	14	4.2 Electrical Design, Drawing and Estimating-I	3.0	50	20	70	4	40	20	60	130
5	1	-	-	-	6	4.3 Power Plant Engg.	2.5	50	20	70	-	-	-	-	70
4	1	-	-	-	5	4.4 Trans. & Distri of Elect	2.5	50	20	70	-	-	-	-	70
18	2	8	5	-	33	<-----TOTAL----->	--	200	80	280	--	80	40	120	400
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL															
4	1	-	3	-	8	4.5 Power Electronics	2.5	50	20	70	3	35	15	50	120
22	3	8	8	-	41	<-----TOTAL----->	--	250	100	350	--	115	55	170	520
Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10)															25
TOTAL FOR ELECT. ENGG.-400+25=425															TOTAL FOR ELECT. ENGG. (INDUST. CONTROL) --520+25= 545

B. COMPULSORY SUBJECT OF I & II SEMESTER ELECTRICAL ENGINEERING TO BE TAUGHT IN III & IV SEMESTER TO ITI PASSED STUDENTS OF TRADES ARE AS FOLLOWS :
 I. WIREMAN II. ELECTRICIAN III. ELECTROPLATER IV. ELECTRICAL SECTOR

Curriculum						S U B J E C T	Scheme of Examination								
Periods Per Week							Theory			Practical			Grand Total		
Le	Tut	Dr	Lab	Work	Tot		Examination	Sess.	Total	Examination	Sess.	Total			
c.	ori	aw	Shop	al		Dur.	Marks	Marks	Dur.	Marks	Marks	Marks			
6	-	-	-	-	6	1.4 Applied Chemistry(*)	2.5	50	--	50	3	40	-	40	90
3	1	-	4	-	8	2.2 Applied Physics-II(*)	2.5	50	--	50	3	40	-	40	90
9	1	-	4	-	14	<-----TOTAL----->	--	100	--	100	--	80	-	80	180

- NOTE:- (1) (*) It is compulsory to appear & to pass in examination From III Semester To VI Semester, But marks will not be included for division and percentage of obtained marks.
 (2) (*) Four Semester (Two Years) of Extra Time will be given after diploma curriculum period (If Required) to pass the above paper (1.1 To 1.4 and 2.1 to 2.2) examination (As Per G. O. No. 2221/16-Pra. Shi.-3-2009 Dated 28-08-2009) & Revised G.O. No. 2704/16-Pra.Shi.-3-2013-46(8)/2002 Dated 09-01-2013
 (3) Each period will be of 50 minutes duration.
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STUDY AND EVALUATION SCHEME FOR LATERAL AND ITI PASSED STUDENTS
 1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
 2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
 (Effective From)

V Semester

Curriculum						S U B J E C T	Scheme of Examination								
Periods Per Week							Theory				Practical				Grand Total
Le	Tut	Dr	Lab	Work	Tot		Examination	Sess.	Total	Examination	Sess.	Total	Dur.	Marks	
c.	ori	aw	Shop	al	al	Dur.	Marks	Marks	Dur.	Marks	Marks				
COMMON SUBJECTS															
-	-	-	4	-	4	5.1 Integrative Communication	--	--	--	--	40	20	60	60	
6	2	-	-	-	8	5.2 Industrial Management and Entrepreneurship Development	2.5	50	20	70	--	--	--	70	
4	1	-	-	-	5	5.3 Switch Gear & Protection	2.5	50	20	70	-	--	--	70	
						5.4 Field Exposure	--	--	--	--	40	15	55	55	
SUBJECTS FOR ELECTRICAL ENGG.															
4	1	-	4	-	9	5.5 Industrial Elex. & Control	2.5	50	20	70	3	70	35	105	175
4	1	-	4	-	9	5.6 Electrical Machine II	2.5	50	20	70	3	70	35	105	175
5	1	-	-	-	6	5.7 ELECTIVE (Any One)	2.5	50	20	70	-	--	--	70	
						a. Control of Electrical Machine									
						b. Process Control Instrumentation									
						c. Electric Traction									
						d. Renewable Sources of Energy									
						e. High Voltage Engineering									
						f. Energy Management									
23	6	-	12	-	41	<-----TOTAL----->	--	250	100	350	--	220	105	325	675
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL															
5	1	-	4	-	10	5.7 Industrial Control I	2.5	50	20	70	3	60	30	90	160
5	1	-	4	-	10	5.8 Micro processor Develop. Systems	2.5	50	20	70	3	40	25	65	135
5	1	-	4	-	10	5.9 Electrical & Electronics Instrumentation	2.5	50	20	70	3	60	30	90	160
25	6	-	12	-	43	<-----TOTAL----->	--	250	100	350	--	240	120	360	710
Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10) 25															

TOTAL FOR ELECT. ENGG.-675+25=700

TOTAL FOR ELECT. ENGG. (INDUST. CONTROL) --710+25= 735

- NOTE:- (1) Each period will be of 50 minutes duration.
 (2) Each session will be of 16 weeks.
 (3) Effective teaching will be at least 14 weeks.

STUDY AND EVALUATION SCHEME FOR LATERAL AND ITI PASSED STUDENTS
 1. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING
 2. THREE YEARS (SIX SEMESTER) DIPLOMA COURSE IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)
 (Effective From)

VI Semester

Curriculum						Scheme of Examination									
Periods Per Week						Theory				Practical				Grand	
Le c.	Tut ori al	Dr aw ing	Lab	Work Shop	Tot al	S U B J E C T	Examination Dur.	Sess. Marks	Total Marks	Examination Dur.	Sess. Marks	Total Marks	Total Marks	Grand Total	
COMMON SUBJECTS															
4	-	-	-	-	4	6.1 Environmental Education & Disaster Management	2.5	50	--	--	--	--	--	--	
4	1	-	4	-	9	6.2 Installation, Maintenance & Repair of Elect. Machines	2.5	50	20	70	3	70	35	105	
-	-	-	-	6	6	6.3 Project -i. Problem	--	--	--	--	3	100	50	150	
SUBJECTS FOR ELECTRICAL ENGG.															
4	1	-	-	8	13	6.4 Electrical Design, Drawing & Estimating II	3.0	100	40	140	-	--	--	140	
4	1	-	-	-	5	6.5 Utilisation of Elect. Energy	2.5	50	20	70	-	--	--	70	
16	3	-	4	14	37	<-----TOTAL----->	--	200	80	280	--	170	85	255	
SUBJECTS FOR ELECTRICAL ENGG. INDUSTRIAL CONTROL															
5	1	-	-	-	6	6.6 Industrial Control II	2.5	50	20	70	-	--	--	70	
5	1	-	-	-	6	6.7 Control System & Process Application	2.5	50	20	70	-	--	--	70	
18	3	-	-	10	31	<-----Total ----->	-	150	60	210	-	170	85	255	
Games/NCC/Social and Cultural Activity/Community Development Work+ Discipline (15+10)														25	
Total Marks for Electrical Engg.						Total Marks for Electrical Engg.(Industrial Control)									
100% V & VI SEM. 1260						100% V & VI Sem. 1225									
70 % Carry Over III & IV Sem. 749						70% Carry Over of III & IV Sem. 742									
Total 2009						Total 1967									

- NOTE:-
- (1) Each period will be of 50 minutes duration.
 - (2) Each session will be of 16 weeks.
 - (3) Effective teaching will be at least 14 weeks.
 - (4) Remaining periods will be utilised for revision etc.
 - (5) Field visit and extension lectures are to be organised and managed well in advance at institute level as per need.
 - (6) Field exposure will be treated as the part of project 40 marks will awarded on the basis of field exposure report and viva by project examiner.
 - (7) The exology and environment awareness (4 extension lectures).
 - (8) (*) It is compulsory to appear & to pass in examination, But marks will not be included for division and percentage of obtained marks.

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MAIN FEATURES OF THE CURRICULUM

Title of the course :	1. Diploma in Electrical Engg. 2. Diploma in Electrical Engg.(Industrial Control)
Duration	Three Years(Six Semester)
Pattern of the course	Semester System
Intake	60
Type of course	Full Time
Entry qualification	Passed High School with 35% Marks
Mode of admission	Through Joint Entrance Examination

LIST OF EXPERTS

List of experts who contributed in the of curriculum Under Semester System for 6 semester diploma course in Electrical engineering & Electrical Engineering(Industrial Control) held on April 09.04.2015 At I.R.D.T., U. P., Kanpur

- | | | | |
|----|-------------------|-----------------|----------------------|
| 1. | Sri A. P. Singh | Asstt. Director | D. T.E., Kanpur |
| 2. | Sri Jai Ram | H.O.D. | G. P., Gonda |
| 3. | Sri Piyush | H.O.D. | G. P., Kanpur |
| 4. | Sri Ramesh Kumar | Lecturer | M.P. Poly. Gorakhpur |
| 5. | Sri V. P. Shukla | Lecturer | G.P., Unnao |
| 6. | Sri A. K. Dwivedi | Lecturer | G.P., Kanpur |
| 7. | Smt. Neeraj | Lecturer | G. P., Lucknow |
| 8. | Sri Dinesh Sharma | Lecturer | I.R.D.T., Kanpur |

List of experts who contributed in the revision of curriculum diploma course in Electrical Engineering and Electrical Engineering (Industrial Control). in Annual System 26-11-15 at Government Polytechnic, Kanpur.

- | | | | |
|----|---------------------|-----------------|----------------------|
| 1. | Shri Yashveer Singh | Retd. Principal | G.P. Moradabad |
| 2. | Shri C.P. Verma | Assitt. Prof | A.I.T.H., Kanpur |
| 3. | Sri P. K. Sachdeva | H.O.D.(Retd.) | G. P. Barillery |
| 4. | Sri Sunil Kumar | H.O.D., | G.P., Kanpur |
| 5. | Smt. Anju Gupta | Lecturer | G.P., Kanpur |
| 6. | Shri A,K, Dwivedi | Lecturer | G.P., Kanpur |
| 7. | Shri R. K. Mishra | Lecturer | G.P., Kanpur |
| 8. | Shri R. N. Rathore | Lecturer(IC) | G.P., Kanpur |
| 9. | Shri Dinesh Sharma | Lecturer | I.R.D.T.,U.P.,Kanpur |

List of experts who contributed in the revision of curriculum diploma course in Electrical Engineering and Electrical Engineering (Industrial Control). in Annual System 18-05-16 at I.R.D.T., Kanpur For New Papers incorporate Fundamental Communication, Funcational Communication, Integrative Communication Introduction to Computer, I.M.E.D. and all correction for BTE Meeting 28.3.2016.

- | | | | |
|----|-------------------------|-----------|-----------------------|
| 1. | Shri Pyush Kumar | Princiapl | G.P., Chacha,Mainpuri |
| 2. | Shri Sunil Kumar sonker | HOD | G.P., Banda |
| 3. | Shri Sunil Kumar Yadav | Lecturer | G.P.,Kanpur |
| 4. | Shri V. P. Shukla | Lecturer | G.P., Unnao |
| 5. | Shri Dinesh Sharma | Lecturer | I.R.D.T.,U.P.,Kanpur |

List of experts who contributed in the of curriculum Under Semester System for 6 semester diploma course in Electrical engineering & Electrical Engineering(Industrial Control) held on April 25.07.2016 At I.R.D.T., U. P., Kanpur

- | | | | |
|----|------------------------|-----------------|----------------------|
| 1. | Shri Yashveer Singh | Retd. Principal | G.P. Moradabad |
| 2. | Sri P. K. Sachdeva | H.O.D.(Retd.) | G. P. Barillery |
| 3. | Smt. Anju Gupta | Lecturer | G.P., Kanpur |
| 4. | Shri A,K, Dwivedi | Lecturer | G.P., Kanpur |
| 5. | Shri Sunil Kumar Yadav | Lecturer | G.P.,Kanpur |
| 6. | Shri Dinesh Sharma | Lecturer | I.R.D.T.,U.P.,Kanpur |

NEED ANALYSIS :

It was considered essential to revise the curriculum of diploma course in electrical engineering to accommodate new areas of technology as well as update the existing course contents so as to make it more relevant to the needs of the world of work. A number of professionals representing various field organisations, higher technological institutions, I.E.R.T. Allahabad and polytechnics of the State were involved to update the curriculum in electrical engineering.

Experts from the field and higher technological institutes emphasised the need of making the curriculum more technology oriented and practice based. Experts from the field were also of the view that the curriculum should be broad-based in nature, so as to provide larger base of employment flexibility in functioning.

The need for developing information gathering and communication & problem solving activities were also stressed.

It was also suggested by the experts from higher technological institutes that it is very essential that diploma courses should have a foundation of applied sciences up to 10+2 standard. Applied sciences are very essential to develop learning to learn skills in the students.

The professionals from the field were of the view that dead wood from the courses be deleted and courses should not be stuffed with unnecessary information.

Based on the above, curriculum of diploma course in Electrical Engineering was revised.

Job opportunities, activities, activity analysis in to knowledge, skill and attitude requirement and curriculum objectives formed the basis of arriving at the course contents.

I JOB OPPORTUNITIES

S.NO.	Department/Organisation	Position/Designation
1.	State Electricity Boards and state PWDs (Electrical wing),Municipal Corporations State Housing Boards.	Junior Engineer/ Sectional Officer/ Foreman/Line Inspector
2.	Central Government Departments (Post and Telegraphs, Telephones, Radio/Doordarshan National Building Construction Corporation, NTPC, NHPC, Nuclear Power Corporation,Food Corporation of India, Ware Housing Corporation, Shipping Corporation of India, Oil and Natural Gas Commision, CPWD, Central Electricity Authority.	Supervisor/Foreman/ Sectional Officer/ Junior Engineer/ Technical Assistant
3.	Indian Railways	Supervisor/Foreman Electrical Inspector
4.	Civil Aviation	Senior Technician
5.	Military Engineering Services(MES)	Supdt. Grade-II
6.	Vocational and Junior Technical Schools.	Vocational Masters/ Technical Teachers.
7.	Banks, General Insurance Company	Technical Assistants Field Supervisors.
8.	Government Undertakings manufacturing Electrical machines and equipments. (HAL, BHEL, ITI etc.)	Maintenance Supervisor/ Electrical Foreman
9.	Private Sector Undertakings Manufacturing Industries/ Organisations (large/ medium scale).	Service Centre Incharge Production Controller Technical Assistant
10.	Private Electrical Contractors	Technical Assistant
11.	Research Laboratories	Technical Assistant/ research Assistant/ Design Assistant
12.	Technical Education Institutions (ITIs & Polytechnics)	Instructors & Demonstrators
13.	Sales and service of Electrical Products.	Sales Representative service Technician.
14.	Self Employment in:	
	(i) Repair and Maintenance	Owner/Partner

of Electrical equipments,
Machines and appliances.

- (ii) Manufacturing of Household appliances.
- (iii) Ancillary to big units.
- (iv) Wiring contractor.

II JOB ACTIVITIES OF DIPLOMA-HOLDERS IN ELECTRICAL ENGINEERING

- (A) Investigation (R & D)
1. Conducts electrical load survey.
 2. Prepares reports of load survey.
 3. Conducts route survey for marking positions of poles as per given plan of the line and identify soil conditions.
 4. Collects information for determining type and location of faults regarding breakdown of wiring installation, overhead and underground & distribution lines, sub-station equipment, panel boards and machines.
- (B) Design and Drawing (R & D)
1. Designs electrical installations for residential / commercial / buildings and industries and commercial establishments.
 2. Prepares wiring diagrams of electrical installations.
 3. Prepares design and drawing of motor control circuits, signals/alarm and panel board control circuits.
 4. Interprets drawing of electrical installations.
 5. Assists the engineer in designing distribution system of an area.
 6. Designs simple and small electrical and electronics circuits & appliances like battery eliminator, simple transformer etc.
- (C) Testing, Research and Development (R & D)
1. Tests electrical installation, equipment and machines as per Indian Standard specifications.
 2. Tests and calibrates the electrical & electronic instrument including meters.
 3. Tests installations and control equipment after repair, takes remedial measures to avoid recurrence of fault.
 4. Writes test reports.
 5. Assists the engineer in research and development work.
 6. Tests electronic & electric component & circuits.
- (d) Management and Supervision (Production, Installation, Operation).
1. Prepares material equipment and labour

schedule for electrical installations.

2. Supervises the installation of internal wiring, underground and over head distribution lines, motor control systems, H.T. and L.T. Service connection, earthing etc. as per specifications.
3. Prepares details of work for fabrication, supervises construction and erection of electric installations according to specification and schedule.
4. Identifies critical areas requiring close supervision during installation for satisfying safety requirement or tolerance of dimension.
5. Supervises manufacturing processes of electrical equipment/goods for quality control and workmanship.
6. Keeps record of progress of work and sends progress reports to engineer-incharge.
7. Receives and issues material and instruments to workers.
8. Prepares inspection and testing schedule for installation/equipment.
9. Maintains record of public complaints and take measures for rectification of faults in electric installations.
10. Visits site of faults plans and arranges fault rectification.
11. Ensures proper procuring storing and stocking of equipment/material.
12. Communicates with workers and resolves their grievances.
13. Ensures safety of workmen during operations.
14. Undertakes physical verification of stores.
15. Operates control room of substation/Industry
16. Specifies machine, equipment, wiring installation accessories and tests them.
17. Fabricates simple & small electrical & electronics circuits, and appliances like transformer, battery eliminator, etc.

(E) Estimating and Costing

1. Reads drawing of electrical installation and calculates quantity of material required for various electric installation and power projects (overhead distribution line,

substation underground distribution line,
service connection etc.)

2. Writes specifications and selection of the material required for various electric projects.
3. Checks bills of contractor (s) for payment by referring schedule of rates prescribed by electricity authorities.
4. Verifies rates for various items of works.
5. Works in Design and planning.

(F) Maintenance and repairs (Services)

1. Reviews performance of line and equipment at intervals.
2. Detects faults in installations and arranges for their rectification.
3. Undertakes routine and preventive maintenance of electrical instruments/ equipment/ installations.
4. Prepares inspection schedules.
5. Prepares estimates for repair and maintenance.
6. Undertakes repairs of electrical machine, equipment & appliances etc.

III ACTIVITY ANALYSIS (In terms of knowledge and skill)

S.No.	ACTIVITIES	KNOWLEDGE	SKILL
(A) INVESTIGATION:			
1.	Conducts load survey and prepares report.	Symbols, specifications of installation, drawing and their types, distribution systems, demand factor, load factor, diversity factor.	Skill to load survey interpretation of drawing sketching calculation of various factors, preparation of survey report.
2.	Conducts route survey for marking positions of poles as per given plan of the lines and identifying soil condition.	Transmission and distribution systems and their layout, interpretation of drawings survey instruments and their uses (chain surveying dumpy level) standard norms for pole erection, soil sampling procedure. Knowledge of types.	Skill to interpret drawings marking pole location, chaining and levelling for route survey for pole/towers for LT/HT lines.
3.	Collects informations for determining types and location of faults regarding break down of wiring lines, Electrical Machines.	Knowledge of types of faults, reasons, method of location, types of wiring, c) Electrical Machine d) Electrical Power system.	To locate and find causes of faults and prepare report
20.	He must be able to detect faults in electronic circuit used in electrical installation equipment & control circuit.	a) Electronic Circuits & devices b) Control of Machines c) Electrical Design & Drawing	
21.	He must be able to operate computer, writing of small & application programmes & use of given software.	a) Computer Programming	
22.	Supervise & Operate Solar biomass wind microhydel power plants	a) Renewable sources of energy as optional subject	

**1.1 FOUNDATIONAL COMMUNICATION
SECTION "A" (ENGLISH)**

L T P
4 - -

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Units	Coverage Time		
		L	T	P
Section A English				
1.	PARTS OF SPEECH	12	-	-
2.	VOCABULARY BUILDING	05	-	-
3.	Grammar	15	-	-
4.	DEVELOPMENT OF EXPRESSION (Composition)	12	-	-
Section B Hindi				
5.	Topic 5	2	-	-
6.	Topic 6	5	-	-
7.	Topic 7	5	-	-
		56	-	-

DETAILED CONTENTS

1. **PARTS OF SPEECH :**
 - a. Noun
 - b. The pronoun : Kinds and Usage
 - c. The adjective : Kinds and Degree
 - d. Determiner : Articles
 - e. The verb : Kinds
 - f. The Adverb : Kinds, Degree and Usage
 - g. Prepositions
 - h. Conjunctions
 - i. The Interjections
 - j. Subject: Verb Agreement (Concord)
2. **VOCABULARY BUILDING :**
 - a. Antonyms and Synonyms
 - b. Homophones
 - c. One word substitutions
 - d. Idioms and Phrases
 - e. Abbreviations
3. **Grammar**
 - a. Sentence & its types
 - a. Tenses
 - b. Punctuations
 - c. Active and Passive voice
 - d. Transformation of Sentences
 - e. Synthesis of Sentences
 - f. Direct and Indirect Narrations
4. **DEVELOPMENT OF EXPRESSION (Composition) :**

- a. Paragraph Writing
- b. Essay Writing
- c. Proposal Writing
- d. Letter Writing (Formal, Informal, Business, official etc.)
- f. Report Writing
- g. Note Making
- h. News Making
- i. Application Writing
- j. Minute Writing
- k. Invitation Letter Writing

SECTION "B" (Hindi)

- 5& laKk] loZuke] fo'ks"k.k] fdz;k fo'ks"k.k] o.kZ lek1] laf/k] vyadkj] j1] milxZ izR;iA
- 6& i= ys[ku] fufonk lafonk] nj vkea=.k ¼dksVs'ku½ vihy] LorU= vfHkO;fDr] izfrosnu ys[ku] izsl foKfIrA
- 7& okD;@okD;ka'k ds fy, 'kCn] i;kZ;okph ;k lekukFkhZ 'kCn] foykse 'kCn] vusdkFkhZ 'kCn] 'kCn;qXe ;k leqPpkfjr 'kCn lewg] okD; 'kqf) ¼'kq) v'kq) okD;½] eqgkojs ,oa yksdksfDr;kWaA

1.2 APPLIED MATHEMATICS I(A)
[Common to All Engineering Courses]

L T P
3 2/2 -

Rationale:

The study of mathematics is an important requirement for the understanding and development of any branch of engineering. The purpose of teaching mathematics to diploma engineering students is to impart them basic knowledge of mathematics which is needed for full understanding and study of engineering subjects.

S.N.	Units	Coverage Time		
		L	T	P
1.	Algebra- I	8	3	-
2.	Algebra- II	8	3	-
3.	Trigonometry	6	2	-
4.	Differential Calculus-I	10	3	-
5.	Differential Calculus-II	10	3	-
		42	14	-

DETAILED CONTENTS:

1. ALGEBRA-I : (10 Marks)
 - 1.1 Series : AP and GP; Sum, nth term, Mean
 - 1.2 Binomial theorem for positive, negative and fractional index (without proof). Application of Binomial theorem.
 - 1.3 Determinants : Elementary properties of determinant of order 2 and 3, Multiplication system of algebraic equation, Consistency of equation, Cramer's rule
2. ALGEBRA-II:(10 Marks)
 - 2.1 Vector algebra : Dot and Cross product, Scaler and vector triple product.
 - 2.2 Complex number.

Complex numbers, Representation, Modulus and amplitude, De Moivre theorem, its application in solving algebraic equations, Mod. function and its properties..
3. TRIGONOMETRY :(8 Marks)
 - 3.1 Relation between sides and angles of a triangle : Statement of various formulae showing relationship between sides and angle of a triangle.
 - 3.2 Inverse circular functions : Simple case only
4. DIFFERENTIAL CALCULUS - I : (12 Marks)
 - 4.1 Functions, limits, continuity, - functions and their graphs, range and domain, elementary methods of finding limits (right and left), elementary test for continuity and differentiability.

- 4.2 Methods of finding derivative, - Function of a function, Logarithmic differentiation, Differentiation of implicit functions.
- 5. DIFFERENTIAL CALCULUS -II :(10 Marks)
 - 5.1 Higher order derivatives, Leibnitz theorem.
 - 5.2 Special functions (Exponential, Logarithmic, Inverse circular and function), Definition, Graphs, range and Domain and Derivations of each of these functions.
 - 5.3 Application - Finding Tangents, Normal, Points of Maxima/Minima, Increasing/Decreasing functions, Rate, Measure, velocity, Acceleration, Errors and approximation.

1.3 APPLIED PHYSICS-I

[Common to All Engineering Courses]

L T P
3 2/2 -

Rationale:

Engineering physics is a foundation Course. Its purpose is to develop proper understanding of physical phenomenon and scientific temper in the students. While teaching the subject, teachers should make maximum use of demonstrations to make the subject interesting to the students.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Topics	L	T	P
1.	Units & Dimensions	3	1	-
2.	Errors in Measurement	3	1	-
3.	Circular Motion	4	1	-
4.	Motion of Planets	4	1	-
5.	Dynamics of rigid body (Rotational Motion)	5	1	-
6.	Fluid Mechanics and Friction	4	1	-
7.	Friction	4	1	-
8.	Harmonic Motion	5	2	-
9.	Heat & Thermodynamics	6	4	-
10.	Acoustics	4	1	-
		42	14	-

DETAILED CONTENTS:

1. Units and Dimensions (4 Marks)

S.I. Units & Dimensions of physical quantities, Dimensional formula and dimensional equation. Principle of homogeneity of dimensions and applications of homogeneity principle to:

- i) Checking the correctness of physical equations,
- ii) Deriving relations among various physical quantities,
- iii) Conversion of numerical values of physical quantities from one system of units into another. Limitations of dimensional analysis.

2. ERRORS AND MEASUREMENT (4 Marks)

Errors in measurements, accuracy and precision, random and systematic errors, estimation of probable errors in the results of measurement (Combination of errors in addition, subtraction, multiplication and powers). Significant figures, and order of accuracy in respect to instruments,

3. Circular Motion (5 Marks)

Central forces. Uniform Circular motion (Horizontal and Vertical cases), angular velocity, angular acceleration and centripetal acceleration. Relationship between linear and angular velocity and acceleration. Centripetal and

centrifugal forces. Practical applications of centripetal forces. Principle of centrifuge.

4. MOTION OF PLANETS AND SATELLITES :(5 Marks)

Gravitational force, Acceleration due to gravity and its variation w.r. to height and depth from earth, Kepler's Law, Escape and orbital velocity, Time period of satellite, Geostationary, Polar satellites (Concept Only)

5. Dynamics of Rigid Body (Rotational Motion) (6 Marks)

Rigid body, Rotational motion, Moment of inertia, Theorems (Perpendicular and Parallel axis) of moment of inertia (Statement). Expression of M.I. of regular bodies (Lamina, Sphere, Disc, Cylinder), Concept of Radius of gyration, angular momentum, Conservation of angular momentum, Torque, Rotational kinetic energy. Rolling of sphere on the slant plane. Concept of Fly wheel.

6. Fluid Mechanics :(5 Marks)

Surface tension, Capillary action and determination of surface tension from capillary rise method, Equation of continuity ($A_1V_1=A_2V_2$), Bernoulli's theorem, and its application stream line and Turbulent flow, Reynold's number.

7. Friction :(4 Marks)

Introduction, Physical significance of friction, Advantage and disadvantage of friction and its role in every day life. Coefficients of static and dynamic friction and their measurements. viscosity, coeff. of viscosity, & its determination by stoke's method.

8. Harmonic Motion (6 Marks)

Periodic Motion, characteristics of simple harmonic motion; equation of S.H.M. and determination of velocity and acceleration. Graphical representation. Spring-mass system. Simple pendulum. Derivation of its periodic time. Energy conservation in S.H.M.. Concept of phase, phase difference, Definition of free, forced, undamped and damped vibrations, Resonance and its sharpness, Q-factor.

9. Heat & Thermodynamics: (6 Marks)

Modes of heat transfer (Conduction, Convection and Radiation), coefficient of thermal conductivity Isothermal and adiabatic process. Zeroth First, Second Law of Thermodynamics and Carnot cycle, Heat Engine (Concept Only).

10. Acoustics (5 Marks)

Definition of pitch, loudness, quality and intensity of sound waves. Echo, reverberation and reverberation time. Sabine's formula without Derivation. Control of reverberation time (problems on reverberation time). Acoustics of building defects and remedy.

1.4 APPLIED CHEMISTRY

[Common to All Engineering Courses]

L T P
6 - 4

Rationale:

Engineering Chemistry has profound and deep relationship with the industrial and environmental technology. This curriculum intends to impart technical knowledge alongwith productive practice to the students of the diploma engineering. The teachers are expected to guide the students in the classroom and the laboratories according to the curriculum by demonstrations and by showing relevant materials and equipments to inculcate interests in learning among students.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Topics	L	T	P
1.	Atomic Structure	4	-	-
2.	Chemical Bonding	6	-	-
3.	Classification of Elements	4	-	-
4.	Electro Chemistry-I	7	-	-
5.	Electro Chemistry-II	8	-	-
6.	Chemical Kinetics	4	-	-
7.	Catalysis	4	-	-
8.	Solid State	4	-	-
9.	Fuels	4	-	-
10.	Water Treatment	6	-	-
11.	Colloidal State	4	-	-
12.	Lubricants	4	-	-
13.	Hydrocarbons	7	-	-
14.	Organic Reactions & Mechanism	8	-	-
15.	Polymers	4	-	-
16.	Synthetic Materials	6	-	-
-----		84	-	56

DETAILED CONTENTS:

- ATOMIC STRUCTURE :(3 MARKS)
Basic concept of atomic structure, Matter wave concept, Quantum number, Haisenberg's Uncertainty Principle, Shaples of orbitals.
- CHEMICAL BONDING :(4 MARKS)
Covalent bond, Ionic & Co-ordinate, Hydrogen bonding, Valence bond theory, Hybridisation, VSEPR theory, Molecular orbital theory.
- CLASSIFICATION OF ELEMENTS :(3 MARKS)
Modern classification of elements (s,p,d and f blcok elements), Periodic properties : Ionisation potential electro negativity, Electron affinity.

4. ELECTRO CHEMISTRY-I:(3 MARKS)

Arrhenius Theory of electrolytic dissociation, Transport number, Electrolytic conductance, Ostwald dilution law. Concept of Acid and bases : Bronsted, Arrhenius and Lewis theory. Concept of pH and numericals. Buffer solutions, Indicators, Solubility product, Common ion effect with their application,

5. ELECTRO CHEMISTRY-II:(3 MARKS)

Redox reactions, Electrode potential(Nernst Equation), Electro-chemical cell (Galvanic and Electrolytic). EMF of a cell and free energy change. Standard electrode potential, Electro chemical series and its application. Chemical and Electrochemical theory of corrosion, Galvenic Series. Prevention of corrosion by various method.

6. CHEMICAL KINETICS :(3 MARKS)

Law of mass action, order and molecularity of rection. Activation energy, rate constants, Ist order reactions and 2nd order reactions.

7. CATALYSIS :(2 MARKS)

Definition Characteristics of catalytic reactions, Catalytic promotors and poison , Autocatalysis and Negative catalysis, Theory of catalysis, Application.

8. SOLID STATE :(2 MARKS)

Types of solids (Amorphous and Crystalline), Classification (Molecular, Ionic, Covalent, Metallic), Band theory of solids (Conductors, Semiconductors and Insulators), types of Crystals, FCC, BCC, Crystal imperfection.

9. FUELS :(3 MARKS)

Definition, its classification, high & low Calorific value.Determination of calorific value of solid and liquid fuels by Bomb calorimeter.

Liquid fuel - Petroleum and its refining, distillate of petroleum (Kerosene oil, Diesel and Petrol), Benzol and Power alchol. Knocking, Anti-knocking agents, Octane number and Cetane number.

Cracking and its type, Gasoling from hydrogenation of coal (Bergius process and Fischer tropsch's process)

Gaseous Fuel - Coal gas, Oil gas, Water gas, Producer gas, Bio gas, LPG and CNG.

Numerical Problems based on topics

10. WATER TREATMENT :(3 MARKS)

Hardness of water, Its limits and determination of hardness of water by EDTA method. Softening methods (Only Sods lime, Zeolote and Ion exchange resin process). Disadvantage of hard water in different industries, scale and sludge

formation, Corrosion, Caustic embrittlement, primming and foarming in biolers.

Disinfecting of Water By Chloramine-T, Ozone and Chlorine. Advantage and disadvantage of chlorinational, Industrial waste and sewage, Municipality waste water treatment, Definition of BOD and COD. Numerical Problems based on topics.

11. COLLOIDAL STATE OF MATTER :(3 MARKS)

Concept of collidal and its types, Different system of colloids, Dispersed phase and dispersion medium. Methods of preparation of colloidal solutions, Dialysis and electro dialysis. Properties of colloidal solution with special reference to absorption, Brownian Movement, tyndal effect, Electro phoresis and coagulation. relative stability of hydrophillic and hydrophobie colloids. Protection and protective colloids. Emulsion, Types, preparation, properties and uses. Application of colloids chemistry in different industries.

12. LUBRICANTS :(3 MARKS)

Definition, classification, Necessasity and various kinds of lubricants. Function and mechanism of action of lubricants and examples. Properties of lubricants, Importance of additive compunds in lubricants, Synthetic lubricants and cutting fluids. Industrial application, its function in bearing.

13. HYDROCARBONS:(4 MARKS)

- A. Classification and IUPAC nomeuclature of organic compounds hamologous series (Functional Group)
- B. Preparation, properties and uses of Ethane, Ethene, Ethyne (Acetylene), Benzene and Toluene.

14. ORGANIC REACTIONS & MECHANISM:(4 MARKS)

- 1. Fundamental auspects -
 - A. Electrophiles and nucleophiles, Reaction Intermediates, Free radical, Carbocation, Carbanion
 - B. Inductive effect, Mesomeric effect, Electromeric effect.
- 2.A. Mechanism of addition reaction (Markonicove's Rule, Cyanohydrin and Peroxide effect),
- B. Mechanism of Substitution reactions; (Nucleophillic) hydrolysis of alkyle halide, electrophillic substitution halogenation, Sulphonation, Niration and friedel-Craft reaction.
- C. Mechanism of Elimination reaction - Dehydration of primary alcohol, Dehyrohalogenation of primary alkyl halide.

15. POLYMERS :(3 MARKS)

- 1. Polymers and their classification. Average degree of polymerisation, Average molecular weight, Free radical polymerisation (Mechanisms)

2. Thermosetting and Thermoplastic resins -
 - A. Addition polymers and their industrial application- Polystyrene, PVA, PVC, PAN, PMMA, Buna-S, Buna-N, Teflon.
 - B. Condensation polymer and their industrial application : Nylon 6, Nylon 6,6, Bakelite, Melamine formaldehyde, Urea formaldehyde, Terylene or Decron, Polyurethanes.
3. General concept of Bio polymers, Biodegradable polymers and inorganic polymers(Silicon)
16. SYNTHETIC MATERIALS :(4 MARKS)
 - A. Introduction - Fats and Oils
 - B. Saponification of fats and oils , Manufacturing of soap.
 - C. Synthetic detergents, types of detergents and its manufacturing.
3. EXPLOSIVES: TNT, RDX, Dynamite.
4. Paint and Varnish

LIST OF PRACTICALS

1. To analyse inorganic mixture for two acid and basic radicals from following radicals
 - A. Basic Radicals :

NH₄⁺, Pb⁺⁺, Cu⁺⁺, Bi⁺⁺⁺, Cd⁺⁺, As⁺⁺⁺, Sb⁺⁺⁺,

Sn⁺⁺, Al⁺⁺⁺, Fe⁺⁺⁺, Cr⁺⁺⁺, Mn⁺⁺, Zn⁺⁺, Co⁺⁺

Ni⁺⁺, Ba⁺⁺, Sr⁺⁺, Ca⁺⁺, Mg⁺⁺
 - B. Acid Radicals :

CO₃⁻⁻, S⁻⁻, SO₃⁻⁻, CH₃COO⁻, NO₂⁻,

NO₃⁻, Cl⁻, Br⁻, I⁻, SO₄⁻⁻
2. To determine the percentage of available Chlorine in the supplied sample of Bleaching powder.
3. To determine the total hardness of water sample in terms of CaCO₃ by EDTA titration method using Eriochroma black-T indicator.
4. To determine the strength of given HCl solution by titration against NaOH solution using Phenolphthalein as indicator.
5. To determine the Chloride content in supplied water sample by using Mohr's methods.
6. Determination of temporary hardness of water sample by O-Henry's method.

1.5 ELECTRICAL AND ELECTRONICS ENGG. MATERIALS

L T P
5 - -

Rationale :

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

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Classification	10	-	-
2.	Conducting materials	15	-	-
3.	Insulating materials	15	-	-
4.	Magnetic materials	10	-	-
5.	Semiconductor materials	10	-	-
6.	Special purpose materials	10	-	-
		70	-	-

DETAILED CONTENTS

1. Classification

Classification of materials into conducting, semiconducting and insulating materials with reference to their atomic structure.

2. Conducting Materials

- (i) Resistivity and factors affecting resistivity, such as temperature, alloying and mechanical stressing.
- (ii) Super conductivity and super conducting material.
- (iii) Low resistivity materials e.g. copper, aluminium and steel, their general properties as conductor e.g. resistivity, temperature co-efficient, mechanical properties, corrosion, solder ability, contact resistance and practical application. Uses of mercury as conducting material.
- (iv) Comparison of copper, aluminium and steel for various applications as electrical conductor.
- (v) Low resistivity copper alloys: brass, bronze (cadmium and beryllium), their practical application.
- (vi) High resistivity materials : manganin, constantan nichrome, carbon, tungsten, their practical applications.
- (vii) Electric lamp materials.

- (viii) Brush contact materials.
 - (ix) Soldering materials.
 - (x) Thermocouple materials, Fuse materials.
3. Insulating Materials
- (i) Introduction.
 - (ii) Properties of insulating material.
 - Electrical properties: Volume resistivity, Surface resistivity, Dielectric Loss, Dielectric Constant, Dielectric strength.
 - Mechanical properties:- Mechanical strength
 - Physical properties :- Hygroscopicity tensile and compressive strength, Abrasive resistance brittleness.
 - Thermal properties - Heat resistance, Classification according to high permissible temperature rise, Effect of over loading on the life of an electrical appliances, Increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity.
 - Chemical properties - Solubility, Chemical resistance, Weather ability.
 - (iii) Insulating materials and their application-
 - Definition and classification
 - Thermo setting materials e.g. Phenol Formaldehyde, Resins (i.e. Bakelite), Amino resins (Ureca formaldehyde and Malamine formaldehyde), Epoxy resins their properties, Applications and Commercial names.
 - Thermo Plastic materials e.g. Polyvinyl Chloride (P.V.C.), Poly Ethelene Silicons their properties application and commercial names. Brief description of extrusion and moulding process of using plastic materials in electrical engineering.
 - Natural Insulating Materials- Mica and Mica products, Asbestos and Asbestos products, Ceramic materials (Porcelain and Stealite), Glass and glass products, Cotton, Silk, Jute, Paper (Dry and impregnated), Rubber Butuman, Mineral and insulating oil for transformer, switch gear, capacitors, high voltage cables, insulating varnishes for coating and impregnation, Enamels for winding wires, Glass fibre sleeves
 - Gaseous Materials e.g. Air, Hydrogen, Nitrogen and SF₆
4. Magnetic Materials :
- (i) Classification of magnetic materials into soft and hard magnetic materials.
 - (ii) Soft magnetic materials - high silicon alloy steel for transformers and low silicon alloy steel, for electric rotating machine cold rolled grain oriented and non-oriented steel, Nickel iron alloy, soft ferrites, their properties and uses.

- (iii) Hard magnetic materials - tungsten steel, chrome steel, cobalt steel, alnico, hard ferrites, their properties and applications.
- 5. Semiconductor Materials
Introduction, semiconductor and their applications, Different semiconductor materials used in manufacturing various semiconductor (Si & Ge), Material used for electronic components like resistor, capacitor, diode, transistors and inductors.
- 6. Special Purpose Materials :
Materials used in transistor and IC manufacturing, PC BS, computer memory devices (name of such materials to be added)
Ferrous and non ferrous materials.
Thermistor, Sensistor, Varistor and their practical applications.

1.6 WORKSHOP PRACTICE

[Common with Civil Engg., Civil Engg. (sp. in Rural Engg.), Electrical, Ceramic, Dairy, Agriculture, Chemical Technology (Rubber & Plastic), Chemical Technology (fertilizer), Four year chemical Engg.]

[Four year Past time Mechanical Engg. (sp. in Production Engg.)]

L T P
- - 14

Rationale

A diploma holder in any branch of engineering has to work in between a skilled workman and an Engineer. In order to have effective control over skilled workmen it is necessary that the supervisory staff must have adequate knowledge and skill. For development of skills workshop practice is very essential.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Carpentry shop	-	-	20
2.	Painting & polishing shop	-	-	16
3.	Sheet metal and soldering shop	-	-	56
4.	Fitting shop, Plumbing & Fastening Shop	-	-	24
5.	Foundry shop	-	-	20
6.	Smithy shop	-	-	24
7.	Welding shop	-	-	20
8.	Machine shop	-	-	16
		-	-	196

DETAILED CONTENTS

1. **Carpentry Shop :**
 - EX-1 Introduction & demonstration of tools used in carpentry shop and different types of joints, types of wood, seasoning and preservation of wood
 - EX-2 Planing and sawing practice
 - EX-3 Making of lap joint
 - EX-4 Making of mortise and tenon joint
 - Ex-5 Making of any one utility article such as wooden-picture frame, hanger, peg, name plate, etc.

2. **Painting and Polishing Shop:**
 - EX-1 Introduction of paints, varnishes, Reason for surface preparation, Advantage of painting, other method of surface coating i.e. electroplating etc.
 - EX-2 To prepare a wooden surface for painting apply primer on one side and to paint the same side. To prepare french polish for wooden surface and polish the other side.
 - Ex-3 To prepare metal surface for painting, apply primer and paint the same.
 - EX-4 To prepare a metal surface for spray painting, first spray primer and paint the same by spray painting gun and compressor system.

- * The sequence of polishing will be as below:
 - i) Abrasive cutting by leather wheel.
 - ii) Polishing with hard cotton wheel and with polishing material.
 - iii) Buffing with cotton wheel or buff wheel.

- 3. Sheet Metal and Soldering Shop :
 - EX-1 Introduction and Types of sheets, measuring of sheets
 - EX-2 Study and sketch of various types of stakes/anvil.
 - EX-3 Introduction & demonstration of tools used in Sheet metal working shop.
 - EX-4 Cutting, shearing and bending of sheet.
 - EX-5 To prepare a soap case by the metal sheet.
 - EX-6 To make a funnel with thin sheet and to solder the seam of the same.
 - EX-7 To make a cylinder and to solder the same.
 - EX-8 Preparation of different type of joints such as Lap joint-single seam, double seam. Hemp and wired joints.
 - EX-9 To braze small tube/conduit joints.

- 4. Fitting Shop, Plumbing Shop & Fastening Shop:
 - EX-1 Study of materials, limits, fits and tolerances.
 - EX-2 Introduction & demonstration of tools used in Fitting Shop.
 - EX-3 Hacksawing and chipping of M.S. flat. Filing and squaring of chipped M.S. job. Filing on square or rectangular M.S. piece.
 - EX-4 Making bolt & nut by tap and die set and make its joints
 - EX-5 To drill a hole in M.S. Plate and tapping the same to create threads as per need.
 - EX-6 Utility article-to prepare double open mouth spanner for 18" hexagonal head of a bolt.
 - EX-7 Cutting and threading practice for using socket, elbow and tee etc. and to fit it on wooden practice board.
 - EX-8 Study of-bib cock, cistern or stop cock, wheel valve and gate valve etc.
 - EX-9 Practice of bolted joints
 - EX-10 To prepare a rivetted joint
 - EX-11 To make a pipe joint
 - EX-12 To make a threaded joint
 - EX-13 Practice of sleeve joint

- 5. Foundry Work
 - EX-1 Study of metal and non metals
 - EX-2 Study & sketch of the foundry tools.
 - EX-3 Study & sketch of cupola & pit furnace.
 - EX-4 To prepare the green moulding sand and to prepare moulds (single piece and double piece pattern sweep mould)
 - EX-5 Casting of non ferrous (lead or aluminium) as per exercise 3.

- 6. Smithy Shop :
 - EX-1 Study & Sketch of Tools used in smithy shop.
 - EX-2 To prepare square or rectangular piece by the M.S. rod.
 - EX-3 To make a ring with hook for wooden doors.

EX-4 Utility article-to prepare a ceiling fan hook.

7. Welding Shop :

EX-1 Introduction to welding, classification of welding, types of weld joints.

EX-2 Welding practice-gas and electric.

EX-3 Welding for lap joint after preparing the edge.

EX-4 Welding of Butt joint after preparation of the edge.

EX-5 'T' joint welding after preparation of edge.

EX-6 Spot welding, by spot welding machine.

8. Machine Shop

EX-1 Study & sketch of lathe machine.

EX-1 Study & sketch of grinders, milling M/c, Drilling M/c and CNC Machines

Ex-2 Plain and step turning & knurling practice.

Ex-3 Study and sketch of planing/Shaping machine and to plane a Rectangle of cast iron.

II Semester

2.1 APPLIED MATHEMATICS I (B)
[Common to All Engineering Courses]

L T P
3 2/2 -

Rationale:

The study of mathematics is an important requirement for the understanding and development of any branch of engineering. The purpose of teaching mathematics to diploma engineering students is to impart them basic knowledge of mathematics which is needed for full understanding and study of engineering subjects.

S.N.	Units	Coverage Time		
		L	T	P
1.	Integral Calculus-I	12	4	-
2.	Integral Calculus-II	12	4	-
3.	Coordinate Geometry (2 Dimensional)	10	3	-
4.	Coordinate Geometry (3 Dimensional)	8	3	-
		42	14	-

DETAILED CONTENTS:

1. INTEGRAL CALCULUS - I : (14 Marks)
 - Methods of Indefinite Integration :-
 - 1.1 Integration by substitution.
 - 1.2 Integration by rational function.
 - 1.3 Integration by partial fraction.
 - 1.4 Integration by parts.
2. INTEGRAL CALCULUS -II :(14 Marks)
 - 2.1 Meaning and properties of definite integrals, Evaluation of definite integrals. Integration of special function.
 - 2.2 Application : Finding areas bounded by simple curves, Length of simple curves, Volume of solids of revolution, centre of mean of plane areas.
 - 2.3 Simposns 1/3rd and Simposns3/8th rule and Trapezoidal Rule : their application in simple cases.
3. CO-ORDINATE GEOMETRY (2 DIMENSION):(14 Marks)
 - 3.1 CIRCLE :
 - Equation of circle in standard form. Centre - Radius form, Diameter form, Two intercept form.
 - 3.2 Standard form and simple properties
 - Parabola $x^2=4ay$, $y^2=4ax$,

$$\text{Ellipse } \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$\text{Hyperbola } \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

4. CO-ORDINATE GEOMETRY (3 DIMENSION):(8 Marks)

4.1 Straight lines and planes in space -

Distance between two points in space, direction cosine and direction ratios, Finding equation of a straight line and Plane (Different Forms),

4.2 Sphere $x^2 + y^2 + z^2 + 2gx + 2fy + 2wz = d$ (Radius, Centre and General Equation)

2.2 APPLIED PHYSICS-II

[Common to All Engineering Courses]

L T P
3 2/2 4

Rationale:

Engineering physics is a foundation Course. Its purpose is to develop proper understanding of physical phenomenon and scientific temper in the students. While teaching the subject, teachers should make maximum use of demonstrations to make the subject interesting to the students.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Topics	L	T	P
1.	Optics	4	1	-
2.	Introduction To Fiber Optics	4	1	-
3.	Laser & its Application	4	1	-
4.	Electrostatics	4	1	-
5.	D.C. Circuits	4	1	-
6.	Magnetic Materials & Their Properties	4	1	-
7.	Semi Conductor Physics	4	1	-
8.	Introduction Diode & Transistors	4	2	-
9.	Introduction To Digital Electronics	4	2	-
10.	Non-conventional energy sources	6	3	-
		42	14	56

1. Optics (4 Marks)

Nature of light, Laws of Reflection and Refraction, Snell's Law, Interference (Constructive and Destructive), Diffraction and Polarization (Concept Only), Law of Malus and Polaroids.

2. Introduction To Fibre Optics :(5 Marks)

Critical angle, Total internal reflection, Principle of fibre optics, Optical fibre, Pulse dispersion in step-index fibres, Graded index fibre, Single mode fibre, Optical sensor.

3. Lasers and its Applications (4 Marks)

Absorption and Emission of energy by atom, Spontaneous and Stimulated Emission, Population inversion, Main component of laser and types of laser- Ruby Laser, He-Ne laser and their applications. Introduction to MASER.

4. Electrostatics :(4 Marks)

Coulomb's Law, Electric field, Electric potential, Potential energy, Capacitor, Energy of a charged capacitor, Effect of dielectric on capacitors.

5. D.C. Circuits (5 Marks)

Ohm's Law, Kirchoff's Law and their simple application,

Principle of Wheat Stone bridge and application of this principle in measurement of resistance (Meter bridge and Post Office Box); Carey Foster's bridge, potentiometer.

6. Magnetic Materials and Their Properties: (5 Marks)

Dia, Para and Ferro-magnetism, Ferrites, Magnetic Hysteresis Curve and its utility. Basic idea of super conductivity, Meissner's effect.

7. Semiconductor Physics (4 Marks)

Concept of Energy bands in solids, classification of solids into conductors, insulators and semiconductors on the basis of energy band structure. Intrinsic and extrinsic semiconductors, Electrons and holes as charge carriers in semiconductors, P-type and N-type semiconductors.

8. Junction Diode and Transistor : (6 Marks)

Majority and Minority charge carriers, P-N junction formation, barrier voltage, Forward and reverse biasing of a junction diode, P-N junction device characteristics, Formation of transistor, transistor-action, Base, emitter and collector currents and their relationship LED's.

9. Introduction To Digital Electronics : (6 Marks)

Concept of binary numbers, Interconversion from binary to decimal and decimal to binary. Concepts of Gates (AND, NOT, OR).

10. Non-conventional energy sources: (7 Marks)

(a) Wind energy : Introduction, scope and significance, measurement of wind velocity by anemometer, general principle of wind mill.

(b) Solar energy: Solar radiation and potentiality of solar radiation in India, uses of solar energy: Solar Cooker, solar water heater, solar photovoltaic cells, solar energy collector.

PHYSICS LAB

Note: Any 4 experiments are to be performed.

1. Determination of coefficient of friction on a horizontal plane.
2. Determination of 'g' by plotting a graph T^2 versus l and using the formula $g = 4\pi^2 / \text{Slope of the graph line}$
3. Determine the force constant of combination of springs in case of 1. Series 2. Parallel.
4. To verify the series and parallel combination of Resistances with the help of meter bridge.
5. To determine the velocity of sound with the help of resonance tube.
6. Determination of viscosity coefficient of a lubricant by Stoke's law.
7. Determination of E_1/E_2 of cells by potentiometer.
8. Determination of specific resistance by Carey Foster bridge.
9. Determination of resistivity by P.O.Box.
10. Verification of Kirchoff's Law.
11. To draw Characteristics of p-n Junction diode.
12. To measure instantaneous and average wind velocity by indicating cup type anemometer/hand held anemometer.

NOTE :

Students should be asked to plot a graph in experiments (where possible) and graph should be used for calculation of results. Results should be given in significant figures only.

2.3 BASIC ELECTRICAL ENGINEERING

L T P
5 - 3

Rationale

An electrical diploma holder is involved in various jobs ranging from preventive maintenance of machines to fault location in circuits, commission of new machines to selection of suitable apparatus, designing of small components for improvement. In order to carry out these and similar jobs effectively on any equipment circuitry or machinery, specialised knowledge of concerned field is essential.

However, for acquiring knowledge in any specialised field of electrical engineering, a group of certain common fundamental concepts, principles and laws involved and mastering of some manual skills are pre-requisites. To be covered in the subject of basic electricity.

Sl.N.	Units	Coverage Time		
		L	T	P
1.	Basic terminology and their concept	3	-	-
2.	D.C. circuits	9	-	-
3.	Batteries	04	-	-
4.	Capacitors	08	-	-
5.	Electromagnetism	9	-	-
6.	Electromagnetic induction	9	-	-
7.	A.C. circuits	14	-	-
8.	Transients and Harmonic	6	-	-
9.	Polyphase circuits	08	-	-
		70	-	42

DETAILED CONTENTS

1. Basic Terminology and their concepts
 - 1.1 Current, EMF, potential difference (Voltage), resistance, resistivity their units conductors & insulators, Insulation resistance of a cable.
 - 1.2 Effect of temperature on the resistance of conductors, semiconductors (C, Si, Ge) and insulators physical explanation, temperature coefficient of resistance.
 - 1.3 Electrical power, energy and their units (SI), Heating effect of electric current and its practical examples.
 - 1.4 Relationship between electrical, mechanical and thermal SI units of work, power and energy, Electrical Safety and precautions.
2. D.C. Circuits
 - 2.1 Kirchoff's laws.
 - 2.2 Simple numerical problems based on Kirchoff's laws.

- 2.3 Introduction to Thevenin and Superposition theorem, Norton's theorem
- 3. Batteries
 - 3.1 Construction, chemical changes during charging and discharging of lead acid cells.
 - 3.1(a) Indications of a fully charged battery.
 - 3.2 Capacity and efficiency of lead acid cell / battery.
 - 3.3 Charging of 6 V., 12 V. commercial batteries.
 - 3.3(a) Grouping of cells.
 - 3.4 Care and maintenance of commercial batteries.
 - 3.5 Problems/defects in lead acid batteries.
 - 3.6 Concept of Nickel-Iron and Nickel Cadmium Batteries.
 - 3.7 Concept of solid sealed maintenance free batteries (SMF batteries), Oxygen recombination principle.
- 4. Capacitors
 - 4.1 Concept of capacitor, types of capacity of parallel plate capacitor, Composite capacitor and effect of physical parameters.
 - 4.1 Energy stored in a capacitor, dielectric and its influence on capacitance of a capacitor, dielectric constant dielectric breakdown and dielectric strength. Dielectric loss.
 - 4.3 Series and parallel combination of capacitors.
 - 4.3(a) Capacitance of multi-plate capacitors.
 - 4.4 Variable capacitors.
 - 4.5 Charging and discharging of capacitors.
 - 4.6 Simple problems on capacitors.
- 5. Electromagnetism
 - 5.1 Concept of magnetic flux, flux density, magnetic field intensity, permeability and their units.
 - 5.2 Magnetic circuits, concept of reluctance and mmf and simple problems.
 - 5.3 Analogy between electric and magnetic circuits.
 - 5.4 B-H curve and magnetic hysteresis (No mathematical derivation).
 - 5.5 Elementary ideas about hysteresis loss.
 - 5.5(a) Lifting powers of a magnet.
- 6. Electromagnetic Induction
 - 6.1 Faraday's laws of electromagnetic induction. Lenz's law, simple problem. Dynamically induced emf.
 - 6.2 Self induced emf, inductance, its role in electrical circuits. Simple problems.
 - 6.3 Mutually induced emf, mutual inductance, its role in electrical circuits. Simple problems.

- 6.4 Energy stored in magnetic circuit.
 - 6.5 Rise and decay of current in inductors.
 - 6.6 Force on a current carrying conductor placed in a magnetic field and its applications.
 - 6.7 Elementary idea about eddy current loss.
7. A.C.Circuits
- 7.1 Recapitulation of terminology, instantaneous value, maximum (peak) value, cycle, frequency, alternate current and voltage. Difference between AC and DC.
 - 7.2 Equation of an alternating voltage and current and wave shape varying sinusoidally.
 - 7.3 Average and RMS value of alternating voltage and current. Importance of RMS value. Simple problems.
 - 7.4 Concept of phase, phase difference and phasor representation of alternating voltage and current.
 - 7.5. A.C. through pure resistance, inductance, capacitance, phasor diagram and power absorbed.
 - 7.6 R-L series circuit, idea of impedance and calculations.
 - 7.7 Apparent power, reactive power and active power, power factor, its importance and simple problems.
 - 7.8 R-C series circuit , simple problems.
 - 7.9 R-L-C series circuit , simple problems.
 - 7.10 Solution of simple parallel A-C circuits by
 - (a) Phasor diagram method,
 - (b) Admittance method.
 - 7.11 Solution of AC circuits series/parallel by j method. (simple problems).
 - 7.12 Resonance (Series and parallel) and practical application, simple problems.
8. Transients and Harmonics
- Introduction, Types of transients, Important differential equations, First and second order equations, Transients in R-L series circuits (D.C.), Short circuit current, Time constant, Transients in R-L series circuits (A.C.), Transients in R-C series circuits (D.C.), Transients in R-C series circuits (A.C.), Double energy transients, Fundamental wave and harmonics, Different complex waveforms, General equation of complex wave, R.M.S. value of a complex wave, Power supplied by complex wave, Harmonics in single phase A.C. circuits, Selective resonance due to harmonics, Effect of harmonics on measurement of inductance and capacitance.
9. Polyphase System
- 8.1 Introduction to polyphase system. Advantage of three

phase system over single phase system.

- 8.2 Star and Delta connections. Relationship between phase and line value of currents and voltage. Power in polyphase circuits. Simple problems of balanced circuits only.

BASIC ELECTRICAL ENGG. LAB

- i) To show the variation of resistance of a lamp with temperature by plotting a V-I curve for 60W and 100W filament lamps.
- ii) To verify the Kirchoff's laws.
- iii) To observe the B-H curve for a ferro-magnetic core on CRO.
- iv) To find the relationship between voltage and current for R-L series circuit for variable resistances & variable inductance.
- v) To determine the variation in the values of inductance of a coil for different positions of the movable iron core.
- vi) To measure the power factor in a single phase AC circuit by using voltameter, ammeter & wattmeter.
- vii) To test a battery for charged and discharged condition and to charge a battery.
- viii) Verification of voltage and current relations in Star and delta connected systems.
- ix) To charge and discharge a capacitor and to show the graph on C.R.O.
- x) Verification of laws of capacitors in series and parallel.

2.4 ELECTRONICS - I

L T P
5 - 3

Rationale:

At present electronic gadgets are being extensively used in manufacturing processes in industries, power system operations and communication system, computers etc. Even for an electrical diploma holder it is absolutely necessary to have a basic understanding of electronic components, circuits and devices like..

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Semiconductor diode	9	-	-
2.	Bipolar Junction transistor	9	-	-
3.	Single stage transistor amplifier	9	-	-
4.	FET MOSFET & CMOS	9	-	-
5.	Multi Stage & Power amplifier	12	-	-
6.	Feedback amplifiers	7	-	-
7.	Regulated power supply	7	-	-
8.	Oscillator	8	-	-
		70	-	42

1. Semiconductor Diodes

Semiconductor materials N type and P Type P.N. junction, its forward and reversed biasing; junction diode characteristics, static and dynamic resistances and their calculation from diode characteristics.

Diode (P-N junction) as , half wave, full wave rectifier including bridge rectifier, relationship between D.C. output voltage and A.C. input voltage, rectification efficiency and ripple factor for rectifier circuits, filter circuits, shunt capacitor, series inductor, capacitor input filter.

Different types of diodes, brief idea of characteristics and typical applications of power diodes, zener diodes, varactor diodes, point contact diode, tunnel diodes, LEDs and photo diodes.

Important specifications of rectifier diode and zener diode.

2. Bipolar Junction Transistor :

Concept of bipolar junction transistor as a two junction three terminal device having two kinds of charge carriers, PNP and NPN transistor, their symbols and mechanisms of current flow, explanation fundamental current relations. Concept of leakage current (I_{cbo}) effect of temperature on leakage current.

Standard notation for current and voltage polarity; CB, CE, and CC configurations. Transistor input and output characteristics, concept of active, cut off and saturation region.

Common emitter configuration: current relations in CE configuration, collector current in terms of base current and

leakage current (I_{ce0}), relationship between the leakage current in CB and CE configuration, input and output characteristics, determination of dynamic input and output resistances and current amplification factor from the characteristics.

3. Single Stage Transistor Amplifier

Single stage CE amplifier with proper biasing circuit and its working as voltage amplifier. AC load line and its use in:

- (a) Explanation of phase reversal of the output voltage with respect to input voltage. Introduction to tuned voltage amplifier.

4. FIELD EFFECT TRANSISTOR (FET), MOSFET & CMOS

A. FET :

- Construction, operation, characteristics and Biasing of Junction FET.
- Analysis of Single stage CB, CG and CD amplifier. (Only Brief Idea)

B. MOSFET :

- Construction, operation, characteristics and Biasing of MOSFET in both depletion and enhancement modes.
- Analysis of Single stage CB, CG and CD amplifier. (Only Brief Idea)

C. CMOS :

- Construction, operation, characteristics of CMOS in in both depletion and enhancement modes.
- Use of CMOS as Inverter, Different Application of CMOS, CMOS IC.
- Comparison of JEET, MOSFET and Bipolar transistor.

5. MULTISTAGE & POWER AMPLIFIERS:

- 5.1 Need of multistage amplifier, different coupling schemes and their working, brief mention of application of each of the type of coupling.
- 5.2 Working of R.C. coupled and transformer coupled multistage amplifier, approximate calculation of voltage gain and frequency response for a two stage R-C coupled amplifier. Working principles of push pull amplifier circuits its advantages over single ended power amplifier.

6. Feedback in Amplifiers

Basic principles and types of feedback, derivation of expression for the gain of an amplifier employing feedback. Effect of negative feedback on gain, stability, distortion, and band width. (only physical explanation) typical feedback circuits:

- (a) RC coupled amplifiers with emitter by-pass capacitor removed.
 - (b) Emitter follower, complementary symmetry power amplifier and its applications.
7. Regulated Power Supply
- 7.1 Concept of regulation.
 - 7.2 Basic regulator circuits (using zener diode).
 - 7.3 Concept of series and shunt regulator circuits.
 - 7.4 Three terminal voltage regulator ICs (positive negative and variable) application. Block diagram, Pin configuration and working of popular regulator IC.
8. OSCILLATORS:
- 8.1 Application of oscillators.
 - 8.2 Use of positive feedback/negative resistance for generation of oscillation, Barkhausen's criterion for oscillations.

ELECTRONICS I LAB:

1. Semiconductor diode : identification of types of packages, terminals and noting different ratings using data books for various types of semiconductor diodes (germanium, point contact, silicon low power and high power and switching diode).
2. Rectifier circuits using semiconductor diode measurement of input and output voltage and plotting of input and output waveshapes:
 - i) Half wave rectifier
 - ii) Full wave rectifier (centre tapped and bridge rectifier circuits).
3. Plot the waveshapes of a full wave rectifier with shunt capacitor, series inductor, and filter circuit
4. Single stage common emitter amplifier circuit
 - i) Measurement of voltage gain at 1 KHZ for different load resistances.
 - ii) Plotting of frequency response of a single stage amplifier circuit.
 - iii) Measurement of input and output impedance of the amplifier circuit.
5. To measure the overall gain of two stage R.C coupled amplifier at 1 KHZ and note the effect of loading of second stage on the first stage.
- 6.(a) To plot the load Vs output power characteristic to determine the maximum signal input for undistorted signal output.
 - (b) The above experiment is to be performed with single ended power amplifier, transistorized push pull amplifier. Complementary symmetry power amplifier.
7. To observe the effect of a by-pass capacitor by measuring voltage gain and plotting frequency response for a single stage amplifier.
8. To measure input and output impedance of a feedback amplifier with and without by-pass capacitor.
9. Measurement of voltage gain, input and output impedance and plotting of frequency response of an emitter follower circuit.
10. Plot the FET characteristics and determination of its parameters from these characteristics.
11. To test adjustable IC regulator and current regulator.
12. Identification of Some Popular IC of 74 and 40 series with Pin Number and other details.
13. Application and use of Multimeter, CRO, Audio Oscillator and Power Supply (D.C.)

2.5 ENGINEERING DRAWING

[Common to Three years Diploma Course in Civil Engg.,
Electrical Engg., Chemical Engg., Dairy, Ceramic, Textile
Technology, Textile Chemistry]

[Also Common to Four year Part-time Diploma Course in
Electrical Engineering, Mechanical Engineering
(Specialization in Production Engineering)]

[Also common to First year Diploma Course in Chemical
Technology : (1) Fertilizer Technology, (2) Rubber and
Plastic Technology]

L T P
4 - 10

Rationale

Drawing, which is known as the language of engineers, is a widely used means of communication among the designers, engineers, technicians, draftmen and craftsmen in the industry. The translation of ideas into practice without the use of this graphic language is really beyond imagination. Thus, for the effective and efficient communication among all those involved in an industrial system, it becomes necessary that the personnel working in different capacities acquire appropriate skills in the use of this graphic language in varying degrees of proficiency in accordance with their job requirements.

Generally speaking, an engineering technician working at the middle level of the threetier technical manpower spectrum, is required to read and interpret the designs and drawings, provided to him by technologists and subsequently to translate them to the craftsmen for actual execution of the job.

This course in Engineering Drawing has been designed, keeping in view, the above referred job functions of a technician in the industry. This preliminary course aims at building a foundation for the further courses in drawing and other allied subjects. The contents of the course have been selected as to form a core for the various diversified fields of engineering. It is expected that at the end of this session, the students acquires sufficient skill drafting and some ability in spetial visualization of simple objects.

Sl.N.	Units	Coverage Time		
		L	T	P
1.	Drawing Instruents and their use	5	-	4
2.	A. Lettering techniques	3	-	16
	B. Introduction to scales	2	-	8
3.	Conventional Presentation	5	-	8
4.	A. Principles of projections	3	-	12
	B. Point Line, Plane	2	-	28
5.	Orthographic projection of simple geometrical solids	5	-	12
6.	Section of Solids	5	-	20
7.	Isometric Projection	5	-	20
8.	Free Hand Sketching	5	-	8
9.	Development of surfaces	5	-	24
10.	Orthographics Projection of Machine Parts	5	-	12
11.	Practice on Auto Cad	6	-	24
		56	-	140

C O N T E N T S

NOTE :	Latest Indian Standards Code of Practice to be followed.	
1.	Drawing, instruments and their uses.	1 Sheet
1.1	Introduction to various drawing, instruments.	
1.2	Correct use and care of Instruments.	
1.3	Sizes of drawing sheets and their layouts.	
2. (a)	Lettering Techniques	2 Sheet
	Printing of vertical and inclined, normal single stroke capital letters.	
	Printing of vertical and inclined normal single stroke numbers.	
	Stencils and their use.	
(b)	Introduction to Scales	2 Sheet
	Necesssity and use, R F	
	Types of scales used in general engineering drawing. Plane, diagonal and chord scales.	
3.	Conventional Presentaion :	1 Sheet
	Thread (Internal and External), Welded joint, Types of lines, Conventional representation of materials, Conventional representation of machine parts.	
4. (a)	Principles of Projection	1 Sheet
	Orthographic, Pictorial and perspective.	
	Concept of horizontal and vertical planes.	
	Difference between I and III angle projections.	
	Dimensconing techniques.	
(b)	Projections of points, lines and planes.	1 Sheet
5 (a)	Orthographic Projections of Simple	2 Sheet
	Geometrical Solids	
	Edge and axis making given angles with the reference planes. Face making given angles with reference planes. Face and its edge making given angles with referance planes.	
(b)	Orthographic views of simple composite solids from their isometric views.	
(c)	Exercises on missing surfaces and views	
6.	Section of Solids	2 Sheet

Concept of sectioning

Cases involving cutting plane parallel to one of the reference planes and perpendicular to the others.

Cases involving cutting plane perpendicular to one of the reference planes and inclined to the others plane, true shape of the section

7. Isometric Projection. 2 Sheet
- Isometric scale
- Isometric projection of solids.
8. Free hand sketching 1 Sheet
- Use of squared paper
- Orthographic views of simple solids
- Isometric views of simple job like carpentary joints
9. Development of Surfaces 2 Sheet
- Parallel line and radial line methods of developments.
- Development of simple and truncated surfaces (Cube, prism, cylinder, cone and pyramid).
10. ORTHOGRAPHIC PROJECTION OF MACHINE PARTS: 2 Sheet
- Nut and Bolt, Locking device, Wall bracket
11. PRACTICE ON AUTO CAD : 2 Sheet
- Concept of AutoCAD, Tool bars in AutoCAD, Coordinate System, Snap, Grid and Ortho mode. Drawing Command - Point, Line, Arc, Circle, Ellipse. Editing Commands - Scale, Erase, Copy, Stretch, Lengthen and Explode. Dimensioning and Placing text in drawing area. Sectioning and hatching. Inquiry for different parameters of drawing.
- NOTE :
- A. The drawing should include dimension with tolerance wherever necessary, material list according to I.S. code. 25% of the drawing sheet should be drawn in first angle projection and rest 75% drawing sheet should be in third angle figure
- B. Practice on AutoCAD latest software is to be done in AutoCAD lab of Mechanical Engineering Department of the Institute.

3.1 Functional Communication

L	T	P
4	-	-

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Units	Coverage Time		
		L	T	P
Section A English				
1.	On Communication	04	-	-
2.	Exploring Space	04	-	-
3.	Sir C.V. Raman	04	-	-
4.	Professional Development	04	-	-
5.	Buying a Second Hand Bicycle	04	-	-
6.	Leadership and Supervision	04	-	-
7.	First Aid	03	-	-
8.	The Romanance of Reading	03	-	-
9.	No Escape from Computers	03	-	-
10.	Bureau of Indian Standards	03	-	-
Section B Hindi				
1.	Topic 1	02	-	-
2.	Topic 2	02	-	-
3.	Topic 3	02	-	-
4.	Topic 4	02	-	-
5.	Topic 5	02	-	-
6.	Topic 6	02	-	-
7.	Topic 7	02	-	-
8.	Topic 8	01	-	-
9.	Topic 9	02	-	-
10.	Topic 10	02	-	-
11.	Topic 11	01	-	-
		56	-	-

Section "A" (English)

Text Lessons

Unit I.	On Communication
Unit.II	Exploring Space
Unit.III	Sir C.V. Raman
Unit.IV	Professional Development of Technicians
Unit.V	Buying a Second Hand Bicycle
Unit.VI	Leadership and Supervision
Unit.VII	First Aid
Unit.VIII	The Romanance of Reading
Unit.IX	No Escape from Computers
Unit.X	Bureau of Indian Standards

Section "B" Hindi

1& Lojkstxkj

2& Hkkjrh; oSKkfudksa ,oa rduhfd;ksa dk Hkkjr ds fodkl esa ;ksxnku
3& xzkE; fodkl
4& ifjokj fu;kstu
5& lkekftd laLFkk;sa
6& fu;kstu vkSj tu dY;k.k
7& Hkkjr esa izkS|Skfxdh ds fodkl dk bfrgkl
8& gfjr dzkafUr
9& i;kZoj.k ,oa ekuo iznw"k.k
10& Jfed dY;k.k
11& Hkkjr esa Jfed vkUnksyu

3.2 APPLIED MATHEMATICS II

[Common to All Engineering Courses]

L	T	P
5	2	-

Rationale :

The study of mathematics is an important requirement for the understanding and development of concepts of Engg. The purpose of teaching mathematics to the Diploma Engg. students is to give them basic foundation and understanding of mathematics so that they can use the same for the understanding of engineering subjects and their advancements.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Matrices	16	6	-
2.	Differential Calculus	15	6	-
2.	Differential Equations	15	6	-
4.	Integral Calculus	12	5	-
5.	Probability & Statistics	12	5	-
		70	28	-

DETAILED CONTENTS

1. MATRICES :(12 Marks)

1.1 Algebra of Matrices, Inverse :

Addition, Multiplication of matrices, Null matrix and a unit matrix, Square matrix, Symmetric, Skew symmetric, Hermitian, Skew hermitian, Orthogonal, Unitary, diagonal and Triangular matrix, Determinant of a matrix.

Definition and Computation of inverse of a matrix.

1.2 Elementary 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 a 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 eigen values and eigen 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 :(10 Marks)
- 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, Eulens theorem for homogeneous functions, Jacobians.
- 2.3 Vector Calculus :
- Vector function, Introduction to double and triple integral, differentiation and integration of vector functions, gradient, divergence and curl, differential derivatives.
3. DIFFERENTIAL EQUATION :(10 Marks)
- 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, equtions 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 $X=e^{ax}$, $\sin ax$, $\cos ax$, 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 Marks)
- 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 :(6 Marks)

5.1 Probability :

Introduction, Addition and Multiplication theorem and simple problem.

5.2 Distribution :

Discrete and continuous distribution, Binomial Distribution, Poisson Distribution, Normal Distribution..

3.3 ELECTRICAL INSTRUMENTS AND MEASUREMENTS

L T P
5 1 4

Rationale:

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

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

Sl.N.	Units	Coverage Time		
		L	T	P
1.	Introduction	4	1	-
2.	Measurements & errors	4	1	-
3.	Ammeters and voltmeters	8	2	-
4.	Wattmeter and maximum demand indicator	8	2	-
5.	Energymeter	6	1	-
6.	Miscellaneous measuring instruments	8	1	-
7.	Electronic instruments	10	2	-
8.	Measurement of inductance and capacitance	10	2	-
9.	Elements of process instrumentation	12	2	-
		50	14	56

DETAILED CONTENTS

- 1 Introduction to electrical measuring instruments:
 - 1.1 Concept of measurement and instruments.
 - 1.2 Electrical quantities and instruments for their measurements.
 - 2.1 Measurement and Errors. Accuracy, precision, types of errors, probability of errors and Gaussian Errors curve, sensitivity, resolution and stability. Classification of errors.
 - 2.2 Types of electrical measuring instruments, indicating, integrating and recording instruments.
 - 2.3 Essentials of indicating instruments, deflecting, controlling and damping torques.
3. Ammeters and voltmeters (moving coil and moving iron type)
 - 3.1 Concept of ammeters and voltmeters and difference between them.

- 3.2 Construction and working principle of moving coil and moving iron instruments. Merits and demerits.
- 3.3 Extension of range, use of C.T. & P.T.
- 4. Wattmeters (Dynamometer type) and Maximum Demand Indicator:
 - 4.1 Construction, working principle, merits and demerits of dynamometer type wattmeter.
 - 4.2 Power measurement in three phase circuit by Two wattmeter and three wattmeter methods, simple problems.
 - 4.4 Construction and working principle of maximum demand indicators.
- 5. Energymeter (Induction type):
 - 5.1 Construction, working principle, merits and demerits of single-phase and three phase energy meters.
 - 5.2 Testing of energy meters for calibration. Errors and compensation. Simple problems.
 - 5.3 Digital Energy meter (Single Phase/Three Phase) Construction working and application
 - 5.4 Trivector Meter, Construction, Working & Its Application.
- 6. Miscellaneous Measuring Instruments:

The construction, working principle and application of: ohm-meter, meggar, earth tester, multimeter, frequency meter (reed-type) single phase power factor meter (Electrodynamometer type), 3-phase power factor meter, phase sequence indicator, synchronoscope.
- 7. Electronic Instruments:
 - 7.1 Cathode Ray Oscilloscope, construction, working of CRO. Simple applications (like measurement of voltage current and frequency).
 - 7.2 Introduction to electronic multimeter, analog multimeter, digital multimeters and V.T.V.M.
- 8. Measurement of Resistance Inductance and Capacitance
 - 8.1 Bridges : Maxwell bridge, Wein's bridge and Schering bridge.
 - 8.2 Potentiometer, Kelvin's double bridge.
- 9. Elements of Process Instrumentation
 - 9.1 Block diagram of process instrumentation system and purpose of each block.
 - 9.2 Basic principles of various sensors/transducers for measurement of temperature, pressure, strain and liquid level.

ELECTRICAL INSTRUMENTS AND MEASUREMENT LAB

- (i) To extend the range of an ammeter/voltmeter.
- (ii) To convert an ammeter into voltmeter.
- (iii) To calibrate 1-phase energymeter by direct loading method.
- (iv) To make proper connections of indicating/integrating instruments in a circuit e.g. wattmeter, frequency meter, power factor meter, 1-phase and 3-phase energy meter (Analog type/Digital Type) etc.
- (v) To measure power, power factor in a 1-phase circuit using wattmeter and power factor meter and verify results with calculations.
- (vi) Measurement of power and power factor of a 3-phase balanced load by 2-wattmeter method.
- (vii) Measurement of voltage, frequency of a sinusoidal signal with C.R.O.
- (viii) Measurement of resistance, voltage, current with electronic multimeters (Analog & Digital) and compare the reading.
- (ix) To measure strain by transducer.
- (x) To measure inductance by maxwell's bridge.
- (xi) To measure capacitance by Wein's/Schering bridge.
- (xii) To calibrate three phase energy meter with the help of standard 3 phase energy meter.
- (xiii) To connect a Trivector meter in a three phase circuit and make measurement of different quantities.

3.4 INTRODUCTION TO COMPUTER

[Common with Civil Engg., Civil (Spl. With Rural), Mechanical Engg., (Specialisation in Production, Automobile, Refrigeration and Air conditioning), Electronics Engg., Instrumentation and Control Engg., Dairy Engg., Leather Technology, Footwear and Leather Goods Tech., Ceramics, Chemical Engg. (Four year Sandwich), Chemical Tech. (Rubber & Plastic), Chemical Tech. (Fertilizer)]

L T P
2 - 5

Rationale:

Computers are being used for design and information processing in all branches of engineering. An exposure to fundamentals of computer programming is very essential for all diploma holders. This subject has been included to introduce students in the use and application of computers in engineering.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Introduction to Computer	4	-	-
2.	Introduction To Operating System (MS DOS/Windows)	3	-	-
3.	Word Processing	4	-	-
4.	Worksheet	4	-	-
5.	Presentation	4	-	-
6.	Data Base Operation	3	-	-
7.	Introduction to Internet	2	-	-
8.	Introduction to advance tools	4	-	-
		28	-	70

DETAILED CONTENTS

1. Introduction to Computer:
 - A. Block Diagram of Computer.
 - B. Types Of Computer
 - C. Types of Input and Output devices
 - D. Memories Devices (Its Types and Basic).
2. INTRODUCTION TO OPERATING SYSTEMS (MS-DOS/MS-WINDOWS:)

What is operating system, its significance, Commands of DOS, Features/Application of window.
3. WORD PROCESSING:

File : Open, Close, Save, Save as, Search, Send to, Print Preview, Print and Page Setup

Edit : Cut, Copy, Paste, Office Clipboard, Select All, Find, replace, Goto, etc.

View : Normal/Web Layout/Print Layout; Tool Bars; Header/Footer; Zoom, etc.

Insert: Break, Page Number, Date & Time, Symbol, Comment, Reference, etc.
Format: Font, Paragraph, Bullets & Numbering, Borders & Shading, Column, Change case, Back ground, etc.
Tools : Spelling & Grammer, Language, Word Count, Letters & Mailing, Options, Customize, etc.
Table : Draw, Insert, Delete, Select, Auto Format, AutoFit, Convert, Sort, Formula, etc.
Mail Merge

4. WORKSHEET:

Introduction, Use of Tools/Icons for preparing simple Mini Project.

5. PRESENTATION :

Introduction, Use of Tools/Icons for preparing simple presentation on Power Point.

6. DATABASE OPERATION :

Create database using MS Access, Create Table and Creating Reports.

7. Introduction to Internet:

What is Network, How to send & receive messages, Use of Search Engines, Surfing different web sites. Creating Mail ID, Use of Briefcase, Sending./replying emails.

8. INTRODUCTION TO ADVANCE TOOLS :

I. Steps requires to solving problems.

- A. Flow Chart
- B. Algroithm
- C. Programming

II. Use of advance Tools such as Skype, Teamviewer, Installation of Modem, use of WiFi, Etc.

INTRODUCTION TO COMPUTER LAB

List Of Practicals

1. Practice on utility commands in DOS.
2. Composing, Correcting, Formatting and Article (Letter/Essay/Report) on Word Processing tool Word and taking its print out.
3. Creating, editing, modifying tables in Database tool.
4. Creating labels, report, generation of simple forms in Database tool.
5. Creating simple spread sheet, using in built functions in Worksheet tool..
6. Creating simple presentation.
7. Creating mail ID, Checking mail box, sending/replying e-mails.
8. Surfing web sites, using search engines.

Note : In the final year, related students have to use the concept of MS Word/MS Excel/MS Access/ MS Power Point in their respective branch's project work such as creating project report through MS Word/Creation of statistical data in MS Excel/Creation of database in MS Excel/ Demonstration of project through Power Point Presentation.

SUBJECTS FOR ELECTRICAL ENGG.

3.5 ELEMENTARY MECH. & CIVIL ENGG.

L T P
5 1 3

Rationale

Apart from the common core subjects, some engineering subjects are included in the diploma course of electrical engineering. One of these subjects is Elementary Mech. & Civil Engg. to impart some necessary knowledge and skill about civil and mechanical nature. Inclusion of the subject is further justified by the fact that in practical field, any job of electrical technician is intermingled with either civil or mechanical engineering. As such the relevant basic topics of these disciplines are included in the content of the subject.

Some study exercises along with some field work have been suggested to give feel of jobs and equipments involved.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Applied mechanics	10	2	-
2.	Strength of material & power transmission	10	2	-
3.	Hydraulics and hydraulic machines	10	2	-
4.	Heat engines	10	2	-
5.	Civil engineering materials	10	2	-
6.	Foundation	10	2	-
7.	Surveying	10	2	-
		70	14	42

DETAILED CONTENTS

1. Applied Mechanics
General condition of equilibrium of a rigid body under coplaner forces. Concept of tie, strut, beam and trusses. Shear force and bending moment diagram of simply supported beam and cantilever for point load. Concept of centre of gravity, moment of inertia and friction. Mechanical advantage, velocity ratio, mechanical efficiency of simple machines: Lifting machines such as pulley, differential pulley, wheel and axle, simple screw jack, worm and worm wheel.
2. Strength of Materials & Power Transmission:
Stress, strain, elastic constraints, stress in circular shaft subjected to pure torsion only. Rivetted and bolted joints. Power transmission by solid and hollow shaft. Gear trains - simple and compound, fly wheel. Rope and belts - velocity ratio, length, size of belt and power transmitted.
3. Hydraulics & Hydraulic Machines:

Properties of fluids, pressure of fluid and its measurement. Flow of fluids velocity and discharge, Bernaulli's theorem and its application in venturimeter, flow through pipe, head loss due to friction. water turbines- Pelton and Reaction, reciprocating and centrifugal pump.

4. Heat Engines:

External & internal combustion engines, working of diesel and petrol engine, horse power of IC engines, steam generator, construction and working of Babcock & Wilcox boiler, Cochran boiler, condenser, steam turbine classification and principle of operation, gas turbine.

5. Civil Engineering Materials:

General idea of raw materials, manufacturing process, properties and uses of Bricks, lime, cement and Timber.

6. Foundation

- (i) Bearing capacity of soil and its importance, need of foundation for electrical machines.
- (ii) Foundations for heavy, light and vibrating machines.
- (iii) Concrete proportion, mixing w/c ratio, workability RCC and its use.

7. Surveying

- (i) Basics of chaining and leveling
- (ii) Description of Instruments used

Part I :(Mechanical Engineering Laboratory/Hydraulics laboratory

- (i) To operate a diesel engine (starting, running and shutting down) and to study lubricating and cooling system of the engine.
- (ii) To determine BHP of diesel or petrol engine and show that BHP is directly proportional to revolution per minute of engine shaft.
- (iii) To determine mechanical advantage, velocity ratio, efficiency and effort loss due to friction in screw jack.
- (iv) To verify Bernoulli's theorem with the help of Bernoulli's apparatus.
- (v) To determine head loss due to friction in GI pipes.
- (vi) To operate the Pelton wheel and Francis Turbine and to understand its construction and working.
- (vii) To perform tensile test on mild steel and aluminium wire specimen and compare the result.
- (viii) To do alignment and coupling of a motor generator set.

Part II: (Civil Engineering Laboratory):

- (i) Chain survey of a small area
 - (a) Ranging a line
 - (b) Chaining a line
 - (c) Taking offset on the chain line and recording the field book.
- (ii) Leveling
 - (a) To find the difference in level between several points by single setting by the use of dumpy level.
 - (b) To find the difference in level between two distant points by (i) Rise & Fall method, (ii) Line of collimation method.

Models:

1. Cut section models of turbine, pumps.
2. Cut section models boilers, condensers.
3. Cut section models of diesel and petrol engines.
4. Models showing power transmission by, rope, belt, chain and gears.
5. Models of clutch and brakes, shaft conpling.
6. Model of chain pulley block and three systems of pulleys.

3.6 ELECTRICAL MACHINE - I

L T P
5 1 4

Rationale

Knowledge of various types of electrical machines including their performance characteristics is necessary to enable a diploma holder in electrical engineering to select, operate, maintain, test and repair/replace electrical machinery used in various industrial and domestic applications.

Knowledge of various parts and constructional details is also necessary when the diploma holder is placed in a manufacturing industry.

Thus to impart knowledge about the common types of electrical machines which a diploma holder deals with, are d.c. machines, transformers, synchronous machines, voltage regulator etc. Therefore these machines should be taught.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Generalised treatment	21	3	-
2.	D.C. machines	21	3	-
3.	Transformer	21	2	-
4.	A. C. Generator	7	1	-
		70	14	56

1. Generalised Treatment of Electrical Machines:-
 - 1.1 Definitions of motor and generator.
 - 1.2 Torque due to alignment of two magnetic fields and concept of torque angle
 - 1.3 Elementary concept of generator and motor
 - 1.4 Classification of main types of electrical machines and their generalised treatments in respect of their Working (only d.c. machine to be dealt with).
 - 1.5 Common features of rotating electrical machines.
2. D.C. Machines
 - 2.1 Construction of d.c. machines.
 - 2.2 E.M.F. equation
 - 2.3 Electromagnetic torque (torque equation)
 - 2.4 Principle of generating and motoring action.
 - 2.5 Speed and torque equation
 - 2.6 Armature reaction and commutation in d.c. m/cs.
 - 2.7 Factors controlling speed of d.c. motor.
 - 2.8 Speed control methods and starters for d.c. m/cs.
 - 2.9 Characteristics and application of D.C. generators and motors.
3. Transformer

- 3.1 Classification, construction, principle and working of 1 ph. and 3 ph. transformer.
- 3.2 E.M.F. equation.
- 3.3 Phasor diagram on no-load and load.
- 3.4 Transformer connections.
- 3.5 Losses and efficiency.
- 3.6 Voltage drops and regulation.
- 3.7 Connections for parallel operation.
- 3.8 Cooling
- 3.9 Testing of transformer as per IS specification (Type test and routine test, etc.)
- 3.10 Special transformer - current transformer, potential transformer, uses of C.T. and P.T., auto transformer, rectifier transformer, dry type transformer, furnace transformer, earthing transformer, traction transformer and its use.
- 3.11 Welding transformer: constructional detail, comparison between power and welding transformer.
- 4. A. C. Generator (Alternator)

Working principle, construction, Full pitch and short pitch winding, pitch factor or coil span factor, distribution or winding factor, E.M.F. equation, rating of alternators, armature reaction, voltage drops in alternator, vector diagram of loaded alternator, voltage regulation and its determination, Efficiency of alternator, conditions for parallel operation, Methods of parallel operation, operation of alternators when connected to infinite bus bar. Voltage regulator like Tirrill and Brown Boveri type.

ELECTRICAL MACHINE LAB

1. Measurement of induced emf and magnetising current under open circuit condition in D.C. generators.
2. Determination of the relationship between terminal voltage and load current keeping speed constant for
 - (a) Separately excited generator keeping excitation constant
 - (b) D.C. shunt generator.
3. To measure the variation in no load speed of a separately excited d.c. motor for the variation in
 - (a) Armature circuit resistance
 - (b) Field circuit resistance.
4. Measurement of the speed of a d.c. series motor as a function of the load torque.
5.
 - (a) No-load and short circuit test on a single phase transformer.
 - (b) Determination of efficiency and regulation of transformer.
6. To determine the insulation resistance of a transformer at no load and at full load condition.
7. Determination of the magnetisation curve of an alternator (a) at no-load rated speed, (b) at no load half rated speed and (c) at full non-inductive load and rated speed.
8. Determination of the relationship between terminal voltage and load current of an alternator keeping excitation and speed constant.
9. Determination of regulation and efficiency of an alternator from open circuit and short circuit tests.
10. Parallel operation of polyphase alternators and load sharing.

SUBJECTS FOR ELECTRICAL ENGG. (INDUSTRIAL CONTROL)

3.7 ELECTRICAL MACHINES

L T P
6 1 7

Rationale :

Various types of electrical machines are widely used in industrial and domestic applications. A diploma holder in Electrical Engineering is entrusted with the responsibilities of operation, testing, maintenance, repairs, construction details and performance characteristics of electrical machines like DC machines, Synchronous machines. Induction motor, Transformer fractional horse power motor's which a diploma holder deals with should be taught.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Topics	Coverage Time		
		L	T	P
1.	Transformer	15	3	-
2.	D. C. Machines	15	3	-
3.	Synchronous Machines	25	4	-
4.	Three Phase Induction Motor	15	3	-
5.	F. H. P. Motor	14	1	-
Total		84	14	98

DETAILED CONTENTS

1. TRANSFORMER :
 - 1.1 Classification, construction, principle and working of single phase and three phase transformers.
 - 1.2 E. M. F. equation
 - 1.3 Phasor diagram on no load and load
 - 1.4 Losses and efficiency.
 - 1.5 Voltage drops and regulation.
 - 1.6 Transformer connections.
 - 1.7 Parallel operation.
 - 1.8 Cooling
 - 1.9 Type test and routine test.
 - 1.10 Construction and working of single phase and three phase auto transformers.
 - 1.11 Special purpose transformers : Rectifier transformer,

earthing transformer, traction transformer and their use.

2. D. C. MACHINES :

- 2.1 Construction of d. c. machines.
- 2.2 E. M. F. equation
- 2.3 Electromagnetic torque (torque equation)
- 2.4 Principle of generating and motoring action
- 2.5 Speed and torque equation.
- 2.6 Armature reaction and commutation in d.c. m/cs
- 2.7 circuit representation of d. c. machines.
- 2.8 Starters for d. c. machines.
- 2.9 Characteristics and application of D. C. generators and motors
- 2.10 Concept of speed control.

3. SYNCHRONOUS MACHINES :

- 3.1 Construction and working principle of synchronous machines (Alternator and Synchronous motor)
- 3.2 Winding configurations, full pitch and short pitch winding.
- 3.3 E. M. F. equation. Effect of coil span factor and distribution factor.
- 3.4 Armature reaction.
- 3.5 Phasor diagram of alternators and synchronous motor.
- 3.6 Voltage regulation and its determination in alternator.
- 3.7 Losses and efficiency of synchronous machines.
- 3.8 Effect of load and excitation on the performance of synchronous motor, V-curves.
- 3.9 Torque and mechanical power developed in synchronous motor, hunting and its elimination.
- 3.10 Starting methods and application of synchronous motor, synchronous condenser.
- 3.11 Parallel operation of two alternators.
- 3.12 Brown boveri and Tirril voltage regulators.

4. THREE PHASE INDUCTION MOTOR :

- 4.1 Construction and working principle of three phase induction motors (Squirrel cage and Slip ring motors).
- 4.2 Concept of rotating magnetic field for the running of three phase induction motor and its reversing.
- 4.3 Phasor diagram and equivalent circuit.

- 4.4 E. M. F. and current in rotor circuit.
- 4.5 Torque equation, torque slip characteristics.
- 4.6 Losses and efficiency.
- 4.7 Methods of starting on line, Auto transformer, Star delta starters, Starter for slip ring induction motor.
- 4.8 Concept of speed control.
- 4.9 Testing of induction motor.
- 4.10 Application
- 4.11 Comparison of three phase induction motor with three phase synchronous motor.
- 5. F. H. P. MOTOR :
- 5.1 Classification of F. H. P. Motor
- 5.2 Double revolving field theory and principle of operation of single phase induction motor.
- 5.3 Construction, Working and application of -
 - (a) Capacitor Motor (All Types)
 - (b) Shaded Pole Motor
 - (c) Single Phase Series and Universal Motor
 - (d) Repulsion Motor
 - (e) D. C. and Two phase A. C. servo motors.
 - (f) Stepper Motor

LIST OF PRACTICALS

1. Measurement of induced emf and magnetising current under open circuit condition in D. C. generators.
2. Determination of the relationship between terminal voltage and load current keeping speed constant for D. C. shunt generator.
3. To measure the variation in no load speed of a separately excited d. c. motor for the variation in
 - (a) Armature circuit resistance
 - (b) Field circuit resistance
4. Measurement of the speed of a d. c. series motor as a function of the load torque.
5.
 - (a) No-load and short circuit test on a single phase transformer.
 - (b) Determination of efficiency and regulation of transformer.
6. To determine the insulation resistance of a transformer at no load and at full load condition.
7. Determination of the magnetisation curve of an alternator
 - (a) at no-load rated speed, (b) at no-load half rated speed and (c) at full non inductive load and rated speed.
8. Determination of the relationship between terminal voltage and load current of an alternator keeping excitation and speed constant.
9. Determination of regulation and efficiency of an alternator from open circuit and short circuit tests.
10. Parallel operation of polyphase alternators and load sharing.
11. To start a Three Phase Induction motor and to determine its slip at various loads.
12. To determine "V" curves of synchronous motor.
13. To connect and start an induction motor by using Star Delta, Autotransformer starter and to change its direction of rotation.
14. To perform open circuit and blocked rotor test on a Three Phase induction motor and determine its efficiency.

Rationale

The purpose of introducing Electronics II in electrical engineering is to provide basic knowledge of digital electronics, microprocessors, and communication Engineering in accordance with the need of modern technological advancements. Electronics has become an integral part of control system engineering. Electronic control devices are robust cheap, less power consuming and safe. An electrical engineering diploma passout reinforced with general idea in electronics will be more useful to the industries.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Digital electronics	15	-	-
2.	Operational amplifiers	15	-	-
3.	Microprocessors	15	-	-
4.	Communication engg.	15	-	-
5.	Integrated Circuits	10	-	-
		70	-	42

DETAILED CONTENTS

1. Digital Electronics :
 - (I) Introduction - Basic difference between analog and digital signal; Advantages of digital system and its field of applications.
 - (ii) Number system - Binary, Decimal, Octal and Hexadecimal and their need.
 - (iii)A. Logic Gates - Symbol and truth tables of AND, OR NOT, NAND, NOR and EX-OR gates.
Boolean theorems and postulates (without proof)
Realisation of small Boolean functions and reduction using Karnaugh's map upto 3 variables using logic gates and vice-versa.
 - B. Logic Families- TTL, CMOS, MOS, ECL, DTL, HTL, IIL.
 - (iv) Half Adder and full adder circuits and their operations, Display Devices.
 - (v) Encoder, Decoder, Multiplexer and Demultiplexer.
 - (vi) Need of Flip-Flops, Detail idea of counters and (Synchronous and Asynchronous) and resistor with purpose. Idea of astable, monostable, bistable multivibrators.
 - (vii) A/D and D/A conversion.
2. Operational Amplifiers

Specifications of ideal operational amplifier and its block diagram as an inverter, scale changer, adder, subtractor, differential amplifier, buffer amplifier, differentiator integrator, schmitt trigger and log and antilog amplifiers.

3. Microprocessors
 - (i) Microprocessors and its need in modern technology.
 - (ii) Functional block diagram of microprocessors and function of its various blocks with reference to 8085 microprocessors. Concepts of and Assembly language programming with 8085.
4. Communication Engineering
 - (i) Basic block diagram of a modern communication system and its working.
 - (ii) Concept of modulation/demodulation its need and types.
 - (iii) Concept of demodulation its need and types.
 - (iv) Introduction to digital and data communication.
 - (v) Introduction to modern ways of communication- Brief idea and concept of optical Fibre communication, Microwave communication, Satelite communication and Mobile communication.
5. INTEGRATED CIRCUITS
 - 5.1 Introduction to IC and its importance in modern electronics, types of IC's.
 - 5.2 Difference between SSI, MSI, LSI, VLSI.

NOTE :

Only brief idea of above topics should be given.

ELECTRONICS II LAB

A - Digital Electronics

10 experiments are to be performed atleast 4 from each group .

1. Familiarisation with bread-board.
Familiarisation with TTL and MOS ICs.
2. Identification of IC-Nos, pin nos, IC types.
3. To observe that logic low and logic high do not have same voltage value in INPUT and OUTPUT of a logic gate.
4. To observe the propagation delay of TTL logic gate.
5. Observation of differences between MOS and TTL gates under the following heads:
 - (a) Logic levels
 - (b) Operating voltages.
 - (c) Propagation delay.

6. Use of Op-Amp.(for IC 741) as inverting and noninverting amplifier, adder, comparator, buffer, scale changer.
7. Use of IC 755 as timer.

Display Devices and Associated Circuits

8. Familiarisation and use of different types of LEDs common anode and common cathode seven segment display

Logic Gates

9. Verification of truth tables for 2 Input NOT, AND, OR NAND,NOR, XOR GATES.
10. To construct half adder and half subtractor using XOR and NAND gates verification of their truth tables.
11. To construct a full adder circuit with XOR and NAND gates.
 - (a) Study of 3 bit adder circuit implemented with OR and NAND gates.
 - (b) To construct 4 bit adder and full subtractor using full adder chip 7480 and NAND GATES.
12. (a) To verify the truth table of 4 bit adder IC chip 7483.
 - (b) To construct the 4-bit adder/2 complement subtractor using 7483 and NAND gates.
12. Flip Flops
To verify the truth table for selected positive edge triggered and negative edge triggered F/F of J-K and D type.
13. Counters

To construct and verify truth table for asynchronous bin and decade counter using J-K flip flops.

- (a) To construct divide by 60 counter using ripple counter IC Chips.
- (b) To use counter IC chip 7493 in the divided by eight mode and divide by sixteen mode.
- (c) To construct a divide by 100 counter using CMOS

To construct a divide by 60 counter using synchronous counter IC chips.

14. Registers

To construct a 4 bit buffer register using 4 bit register IC chips.

To construct a 4 bit universal shift register using flip flops.

To use a 4035 B universal shift register.

B- Microprocessor ;

- 1. Familiarization with 8085 and 8088 Trainer.
- 2. Add two 8 bit numbers.
- 3. a) Obtain 2's complement of 8-bit numbers.
b) Subtraction of two numbers using 2's complement.
- 4. Extract fifth bit of a number in A and store it in another register.
- 5. Count No. of bits in high state in accumulator.
- 6. Check even parity and odd parity.

- 7. a) Add two 16-bit numbers by repetitive addition.
b) Divide two 8-bit numbers by repetitive subtraction.
- 8. a) Smallest number of three digits.
b) Largest number of three digits.
- 9. Arrange numbers in ascending order.
- 10. Write a program to find out sum of first n-multiplier of a number.
- 11. Arrange number in descending order.

15. Use of Op-Amp. (for IC-741) as Inverting and non-inverting amplifier, adder, comparator, buffer, scale changer.

NOTE :

Every Student should Fabricate a Mini Project based on Solid State Device.

4.2 ELECTRICAL DESIGN, DRAWING & ESTIMATING-I

L T P D
4 - 8 2

Rationale

A diploma holder in Electrical Engineering is supposed to have basic idea of the design of small gadgets such as heater coil, miniature transformer etc. He must also have the knowledge of interpreting engineering drawing, reading of blue prints, preparation of estimates for domestic and power wiring, transmission and distribution lines, erection and design of poles and towers and other electrical equipments and accessories. The paper Electrical Design Drawing and Estimating I will provide elementary knowledge about some of the above things.

Sl.No.	Units	Coverage Time			
		L	T	D	P
1.	Electrical symbols and diagrams	7	-	14	
2.	Wiring materials and accessories	7	-	14	
3.	Light and fan circuits	7	-	14	
4.	Alarm circuits	7	-	14	
5.	Internal wiring	7	-	14	
6.	Assembly drawings	7	-	14	
7.	Electrical design	7	-	12	
8.	Armature winding of D.C.m/cs	7	-	16	
		56	-	112	

Electrical Symbols and Diagrams :

- (i) Need of symbols; List of symbols for electrical equipments and accessories used in electrical light, fan and power circuits, alarm and indicating circuit , contactor control circuits as per I.S.S.
 - (ii) Type of diagrams - Wiring diagrams (multiple and single line representation) and schematic diagrams as per I.S.S.
 - * One Drawing Sheet for atleast - 50 symbols.
2. Wiring materials and accessories :
- (1) Brief description, general specifications (as per I.S.S.) and approximate cost of different types of wires, cables, switches, distribution board, switch board, boxes, batten and its accessories, conduit and its accessories, lamp holders, socket out lets, plug ceiling roses. fuse and energy meter used in domestic and power wiring installations.
 - (ii) Brief description, general specifications and approximate cost of switches, push buttons, bells, indicating lights, indicating panels, relays etc. used in alarm circuits.
 - * Study of materials and accessories in work shop.
3. Light and Fan Circuits :

Schematic and wiring diagrams (multiline and single line both) using junction boxes and looping systems for the following types of circuits:-

- (i) Light and fan controlled by necessary switches and regulators.
 - (ii) Stair case wiring
 - (iii) Corridor lighting
 - (iv) One lamp controlled by three or more switches.
 - * One drawing sheet for atleast 4- problems.
 - * Wiring practice for atleast 3-circuits.
4. Alarm Circuits:
- Reading, designing and drawing schematic and wiring diagrams (multiline and single line) of following alarm circuits:-
- (i) Circuits meant to convey information by means of light only.
 - (ii) Circuits meant to convey information by means of bell signals only. (One bell controled by one push button switch, Bell responds circuits using one bell and relay, Bell responds circuits of an office or three rooms)
 - (iii) Circuits meant to convey information by means of bell and light both for call signals.
 - (iv) Circuits meant to convey information by means of bell and light to give 'stop' and 'go' signals.
 - (v) Traffic control light system for 2 road crossing
 - (vi) A light circuit with gets automatically connected to DC supply in case of power failure.
 - * 8-Drawing sheets for atleast 6-problems of each type.
 - * Wiring practice for atleast - 2-circuits of each type.
5. Estimation of Domestic Internal Wiring Circuits :
(Small Houses)
- (i) Description of various wiring systems and methods.
 - (ii) Need of earthing and point to be earthed in internal wiring system as per IE rules.
 - (iii) I.S. specifications, calculation of No. of points (light, fan, socket outlet), calculation of total load including domestic power, determination of no. of circuits, size of wires and cables, switches and mainswitch, distribution board and switch board, batten conduit and other wiring accessories.

- (iv) Layout of installation plan, single line wiring, diagram, calculation of length of batten/conduit of different sizes and wire length; schedule of materials.
- (v) Estimating for small houses using PWD/CPWD electrical schedule rates (E.S.R.)
 - * The drawing sheet for atleast 4-layouts and circuits
 - * Estimation practice for atleast - 2 installations each for small houses.
- 6. Assembly Drawings:-
 - (i) Assembly drawing of simple electrical equipment from actual piece or from a pictorial view (carbon brush holder, open knife switch, miniature circuit breaker, motor terminal block, and similar other electrical items).
 - * 2-Drawing sheets
 - (ii) Poles, towers cables and insulators
 - * 2- Drawing sheets
- 7. Electrical Design :

Design of small transformers upto 1 KVA and chokes, heaters.
Transformer connections and bushing. 2 sheet
Introduction to Computer Aided Design(AutoCAD)
Of a small transformer, chock and bushing
- 8. Armature Winding of D.C.Machines:

Definition of terms used in winding, simple 2 Sheet
Lap and Wave winding exercises for d.c.motor and generator.

ELECTRICAL WIRING & FABRICATION SHOP

1. To prepare a folder/display board of accessories used in domestic wiring with complete specifications.
2. To prepare a display board of tools used in wiring and fabrication shop.
3. Batten wiring containing light, ceiling fan, socket points.
4. Staircase wiring using two way switches.
5. Connection of a fluorescent tube using starter, choke and single way switch and its fault detection.
6. Practice of domestic conduit wiring.
7. Testing of wiring installation by meggar.
8. Connection of mercury lamp along with accessories.
9. Making of an extension board containing two 5 A and 15 Amp plug points controlled by individual switches using MCB/ELCB (Earth Leakage Circuit Breaker).

4.3 POWER PLANT ENGINEERING

L T P
5 1 -

Rationale

Present day civilization of mankind is closely interwoven with energy and in future our existence will be more dependent upon energy. As more and more of energy is produced per person, the comforts, conveniences, and pleasure of life increases with it. As such with the increase in the number of generating plant more diploma holders will be required to run these power plants. Hence we are introducing this with the following objectives:

- i. To acquaint the student with different sources of energy and its utilization to obtain mechanical work,
- ii. To introduce the principles of steam generation, hydro-power generation and nuclear power generation, diesel power generation and gas turbine generation.
- iii. To study the related problems associated with generation.

Sl.No	Units	Coverage Time		
		L	T	P
1.	Thermal stations	9	2	-
2.	Hydroelectric plants	10	3	-
3.	Nuclear power plants	9	2	-
4.	Diesel power plants	6	1	-
5.	Gas turbine plants	9	1	-
6.	Combined working of power plants	9	1	-
7.	Non Conventional Source of Energy	9	2	-
8.	Recent Developments	9	2	-
		70	14	-

DETAILED CONTENTS

1. Thermal Stations:

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 vacuum; economiser, air pre-heater feed water heaters and dust collection. Characteristics of turbo alternators, steam power plant heat balance and efficiency.

2. Hydro-Electric Plants:

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

3. Nuclear Power Plants:

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

4. Diesel Power Plants:

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

5. Gas Turbine Plants:

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

6. Combined Working of Power Plants:

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.

7. Non Conventional Source of Energy:

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

8. Recent Development :

Interconnection of P.S. - Meaning of Interconnection, combined operation of hydro power station with inter connected base load and peak load, parallel operation of inter connectors.

4.4 TRANSMISSION AND DISTRIBUTION OF
ELECTRICAL POWER:

L T P
4 1 -

Rationale:

The polytechnic passouts have to perform variety of activities in the State Electricity Boards, NTPC, NHPC, and NPC in the field of Transmission and Distribution of Electrical Power. The range of these activities vary from simple administrative jobs to public relations, operation and maintenance of equipment and line, fault location, planning and designing of simple distribution schemes, and Executive and Supervisory control in Transmission and Distribution Networks.

It is expected that the different topics in this subject are treated to develop knowledge and skills in the students so that they are able to handle the above jobs efficiently. The topics on transmission and distribution should take into account the use of electricity in rural areas also.

In order to provide practical orientation to the students, guide visits to power stations, substations and sufficient use of Audio Visual Aids in these subject areas is highly recommended. The students should be made aware of the recent developments, current practices in the Electricity Boards to keep them abreast with the modern techniques in the Transmission and Distribution of electrical power.

Sl.No.	Units	Coverage time		
		L	T	P
1.	Electrical design of lines	6	2	-
2.	Constructional features of transmission lines	6	2	-
3.	Economic principle of transmission	6	1	-
4.	Mechanical design of lines	6	2	-
5.	Distribution systems	6	1	-
6.	Construction of distribution lines	6	1	-
7.	Power factor improvement	11	3	-
8.	Under ground cables	6	2	-
9.	Carrier communication	6	1	-
		75_14		

DETAILED CONTENTS

1. Electrical Design of Lines :
Layout of different transmission and distribution systems, advantages of high voltage transmission, HV DC convertor transformer concept of short medium and long lines, parameters of lines, performance of short lines (Regulation, efficiency, vector diagrams) corona formation and its effects on performance of lines. Effect of provision of protection and demand side management on reduction of T & D logic.
2. Constructional Features of Transmission Lines:
Constructional features of transmission lines, types of supports, types of conductors, types of insulators, their properties, selection and testing,

voltage distribution of string insulators, equalisation of potential. Vibration dampers.

3. Economic Principle of Transmission:
Kelvin's law, limitations of Kelvin's law, Modification in Kelvin's law.
 4. Mechanical design of lines :
Sag : Sag measurement, use of sag template Indian Electricity Rules pertaining to clearance, stringing of lines.
 5. Distribution System:
Feeders distributors and service mains, radial and ring main distributors, A.C. distributors fed from one end and both ends. Simple problems on size of feeders and distributors.
 6. Construction of Distribution Lines:
Construction of distribution lines i.e. erection of pole, fixing of insulators on conductors, testing, operation and maintenance of lines.
 7. Power Factor Improvement:
Effect of low power factor, causes of low power factor, necessity for improvement of power factor, methods for improving power factor. Advantages of improved power factor by installing capacitors at consumer end.
 8. Underground Cables:
Power cable construction, comparison of over head lines and under ground cables, laying of cables, cable jointing, using of epoxy resin kits. fault location, Murray loop test, testing of cables, specifications.
 9. Carrier Communication:
Principle of carrier communication over Power Lines, purposes, equipment, difference between radio transmission and carrier communication, block diagrams. Voltage control.
- Faults and Production :
- Causes and types of fault i.e. L-L, L-G, L-L-G. Awareness and concept of energy conservation.

SUBJECTS FOR ELECTRICAL ENGG. (INDUSTRIAL CONTROL)

4.5 POWER ELECTRONICS

L T P
4 1 3

Rationale :

Power electronics deals with high power solid state switching devices. It combines power, electronics and control. It is the application of the solid state electronics for the control and conversion of electric power. Power electronics has already found an important place in industries and are now used in a great variety of higher power applications including heating and welding controls, illumination controls, electric drive controls, power supplies, vehicle propulsion system, higher voltage direct current transmission and many other areas. An electrical engineering diploma holder has to deal with various power electronics equipment and controllers in the industry. Therefore, he should have adequate knowledge of operation and applications of high power switching devices as well as of power electronics and equipment.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Topics	Coverage Time		
		L	T	P
1.	Introduction	6	2	-
2.	Power Semiconductor Diodes	6	2	-
3.	Thyristors	3	1	-
4.	Power Transistors	8	2	-
5.	Controlled Rectifiers	8	2	-
6.	A. C. Voltage Controllers	8	2	-
7.	Choppers	6	2	-
8.	Inverter	6	1	-
9.	Power Supplies	5	1	-
Total		56	14	42

DETAILED CONTENTS

1. INTRODUCTION :
 - (I) Role of power electronics in the field of electric power control.
 - (II) Salient features of power semiconductor devices and relative comparison from application point of view.
 - (III) Characteristics and symbols of power semiconductor devices.
 - (IV) Types of power electronic circuits.
2. POWER SEMI CONDUCTOR DIODES :

- (I) Characteristics and applications of general purpose diode, fast recovery diode and schottky diode.
 - (II) Series and Parallel operation of power diodes.
 - (III) Performance parameters.
3. THYRISTORS :
- (I) Construction, characteristics and application of SCR, Gate, Turn off thyristor (GTO thyristor), Light activated SCR and reverse conducting SCR, Performance parameters.
 - (II) Methods of triggering a SCR, Gate characteristics. General layout of gate triggering circuits, R-C firing circuit, characteristics of UJT and its application in the triggering of SCR, Triggering of GTO thyristor.
 - (III) Commutation of SCR, methods of commutating a SCR, converter grade and Inverter grade SCRs.
 - (IV) Series and Parallel operation of SCR.
 - (V) Protection of SCR and GTO thyristor.
 - (VI) Construction, Characteristics and applications of Diac and Triac.
4. POWER TRANSISTORS :
- (I) Characteristics and application of Bipolar Junction, Transistor, Power MOSFET, Performance Parameter.
 - (II) Base drive requirements, Typical base drive circuits.
 - (III) Series and parallel operation of power transistor.
 - (IV) Protection of power transistor.
5. CONTROLLED RECTIFIERS :
- (I) Phase controlled rectifier operation on resistive and resistive inductive loads. Use of free wheeling diode.
 - (II) Single phase and Three phase controlled and fully controlled bridge rectifiers, Dual converters, Effect of load and source inductance. Performance comparison. Capacitor aided commutation.
 - (III) Single phase and Three phase line commutated bridge invertors.
 - (IV) Simple numerical problems on controlled rectifiers.
6. A. C. VOLTAGE CONTROLLERS :
- (I) Principle of integral cycle control and phase control.
 - (II) Single phase and Three phase A. C. voltage controllers. Various configurations.
 - (III) Single Phase transformer Tap Changer.

(IV) Single phase and Three phase Cyclo-Converter.

7. CHOPPERS :

(I) Principle of operation and control techniques of chopper, current and voltage waveforms for resistive inductive static and motor loads, effects of chopper frequency and load inductance.

(II) Voltage commutated and current commutated thyristor chopper circuits. Power transistor chopper circuits, Use of input and output D. C. filters.

(III) Step up chopper and its applications.

8. INVERTERS :

(I) Single phase series and parallel inverters. Output voltage and current waveforms.

(II) Principle of operation of bridge inverter concept of voltage source. Current source and Pulse width modulated bridge inverter. Performance parameters.

(III) Single phase and Three phase voltage source (auxiliary and complementary commutated only) and current source bridge inverters, methods of voltage control, various techniques of pulse width modulation, comparison of voltage source and current source inverters application.

(IV) High frequency inverters and their application.

9. POWER SUPPLIES :

(I) D. C. and A. C. power supplies, Switched mode power supplies, Resonant power supply and Bi-directional power supply.

(II) Switching mode regulators, Principle of switching mode regulator; Bulk, Boost, Bulk-Boost regulators.

LIST OF PRACTICALS

1. V-I characteristics of SCR.
2. Study of R-C firing circuit of SCR.
3. Study of UJT firing circuit of SCR.
4. Study of Power Transistor as a switch.
5. Study of SCR as a switch.
6. Power control using Diac and Triac.
7. Fabrication and testing of Half Controlled Bridge Rectifier circuit.
8. Fabrication and testing of SCR Chopper Circuit.
9. Fabrication and Testing of Single Phase Series inverter circuit.

COMMON SUBJECTS

V SEMESTER

5.1 INTEGRATIVE COMMUNICATION

L	T	P
-	-	4

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Introduction to Personality Development	-	-	02
2.	Factors Influencing / Shaping Personality	-	-	02
3.	Self Awareness - 1	-	-	03
4.	Self Awareness - 2	-	-	02
5.	Self Awareness - 3	-	-	02
6.	Change Your Mind Set	-	-	02
7.	Interpersonal Relationship and Communication	-	-	03
8.	Non-Verbal communication Communication Skills	-	-	02
9 .	Communication Skills ACTIVITIES	-	-	06
10.	Body Language skills	-	-	03
11.	Leadership Traits & Skills	-	-	03
12.	Attitude	-	-	03
13.	Analyzing & Solving a Problem skills	-	-	02
14.	Time Management skills	-	-	03
15.	Stress Management Skills	-	-	02
16.	Interview Skills	-	-	04
17.	Conflict Motives	-	-	02
18.	Negotiation / Influencing Skills	-	-	02
19.	Sociability	-	-	03
20.	Importance of Group	-	-	03
21.	Values / Code of Ethics	-	-	02
		-	-	56

PERSONALITY DEVELOPMENT

1 Introduction to Personality Development

AIM, Skills, Types of Skills, LIFE SKILLS VS OTHER SKILLS, Concept of Life Skills. Ten core Life Skills identified by WHO

2. Factors Influencing / Shaping Personality :

Introduction, Physical and Social Factors Influencing / Shaping Personality (Hereditary, Self-Development, Environment, Education, Life-situations) Psychological AND Philosophical Factors Influencing / Shaping Personality (Past Experiences, Dreams and Ambitions, Self-Image, Values)

3. Self Awareness - 1

DIMENSIONS OF SELF AWARENESS (Self Realization, Self Knowledge or Self Exploration, Self Confidence, Self Talk, Self Motivation, Self Esteem, Self Image, Self Control, Self Purpose, Individuality and Uniqueness, Personality, Values, Attitude, Character), SELF REALIZATION AND SELF EXPLORATION THROUGH SWOT ANALYSIS AND JOHARI WINDOW,

4. Self Awareness - 2

SYMPATHY VS EMPATHY AND ALTRUISM, Importance of Empathizing with Others,

5. Self Awareness - 3

Self-Awareness through Activity, Body Image (What is Body Image, What Decides our Body Image, What is Poor Body Image, What are the Harmful Effects of Poor Body Image),

Tackling Poor Body Image(Enhance Self-Esteem, Build Up
Critical Thinking, Build up Positive Qualities, Understand
Cultural Variation, Dispel Myths, Utilize Life Skills)

6. Change Your Mind Set

What is Mindset, HOW TO CHANGE YOUR MINDSET (Get the
Best Information Only, Make the best people your Role Model,
Examine Your Current Beliefs, Shape Your Mindset with Vision
and Goals, Find Your Voice, Protect Your Mindset, Let Go of
Comparisons, Put An End To Perfectionism, Look At The
Evidence, Redefine What Failure Means, Stop Worrying About
What "People" Think)

INTERPERSONAL SKILLS

7. Interpersonal Relationship and Communication

INTERPERSONAL RELATIONSHIP , Forms of Interpersonal
Relationship, Must Have in an Interpersonal Relationship,
Interpersonal Relationship between a Man and a Woman (
Passion, Intimacy, Commitment), Relationship Between
Friends, ROLE OF COMMUNICATION IN INTERPERSONAL
RELATIONSHIP (Take Care Of Your Tone And Pitch, Choice of
Words is Important in Relationships, Interact Regularly, Be
Polite, Try To Understand The Other Person's Point Of View As
Well, Individuals Can Also Communicate Through Emails,

8. NON-VERBAL COMMUNICATION Communication Skills

Non-Verbal Communication,
We Communicate with Our Eyes, Communication with Facial
Expression, A Good Gesture, Appearance, Posture and Gait,
Proximity and Touch), IMPORTANCE OF LISTENING,
Characteristics of Good and Effective Listener(Is Attentive, Do
Not Assume, Listen for Feelings and Facts, Concentrate on the
Other Speakers Kindly and Generously, Opportunities)

9. Communication Skills ACTIVITIES -

Activities in Making Collages, Making Advertisements, PPT Preparation &
Presentation, Speaking -Seminars, Group Discussions, Debates,
Extempore Speeches, Listening to an audio clip and telling its
gist, Answering a telephone call, Making enquiries, General tips-
Pronunciation, Tone, Pitch, Pace, Volume, relevance, brief,
simple Reading Newspaper, Magazines (Current Affairs,
Economic magazines, Technical magazines), How to read a
report, article, Writing- Resume Writing, Writing joining report,
Notice writing, Report making, Proposal writing, Advertisement,
Notice for tender, Minutes writing, E-Mail writing,
Listening News, Listening to audio clips.(Lecture, poetry, speech,
songs),

10. Body Language skills

Introduction, What is Body Language , Body Language Parts,
Personal Space Distances (Intimate Distance, Personal Distance,
Social Distance, Public Distance), IMPORTANT BODY
LANGUAGE SIGNS AND THEIR MEANING

UNDERSTANDING OTHERS

11. Leadership Traits & Skills :

Introduction, Important Leadership Traits (Alertness, Bearing,
Courage, Decisiveness, Dependability, Endurance, Enthusiasm,
Initiative, Integrity, Judgment, Justice, Knowledge, Loyalty, Sense
of Humour), Other Useful traits (Truthfulness, Esprit-de-corps,
Unselfishness, Humility and sympathy, Tact without loss of moral
courage, Patience and a sense of urgency as appropriate, Selfconfidence,
Maturity, Mental including emotional stability)

12. Attitude

Types of Attitude, Components of Attitudes (Cognitive

Component, Affective Component, Behavioral Component),
 Types of Attitudes (Positive Attitude, Negative Attitude, Neutral
 Attitude, Rebellious Attitude, Rational and Irrational Attitudes,
 Individual and Social Attitudes), Kinds of Attitude,
 ASSERTIVENESS, How to Develop Assertiveness (Experiment
 and Try New Things, Extend Your Social Circle, Learn to Make
 Decisions for Yourself, Indulge in Knowledge, Admire Yourself &
 Others), Negotiation (Be Sensitive to The Needs Others, Be
 Willing To Compromise, Develop Your Problem-Solving Skills,
 Learn to Welcome Conflict, Practice Patience, Increase Your
 Tolerance For Stress, Improve Your Listening Skills, Learn To
 Identify Bottom-Line Issues Quickly, Be Assertive, Not
 Aggressive)

PROBLEM SOLVING

13. Analyzing & Solving a Problem skills

Critical Thinking, Creative Thinking, Decision Making, Goal
 Setting & Planning, Problem Solving

14. Time Management skills

Need of Time Management, TIME WASTERS (Telephone,
 Visitors , Paper work, Lack of Planning & Fire Fighting ,
 Socializing , Indecision , TV , Procrastination), PRINCIPLES OF
 TIME MANAGEMENT - Develop a Personal Sense of Time (Time
 Log , value of other people's time), Identify Long-Term Goals ,
 Concentrate on High Return Activities , Weekly & Daily Planning
 (The Mechanics of Weekly Planning , Daily Planning), Make the
 Best Use of Your Best Time , Organize Office Work (Controlling
 Interruptions , Organizing Paper Work), Manage Meetings,
 Delegate Effectively, Make Use of Committed Time, Manage
 Your Health,

15. Stress Management Skills

INTRODUCTION, Understanding Stress and its Impact, Expected
 Responses (Physical, Emotional, Behavioral), stress
 signals(thoughts, feelings, behaviors and physical), STRESS
 MANAGEMENT TECHNIQUES (Take Deep Breath, Talk It Out,
 Take A Break, Create a Quite Place in Your Mind, Pay Attention
 to Physical Comfort, Move, Take Care of Your Body, Laugh,
 Mange Your Time, Know Your Limits, Do You Have To Be Right
 Always, Have A Good Cry, Look for the Good Things Around
 You, Talk Less, Listen More), UNDERSTANDING EMOTIONS
 AND FEELINGS-through Activity

16. Interview Skills (2 sessions from Industry Expert is Compulsory)

Curriculum Vitae (When Should a CV be Used, What Information
 Should a CV Include, personal profile, Covering Letter, What
 Makes a Good CV, How Long Should a CV Be, Tips on
 Presentation), Different Types of CV (Chronological, Skills-
 Based), BEFORE THE INTERVIEW , CONDUCTING
 YOURSELF DURING THE INTERVIEW , FOLLOWING
 THROUGH AFTER THE INTERVIEW , Interview Questions To
 Think About , MOCK INTERVIEW - Activity (MOCK INTERVIEW
 EVALUATION - NON-VERBAL BEHAVIORS, VERBAL
 BEHAVIORS, General Etiquettes to face the Board , Telephonic
 interview

17. Conflict Motives -Resolution

Motives of Conflict(Competition for Limited Resources, The
 Generation Gap and Personality Clashes, Aggressive
 Personalities, Culturally Diverse Teams, Competing Work and
 Family Demands, Gender Based Harassment), Merits and
 Demerits of Conflict , Levels of Conflict (Interpersonal Conflict,
 Role Conflict, Inter-group Conflict, Multi-Party Conflict,
 International Conflict), Methods of Conflict Resolution (The Win-
 Lose Approach, The Lose-Lose Strategy, The Win-Win

Approach), Techniques for Resolving Conflicts (Confrontation and Problem Solving Leading to Win-Win, Disarm the Opposition, Cognitive Restructuring, Appeal to Third Party, The Grievance Procedure)

18. Negotiation / Influencing Skills

Why Influencing, What Is Influencing, TYPES OF INFLUENCING SKILLS (Probing And Listening, Building Rapport, Sign Posting, Pacing, Selling, Assertiveness), LAWS AND PRINCIPLES OF INFLUENCE, The Six Laws of Influence (The Law of Scarcity, The Law of Reciprocity, The Law of Authority, The Law of Liking, The Law of Social Proof, The Law of Commitment and Consistency), Influencing Principles (Making a Start, Buy Yourself Thinking Time, Dealing With Disagreement, Difficult And Sensitive Situations)

19. Sociability : Etiquettes And Mannerism & Social Skills

Need for Etiquette , Types of Etiquettes (Social Etiquette, Bathroom Etiquette, Corporate Etiquette, Wedding Etiquette, Meeting Etiquette, Telephone Etiquette, Eating Etiquette, Business Etiquette, E-Mail Etiquettes,), MANNERISMS, HOW TO IMPROVE YOUR SOCIAL SKILLS (Be Yourself, Be Responsible, Be Open & Approachable, Be Attentive, Be Polite, Be Aware, Be Cautious)

20. Importance of Group / Cross Cultural Teams / Team Work skills

Introduction, Types and Characteristics of Groups (Definition of a Group, Classification / Types of Groups, Friendship Group, Task Group, Formal Groups, Informal Group, Effective Group), Importance of a Group, Characteristics of a Mature Group, TYPES AND CHARACTERISTICS OF A TEAM (Definition of a Team, Types of Teams, Functional Teams, Problem Solving Teams, Cross - Functional Teams, Self - Managed Teams), Importance of a Team, Characteristics of a Team

21. VALUES / CODE OF ETHICS

Meaning, A FEW IMPORTANT VALUES (Honesty, Integrity, Purity, Discipline, Selflessness, Loyalty, Fairness, Equality, Trust, Support, Respect, etc)

Note : One Orientation module for the faculty is must.

Involvement of Industry Experts is necessary for Interview Skills

5.2 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

L T P
6 2 -

RATIONALE

The knowledge of this subject is required for all engineers/technicians who wish to choose industry/field as their career. This course is designed to develop understanding of various functions of management, role of workers and engineers and providing knowledge about industrial and tax laws.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Principles of Management	8	-	-
2.	Human Resource Development	10	-	-
3.	Wages and Incentives	4	-	-
4.	Human and Industrial Relations	6	-	-
5.	Professional Ethics	2	-	-
6.	Sales and Marketing management	10	-	-
7.	Labour Legislation Act	10	-	-
8.	Material Management	8	-	-
9.	Financial Management	8	-	-
10.	Entrepreneurship Development	8	-	-
11.	Fundamental of Economics	5	-	-
12.	Accidents and Safety	5	-	-
		84	-	-

DETAILED CONTENTS

1. **Principles of Management**
 - 1.1 Management, Different Functions: Planning, Organising, Leading, Controlling.
 - 1.2 Organizational Structure, Types, Functions of different departments.
 - 1.3 Motivation: Factors, characteristics, methods of improving motivation, incentives, pay, promotion, rewards, job satisfaction, job enrichment.
 - 1.4 Need for leadership, Functions of a leader, Factors for accomplishing effective leadership, Manager as a leader, promoting team work.
2. **Human Resource Development**
 - 2.1 Introduction, objectives and functions of human resource development (HRD) department.
 - 2.2 Recruitment, methods of selection, training strategies and career development.
 - 2.3 Responsibilities of human resource management - policies and functions, selection - Mode of selection - Procedure - training of workers, Job evaluation and Merit rating.
3. **Wages and Incentives**
 - 3.1 Definition and factors affecting wages, methods of wage payment.
 - 3.2 Wage incentive - type of incentive, difference in wage, incentive and bonus; incentives of supervisor.
 - 3.3 Job evaluation and merit rating.
4. **Human and Industrial Relations**
 - 4.1 Industrial relations and disputes.
 - 4.2 Relations with subordinates, peers and superiors.
 - 4.3 Characteristics of group behaviour and trade unionism.
 - 4.4 Mob psychology.
 - 4.5 Grievance, Handling of grievances.

- 4.6 Agitations, strikes, Lockouts, Picketing and Gherao.
- 4.7 Labour welfare schemes.
- 4.8 Workers' participation in management.
- 5. **Professional Ethics**
 - 5.1 Concept of professional ethics.
 - 5.2 Need for code of professional ethics.
 - 5.3 Professional bodies and their role.
- 6. **Sales and Marketing management**
 - 6.1 Functions and duties of sales department.
 - 6.2 Sales forecasting, sales promotion, advertisement and after sale services.
 - 6.3 Concept of marketing.
 - 6.4 Problems of marketing.
 - 6.5 Pricing policy, break even analysis.
 - 6.6 Distribution channels and methods of marketing.
- 7. **Labour Legislation Act (as amended on date)**
 - 7.1 Factory Act 1948.
 - 7.2 Workmen's Compensation Act 1923.
 - 7.3 Apprentices Act 1961.
 - 7.4 PF Act, ESI Act.
 - 7.5 Industrial Dispute Act 1947.
 - 7.6 Employers State Insurance Act 1948.
 - 7.7 Payment of Wages Act, 1936.
 - 7.8 Intellectual Property Rights Act
- 8. **Material Management**
 - 8.1 Inventory control models.
 - 8.2 ABC Analysis, Safety stock, Economic ordering quantity.
 - 8.3 Stores equipment, Stores records, purchasing procedures, Bin card, Cardex.
 - 8.4 Material handling techniques.
- 9. **Financial Management**
 - 9.1 Importance of ledger and cash book.
 - 9.2 Profit and loss Account, Balance sheet.
 - 9.3 Interpretation of Statements, Project financing, Project appraisal, return on investments.
- 10. **Entrepreneurship Development**
 - 10.1 Concept of entrepreneur and need of entrepreneurship in the context of prevailing employment conditions.
 - 10.2 Distinction between an entrepreneur and a manager.
 - 10.3 Project identification and selection.
 - 10.4 Project formulation.
 - 10.5 Project appraisal.
 - 10.6 Facilities and incentives to an entrepreneur.
- 11. **Fundamental of Economics**
 - 11.1 Micro economics.
 - 11.2 Macro economics.
- 12. **Accidents and Safety**
 - 12.1 Classification of accidents based on nature of injuries, event and place.
 - 12.2 Causes and effects of accidents.
 - 12.3 Accident-prone workers.
 - 12.4 Action to be taken in case of accidents with machines, electric shock, fires and erection and construction accidents.
 - 12.5 Safety consciousness and publicity.
 - 12.6 Safety procedures.
 - 12.7 Safety measures - Do's and Don'ts and god housing keeping.

5.3 SWITCH GEAR AND PROTECTION:

L T P
4 1 -

Rationale

In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma passout have become more complex than what they used to be earlier. He is required to work with modern electrical equipment and maintain reliability of supply.

The course is designed to develop the understanding of the principles and working of protective switchgear so that one can handle, install, maintain them and also take decisions at his level in different situations.

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

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Faults	12	3	-
2.	Switch gear	12	3	-
3.	Protective schemes	12	3	-
4.	Protection against over voltages	6	2	-
5.	Different types of substations	14	3	-
		56	14	-

DETAILED CONTENTS

1. Faults:

Types of faults, three phase symmetrical faults, effects of faults on system reliability and stability abnormalities, short circuits and their effects, representation of fault conditions through single line diagrams.
2. Switch Gear:
 - 2.1 Purpose of protective gear, characteristics of a protection system.
 - 2.2 Classification of fuses H.V. Fuses, application and working, grading and co-ordination L.V. fuses, selection of fuses, characteristics.
 - 2.3 Isolators and switches, out door isolators, functions, air break switches breaking capacity of switches.
 - 2.4 Circuit breakers :- requirements of circuit breakers definition of terms associated with circuit-breakers, reasons for arc formation, principles of arc extinction, types of circuit-breakers, comparison with oil circuit breaker classification, rating of circuit breakers, working of different types of

air and oil circuit breaker, specification of circuit breakers, maintenance schedule. SF-6 and Vacuum circuit breakers.

- 2.5 Relays : Requirement of relays, operation principles induction type over current, directional over current, differential, percentage differential relays working, applications and characteristics, basic principles of static relays. Introduction of distance relay.
- 3. Protective Schemes:
 - 3.1 Protection of alternators, stator faults, rotor faults, mechanical conditions, external faults their reasons, effect and protections used.
 - 3.2 Protection of power transformer : types of faults, its effects, types of protective schemes over current earth fault, differential protection, Buchholz devices, winding temp. protection.
 - 3.3 Motor protection: types of faults and protection in motors, thermal relays, protection of small motors, under voltage protection.
 - 3.4 Protection of feeders : radial, parallel and ring feeders protection, directional time and current graded schemes differential protection.
- 4. Protection Against Over Voltages:
 - 4.1 Causes of over voltages, travelling waves earth wire, protective zone, lightning arrestors, space-gap and electrolytic arrestors, surge absorber, location and rating of lightning arrestors. Thyrite lightning arrestor.
- 5. Different Type of Sub-Stations:-
 - 5.1 Layout, single line diagram busbar arrangement, equipments their functions, accessories, study of protective schemes, etc. batteries and their maintenance, operation of small sub-station.
 - 5.2 Reactors: types of reactors, busbar reactor, tuning reactor, arc-suppression reactor, connection of reactors in power stations. uses of reactors.
 - 5.3 Neutral grounding :- types of grounding solid grounding, reactance grounding, arc suppression coil grounding, choice of method of neutral earthing. grounding of sub-station, grounding of line structure and sub station equipment.
 - 5.4 Concept of G.I.S. (Gas Insulated Substation).

5.4 FIELD EXPOSURE

SUBJECTS FOR ELECTRICAL ENGINEERING

5.5 INDUSTRIAL ELECTRONICS & CONTROL

L T P
4 1 4

Rationale

An electrical engineering technician has to bear the variety of responsibilities in industries. He has to deal with manually operated old machines and automatically controlled modern machines and equipments. To deal successfully with wide spectrum of requirements in the industry the passout diploma holder in electrical engineering should be equipped with the knowledge of control system components, thyristor control of electrical machines and other applications of thyristor such as in the control of heating, welding, illumination and static switches etc.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Introduction	6	1	-
2.	High power switching devices	8	2	-
3.	Thyristor and their operation	8	2	-
4.	Thyristor application	8	2	-
5.	Thyristor control of electric machines	8	2	-
6.	PLC	10	3	-
7.	Servo mechanism	8	2	-
		56	14	56

1. Introduction:-
 - (i) Control system classification and method of control.
 - (ii) Concept of open loop and closed loop control.
 - (iii) Introduction to automatic control.
 - (iv) Role of power electronics in the field of control Engg.
2. High power switching devices
 - (a) Power diode characteristics application of general purpose diode, fast recovery diode. and Schott key diode.
 - (b) Control switching devices, construction characteristics and application of S.C.R., power transistor.
3. Thyristor and their Operation:-
 - (i) Thyristor and its types.
 - (ii) SCR, Diac, Triac, their construction, characteristics and applications.
 - (iii) UJT and its characteristics, LDR, LED and photo electric relay.
 - (iv) Methods of switching ON and switching OFF SCR.
 - (v) Phase control using SCR, Diac and Triac and concept of firing angle and its control. Heating, Welding and

Temperature control using SCR.

4. Thyristor Application:-
 - (i) Basic circuit and working of single phase, three phase, half wave, full wave and bridge power convertors (rectifiers) using SCR.
 - (ii) Basic circuit and working of single phase and three phase bridge invertors using SCR.
 - (iii) Basic circuit and working of D.C. and A.C. Choppers.
 - (iv) Basic circuit and working of cycloconverter.
 - (v) Speed control of variable frequency drives.
5. Thyristor Control of Electrical Machines :-
 - A. Speed control of:
 - (i) Single Phase & Three Phase Induction motors.
 - (ii) D.C. motors
 - B. Industrial Control:-
 - (i) Heating control using SCR.
 - (ii) Welding control using SCR.
 - (iii) Temperature, illumination and level control.
 - (iv) Use of SCR and Triac as static switch.
6. PROGRAMMABLE LOGIC CONTROLLER (PLC) & SCADA):

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

Introduction to Supervisory Control and Data Acquisition (SCADA), SCADA functional requirements and components, Power system SCADA and SCADA in power system automation. SCADA communicator requirements.
7. Servo Mechanism:-

Introduction to servomechanism, block diagram open loop & closed loop system, DC & AC servo mechanism, servomotors, application, synchros & application.

INDUSTRIAL ELECTRONICS & CONTROL LAB.

1. Fabrication and testing of electronic fan speed regulator.
2. Power control using Diacs and Triacs.
3. Characteristics of SCR.
4. Speed control of DC shunt motor.
5. Characteristics of U.J.T. firing circuit of S.C.R.
6. Study of light operated relay using LDR or photo diode.
7. Experiment on Time Delay- Relay using SCR & UJT.
8. Study of servo motor and synchros.
9. Thyristersed speed control of 3 phase induction motor.
10. Fabrication and Testing of inverter circuit.

Rationale:

Knowledge of various types of electrical machines operate, maintain, test and repair/replace electrical machinery used in various industrial and domestic applications.

Knowledge of various parts and constructional details is also necessary when the diploma holder is placed in a manufacturing industry.

Thus to impart knowledge about the common types of electrical machines which a diploma holder deals with, are synchronous machines, induction motors, etc. Therefore these machines should be taught.

Sl. No.	Units	Coverage Time		
		L	T	P
1.	Induction motor	16	4	-
2.	Synchronous motor	12	3	-
3.	F.H.P. motors	12	3	-
4.	Electric Drive	10	2	-
5.	Converting Apparatus	6	2	-
		56	14	56

1. Induction Motor

- 1 Rotating magnetic field for 3 ph. concept of motors and its reversing.
- 2 Construction and working of 3 ph. induction motor (squirrel cage and wound rotor motor). Double squirrel cage induction motor.
- 3 Rotor frequency, rotor e.m.f., rotor current and rotor power factor.
- 4 Torque equation
- 5 Torque slip characteristics.
- 6 Principle and methods of speed control
- 7 Methods of starting of induction motor. On line, auto transformer, star delta manual/automatic starters for induction motor. Starter for slip ring ind. motor.
- 8 Application of induction motor .
- 9 Testing of motor as per I.S.
Performance of 3 phase induction motor with the help of circle diagram.
10. Losses and efficiency (simple problems only)
11. Phasor diagram of induction motor.

2. Synchronous Motor

Construction, working principle, effect of load on synchronous motor, vector diagram of synchronous motor, effect of change in excitation on the performance of synchronous motor, V curves, torque & mechanical power developed, condition for max. mechanical power, synchronous condenser, hunting and its elimination, comparison between ind. motor and synch. motor, starting methods and uses of synch. motor.

3. F.H.P. Motors

1. Classification of F.H.P. motors
2. Production of rotating Magnetic field in 1 ph. motors.
3. Double revolving field theory.
4. Construction working and application of
 - (i) Capacitor motor (all types)
 - (ii) Shaded pole motor
 - (iii) 1 ph. synchronous motor
 - (iv) 1 ph. series and universal motor
 - (v) Servo Motor

4. Electric Drives :

- (i) Advantages of electric drives.
- (ii) Characteristics of different mechanical loads.
- (iii) Types of motors used in electric drive.
 - (iv) Use of fly wheels for fluctuating load (only physical concept).
 - (v) Types of enclosures.
 - (vi) Methods of power transfer by devices like belt drive, gears, pulley.
 - (vii) Examples of selection of motors for particular loads.
 - (viii) Applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift.
 - (ix) Specifications of commonly used motors (squirrel cage induction motors, slip ring induction motors, AC series motors).

5. Converting Apparatus

Introduction to different types of converting apparatus e.g. metal rectifier etc.

ELECTRICAL MACHINE II LAB

1. To determine performance characteristics of a polyphase induction motor. (load v/s efficiency, load v/s power factor,

load v/s slip)

2. To start a 3 phase induction motor and to determine its slip at various loads.
3. To determine V curves of a synchronous motor.
4. To connect and start an induction motor by using star delta starter, auto transformer starter, rotor starter and to change its direction of rotation.
5. To perform open circuit and block rotor test on a 3 ph. induction motor and to determine its efficiency.
6. Determination of performance curve and hence the coreloss of a single phase series motor.
7. Voltage and current ratio of metal rectifier.
8. To perform open circuit and short circuit test on a 3 ph. synchronous machine and to determine synchronous impedance and regulation at lagging/leading power factor.
9. Sequential operation of motors using timers.
10. Achieving high starting torque in case of 3 phase slip ring motor by increasing external resistance in rotor circuits and determine speed regulation at different loads

5.7 ELECTIVES

5.7 (a) CONTROL OF ELECTRICAL MACHINES

L	T	P
5	1	-

Rationale:

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

The study of this subject would certainly build up confidence in the students who would like to join the industrial complex.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Control components	10	2	-
2.	A.C. control circuits	10	2	-
3.	Control of synchronous motors	11	2	-
4.	Control of single phase motors	12	2	-
5.	Industrial control circuits	12	2	-
6.	Trouble shooting in control circuits	10	2	-
7.	Basic Concept of PLC	5	2	-
		70	14	

DETAILED CONTENT

1. Control components
 - 1.1 Fuses and combination fuse switch units
 - 1.2 Miniature circuit breaker
 - 1.3 Contactors
 - 1.3.1 Solenoid type
 - 1.3.2 Clapper type
 - 1.4 Over-load relays
 - 1.4.1 Thermal over-load relay
 - 1.4.2 Ratchet type over load relay
 - 1.4.3 Magnetic over-load relay
 - 1.4.4 Dash pot type oil filled relay
 - 1.5 Timing relays
 - 1.5.1 Thermal time delay relay
 - 1.5.2 Pneumatic time delay relay

- 1.5.3 Synchronous motor-driven timer
- 1.5.4 Solid state timer
- 1.6 Phase failure relay
- 1.7 Push-buttons
- 1.8 Selector switches
 - 1.8.1 (Two position)
 - 1.8.2 (Three position)
- 1.9 Limit switches
 - 1.9.1 Single side actuation type
 - 1.9.2 Double side actuation type
 - 1.9.3 Rotary cam type
 - 1.9.4 Heavy duty limit switch
- 1.10 Proximity switches
- 1.11 Solenoid valves
- 1.12 Master controllers & drum switches
- 1.13 Pressure switches
- 1.14 Temperature controller (Thermostat)
- 1.15 Float switches
- 1.16 Mechanical brakes for motors
- 1.17 Control transformer
- 1.18 Rectifiers
- 1.19 Reactors
- 1.20 Capacitors
- 1.21 Symbols for various components
- 1.22 Control diagram
 - 1.22.1 Two wire control circuit
 - 1.22.3 Three wire control circuit
- * Study of components in the Lab.
- 2. A.C.Control Circuits
 - 2.1 Forward/reversing of 3 phase motors
 - 3.2.1 With push-button inter-locking
 - 3.2.2 With Auxillary contact inter-locking
 - 2.2 Sequence starting of motors
 - 2.3 Starting of multispeed squirrel cage motor
 - 2.4 Dynamic braking of squirrel cage induction motor
 - 2.5 Plugging of squirrel cage induction motor

- 2.6 Over-load protection of motors
- 2.7 Single phase protection
- 2.8 Over-temperature protection
- 2.9 Voltage stabiliser for 3 phase and single phase motors.

- 3. Control of Synchronous Motors
 - 3.1 Principle of acceleration
 - 3.2 Motor starter with field application by definite time relay
 - 3.3 Motor starter with field control by polarised field frequency control.
 - 3.4 Motor starter with feild application by slip frequency relay
 - 3.5 Over-load protection scheme

- 4. Control of Single Phase Motors
 - 4.1 Across the line starter
 - 4.2 Reversal of universal motor
 - 4.3 Speed control of universal motor
 - 4.4 Starter for capacitor type split phase motor
 - 4.5 Dynamic braking

- 5. Industrial Control Circuits
 - 5.1 Heater control
 - 5.2 Compressor motor control
 - 5.3 Skip hoist control
 - 5.4 Walking beam
 - 5.5 Battery operated truck
 - 5.6 Conveyor system control
 - 5.7 Lift circuit

- 6. Trouble Shooting in Control Circuits
 - 6.1 Analysing the problems
 - 6.2 Major trouble spots
 - 6.2.1 Fuse base

- 6.2.2 Loose connections
- 6.2.2 Faulty contacts
- 6.2.4 Incorrect wire markers
- 6.2.5 Combination problems
- 6.2.6 Low-voltage
- 6.2.7 Grounds

6.3 Procedures used in trouble-shooting

Troble shooting practice should be done in the lab.

6. PROGRAMMABLE LOGIC CONTROLLER (PLC) :

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

5.7 (b) PROCESS CONTROL AND INSTRUMENTATION

L	T	P
5	1	-

Rationale

The technician has the responsibility of using and maintaining electronic test equipments for measurement, design, testing and trouble shooting. With the introduction of new techniques of process control in modern industries, the use of transducing elements in medicine, agriculture, and other non-engineering areas, the task of the technician has become varied and different from the previous task of measurement only.

The course aims to develop appreciation and understanding of the use of transducers, data handling and transmitting and measurement of a variety of physical quantities.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Introduction	15	3	-
2.	Control system components	15	3	-
3.	Instrument transformer	15	3	-
4.	Transducer	15	3	-
5.	Process instrumentation	10	2	-
		70	14	

1. Introduction:-

Process and process characteristics, Block diagram of a general open and closed loop process. Control system and application.
2. Control system components :

Brief description and working of a potentiometer, differential transformer servo motors. Tacho generator, eddy current clutches relay contactors timing relay temperature switches saturable core reactors & its use as magnetic amplifier.
3. Instrument Transformer

Theory of current and potential transformers ratio & phase angle errors, effect of variation of Power factor, secondary burden and testing of C.T. & P.T.
4. Transducers

Definition of transducers, classification of transducers & its application. Active & passive type their use for measurement of mechanical and electrical quantities, such as speed pressure strain displacement volume temperature magnetic flux and humidity. Application of transducers for instrumentation & control. Selection criteria based on static and dynamic characteristics.
5. Process Instrumentation:

Functional block diagram of instrumentation system.
Description of each block. Description of practical
circuitis for the following:

1. Temperature meausrements: General, heat transfer modes, temperature measuring devices like thermocouples, Pyrometer, resistance thermometer.
2. Flow measurement: General, flow meters: Venturi meter, orifice plate, pitot tube, rotameter, turbine meter, electromagnetic meter & mass flow measurement.
3. Pressure measurements: General, dynamic performance, pressure receiver and transmission line, input impedance, energy level of pressure pickups, pressure pick ups. Manometer, pressure elements differential pressure.
4. Vibration measurements: Vibration measurement systems, analysis of acceleration data.
5. Strain measurements: Requirements for strain measurement, strain gauges, selection of gauges, general strain measurements.

5.7 (c) ELECTRIC TRACTION

L T P
5 1 -

Rationale

Now a days electrical energy finds major application in electric traction besides steam and deisel locomotives. Therefore a diploma holder is required to have elementary knowledge of electric drives used in traction accelerating and breaking arrangments at the control pannel.

Sl. No.	Units	Coverage Time		
		L	T	P
1.	Introduction	4	1	-
2.	Electric traction drives	8	1	-
3.	Power supply for traction	8	2	-
4.	Mechanics of traction	8	2	-
5.	Rectification equipment	6	1	-
6.	Overhead equipments	6	1	-
7.	Track circuit	10	2	-
8.	Supervisory remote control	10	2	-
9.	Rail and return path	10	2	-
		70	14	-

1. Introduction:
Electric traiction system and its advantages over other system, types of electric traction systems. Traction systems for India.
2. Electric traction drives:
Suitability of electric traction drives- D.C. series motor, A.C. series motor, 3 phase induction motor, characteristics of electric traction drives, special design requirements, methods of starting and speed control, different methods of braking, plugging, rheostatic, regenerative.
3. Power supply of electric traction:
Different systems of power supplies, their chronological evaluation, power supply arrangement i.e. traction substation major equipement transformer, circuit breaker, interuptor, protection system, remote control system, design consideration.
4. Mechanics of traction
System of units, speed time curves, their construction, simplification and interpretation for main line, suburban routs, tractive effort, specific energy consumption and factors effecting it. Weight transfer due to torque coefficient of adhesion.
5. Rectification Equipment
Equipments required for rectification their brief theory and working.

6. Over head Equipments
Design aspects of over head equipments catenary and its types, practical aspects of working, maintenance of over head equipments, current collection system, their requirements.
7. Track Circuits
D.C. and A.C. track circuits, signals for traffic control,
8. Supervisory Remote Control
System of remote control, its advantages, mimic diagram, remote control system and network remote control centre (R.C.C.)
9. Rail and Return Path
Earth return protection of under ground equipment, Negative booster, voltage distribution on rails.

5.7 (d) RENEWABLE SOURCES OF ENERGY

COURSE RATIONALE

"Energy" in any form is the focus of attention for an Engineer or a Technologist. Production and storage of energy from all possible, feasible and viable sources in the concern of all of us today, Depletion of fossil fuels in the near future leads to global darkness and an unimaginable state of living.

In the backdrop of energy crisis, which may assume gigantic dimensions, it is apt to us to create awareness in the students of engineering at all levels, the need of harnessing renewable sources of energy, and to teach them the methods of storing and utilisation of such energy.

With this view the subject, renewable sources of energy, is included in the curricula of the final year of electrical engineering diploma course as optional subject.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Introduction	05	01	-
2.	Solar Energy	15	03	-
3.	Biomass	10	03	-
4.	Wind Energy	12	02	-
5.	Microhydel Energy	06	01	-
6.	Tidal Energy	05	01	-
7.	Geothermal Energy	06	01	-
8.	Appropriate Technology	06	01	-
9.	Bio Diesel	05	01	-
		70	14	-

COURSE CONTENTS

1.0 INTRODUCTION:

- 1.1 Global energy scenario
- 1.2 Depletion trends of fossil fuels
- 1.3 Need for alternative sources of energy
- 1.4 Differences between renewable and non-renewable sources of energy examples thereof.

2.0 SOLAR ENERGY:

- 2.1 Concept
- 2.2 Solar radiation
 - * solar radiation at the earth surface
 - * direct and diffused radiation
 - * solar constant
- 2.3 Basic Earth angle
 - * Altitude and Latitude angle
- 2.4 Solar radiation geometry
 - * Declination angle
 - * Azimuth angle
 - * Zenith angle
 - * Solar altitude angle
 - * Tilt angle
 - * Hour angle
 - * Sun rise time and sun set time and day length
- 2.5 Solar radiation measurement

- * Pyroheliometer
- * Pyranometer
- * Solar radiation data
- * Estimation of solar radiation(hourly, daily and monthly)(Introduction)
- 2.6 Fundamental heat transfer equation
- 2.7.1 Flat plate collector
 - * Working principle
 - * Types of plate collector
 - * Sources of losses from a flat plate collector
 - * Collector efficiency(concept)
- 2.7.2 Concentrating collector
- 2.8 Application of flat plate collector
 - Basic Principles of these devices
 - * Solar cooker
 - * Solar water heater
 - * Solar dryer
 - * Solar distillation unit
- 2.9 Advantages and disadvantages of concentrating collector over flat plate collector
- 2.10 Application of solar concentrating collector like solar water heating, space heating and cooling and electric power generation(Basic principles)
- 2.11 Solar photovoltaics system
 - * Principle and Physics of PV cells
 - * PV module, panel and array
 - * Series and parallel connection
 - * Power output calculations
 - * Operation and maintenance of PV systems
 - * Solar Battery- construction, operation, maintenance and effect of sp. gravity of electrolyte.
- 3.0 BIOMASS:
 - 3.1 Introduction to biomass energy and photosynthesis
 - 3.2 Sources of biomass
 - 3.3 Fuel characteristics of biomass-moisture content, proximate and ultimate analysis of fuel
 - 3.4 Biomass conversion: Thermal/Biological
 - 3.5 Biomass pyrolysis
 - 3.6 Charcoal making process
 - 3.7 Gasification and main types of gasifiers
 - 3.8 Combustion of biomass: review of combustion equations-calculations of air requirement flue gas analysis
 - 3.9 Working of anaerobic digestors
 - 3.10 Different types of bio gas generating plant
 - * Fixed Dome Type
 - * Floating Dome Type
 - * Janta Model Type
 - * Deen Bandhu Model
- 4.0 WIND ENERGY:
 - 4.1 Wind map of India
 - 4.2 Intensity of wind energy
 - 4.3 Types of windmills
 - 4.3.1 Vertical axis windmills Darrius and Sarius types
 - 4.3.2 Horizontal axis windmills
 - 4.4 Applications of wind energy
 - 4.4.1 Water pumping
 - 4.4.2 Electric power generation
- 5.0 MICROHYDEL ENERGY:
 - 5.1 Meaning and concept of microhydel power

- 5.2 Site selection for a microhydel project
- 5.3 Methods of power generatio in a microhydel power station
- 6.0 TIDAL ENERGY:
 - 6.1 Meaning of wave and tidal power
 - 6.2 Methods of power generation from waves
 - 6.3 Methods of power generation from tides
- 7.0 GEOTHERMAL ENERGY:
 - 7.1 Potential and classification of geothermal energy and equalayer
 - 7.2 Conversion of geothermal energy into electric power
 - 7.2.1 Components of a power station (Geothermal)
 - 7.2.2 Study of battery storage system
 - 7.3 Multipurpose uses
 - * Crop Drying
 - * Bathing
 - * Refrigeration
- 8.0 Appropriate Technology:
 - 8.1 Introduction: Concept of appropriate technology, modern technology v/s appropriate technology, its need, review of the traditional technologies and their possible modifications.
 - 8.2 Water lifting devices: Traditional methods used in the rural areas for lifting water. Rahat, inertia pumps, low lift pumps, diaphram pumps, use of appropriate technology in their design and construction. Hand and pedal operated devices, water pumping wind mills.
- 9. Bio Diesel
 - 9.1 "Jatropha Karkas" oil as a substitute of diesel fuel.

5.7 (e) HIGH VOLTAGE ENGINEERING

L T P
5 1 -

Rationale:

High voltage principles form an important and essential part of the Electric Power System. The voltage level at which power is transmitted whether it is AC or DC is always on the increase. High voltage testing of electrical equipment is an important field where a diploma engineer may be employed. This can be in a high voltage laboratory of industry manufacturing high voltage equipment or in a electrical supply undertaking responsible for installation, erection and maintenance of high voltage transmission.

S.N.	Units	Coverage Time		
		L	T	P
1.	Topic 1	8	2	-
2.	Topic 2	8	2	-
3.	Topic 3	8	2	-
4.	Topic 4	8	2	-
5.	Topic 5	18	2	-
6.	Topic 6	20	4	-
		70	14	-

DETAILED CONTENTS:

1. BASIC PROCESS OF CONDUCTION AND BREAK DOWN IN SOLID, DIELECTRICS :
 1. Classification of insulating materials.
 2. The di-electric constant.
 3. Properties of dielectric.
 4. Dielectric Break-down
 5. Intrinsic break-down and test apparatus to measure strength of solids.
 6. Frohlic theory of break-down for crystalline dielectric.
 7. Band theory of break-down for amorphous dielectric.
 8. Thermal break-down and time to thermal break-down.
 9. Discharge Break-down.
 10. Electro Chemical Break-down.
 11. Measurement of dielectric loss or loss angle.
 12. Commonly used solid dielectrics.
2. BASIC PROCESS OF CONDUCTION AND BREAK DOWN IN LIQUID AND GASEOUS DIELECTRICS :
 1. Properties of transformer oil.
 2. Conductivity of fluids.
 3. repeated discharges through liquids.
 4. Behaviour of fluids under non-uniform fields.
 5. Corona voltage, visual corona and corona at sub-critical voltage.
 6. Effects of corona.
 7. Discharge through gases.
 8. Gases under varying pressure and temperatures.
 9. Gases under high vacuum.

10. Some common gaseous dielectric.
3. HIGH VOLTAGE GENERATION :
- 3.1 Power Frequency High Voltage Generation :
 1. High Voltage Transformers.
 2. Cascaded Transformers.
 3. Senes Resonance Method.
 4. Resonance Transformers.
- 3.2 High Voltage DC Generation :
 1. Rectifiers.
 2. Voltage Doubling Circuits.
 3. Voltage Multiplier Circuits.
 4. Electrostatic Generation.
- 3.3 Generation of Impulse Voltages :
 1. Basic Impulse Circuit.
 2. Single Stage Impulse Generators.
 3. Multistage impulse generators.
 4. Generation of switching surges.
 5. Generation of high frequency voltages.
4. CONSTRUCTIONAL DETAILS OF CIRCUITS ELEMENT :
 1. High Voltage Capacitor.
 2. High voltages Resistors.
5. MEASUREMENT OF HIGH VOLTAGES :
 - 5.1 Power Frequency Measurement :
 1. Transformer Ratio.
 2. Potential transformers.
 3. Potential dividers.
 - Resistance Potential Dividers
 - Capacitance Potential Dividers.
 4. Ryall crest voltmeter
 5. Sphere-gap method.
 6. Uniform field gap method.
 7. Rod gap.
 8. Needle gap.
 9. Electrostatic Voltmeters.
 10. Quadrant Electrometer.
 11. Ellipsoidal Voltmeters.
 - 5.2 Measurement of DC High Voltage - Generating Voltmeter.
 - 5.3 Measurement of impulse voltages.
6. HIGH VOLTAGE TESTING :
 - 6.1 Transformer Testing.
 - 6.2 Line Insulators Testing
 - Mechanical Strength
 - Porosity
 - Power Frequency Dry Flashover Voltage
 - Power Frequency Wet Flashover Voltage
 - Impulse Voltages Flashover Test
 - Puncture Voltage

- 6.3 Testing of Power Cables
 - Type approval Tests.
 - Development Tests.
- 6.4 Testing of Power transformers - Connection for transformers
- 6.5 Power Capacitor Testing
 - Impulse Test
 - Discharge Test
- 6.6 Isolator Testing
 - Impulse Voltage Test
 - Power Frequency Voltage Dry Test
 - Power Frequency Voltage Wet Test
- 6.7 Current Transformer Testing
 - Power Frequency High Voltage Test
 - Impulse Voltage Test
- 6.8 Testing of voltage transformer-induced voltage test.

LIST OF BOOKS

1. Anderson, J. C.- "Dielectrics"- Chapman and Hall, London.
2. Blume L.F. - "Transformer Engineering"- John Wiley, New York.
3. Meek J. M. and Cragg JD- "Electric Break Down in gases, Oxford
 - i. IS 731(1971) Porcelain Insulator
 - ii. IS 1180(1979) Distribution Transformer
 - iii. IS 1876(1961) Voltage Measurement by Sphere Gap
 - iv. IS 2026(1962) Power Transformers
 - v. IS 2070(1972) Impulse Voltage Testing
 - vi. IS 2071(1974) High Voltage testing
 - vii. IS 2165(1973) Insulation Co-ordination
 - viii. IS 2516(1966) AC Circuits Braker
 - ix. IS 2705(1964) Current Transformers
 - x. IS 3156(1965) Voltage Transformers
 - xi. IS 6792(1972) Determination of Electrical Strength of insulating oils.
4. Power System Transients and High Voltage Principles- B.R. Gupta and L. K. Khera.

5.7 (f) ENERGY MANAGEMENT

L T P
5 1 -

Rationale:

One of the reasons for India not been able to catch up with the desired extent of modernization of industrial processes in light of challenges posed by multinationals is the non-availability of required energy supply. The solution primarily lies in tapping all possible energy generation sources but efficient use of available energy is also important. Energy management focuses on these aspects and the course will develop a awareness amongst the diploma engineers and will enable them to practice of the energy management techniques in whatever field they are engaged in.

S.N.	Units	Coverage Time		
		L	T	P
1.	Energy Management	15	3	-
2.	energy Conservation	15	3	-
3.	Energy Efficient Devices	20	4	-
4.	Energy Audit	15	3	-
5.	Environmental Impact Assessment	5	1	-
		70	14	-

DETAILED CONTENTS:

1. ENERGY MANAGEMENT :
 1. Overview of energy management, need for energy conversation (Started with oil crisis). Environmental Aspects, Alternative sources of energy.
 2. Need for Energy conservation with brief description of oil and coal crisis.
 3. Environmental aspects.
 4. Alternate sources of energy.
 5. energy efficiency-its significance.
2. ENERGY CONSERVATION :
 1. Energy conservation in Domestic Sector - Lighting, Home appliances.
 2. Energy conservation In industrial Sector - Motors, Industrial lighting, Distribution system, Pumps, Fans, Blowers, etc.
 3. Energy conservation in Agriculture sector, Tubewell pumps, Diesel generating sets, Standby energy sources.
 4. Macro level approach for energy conservation at design stage.
3. ENERGY EFFICIENT DEVICES :

1. Need for energy efficient devices.
2. Initial cost versus life cycle cost analysis on life cycle basis.
3. Energy efficient motors as compared to standard motors.
4. BIS specification for energy efficient motors, Salient design features.
5. Efficiency as a function of load, safety margins.
6. Energy efficient lighting system different sources, lumens/watt, LEDs, role of voltage on efficiency.
7. Distribution system- Optimum cable, amorphous core transformer, role of power factor, use of compensating capacitor-manual and automatic, location of capacitors.

4. ENERGY AUDIT :

1. Energy Audit Methodology
2. Efficiency of energy conversion processes, monitoring system.
3. Specific energy consumption- Three pronged approach, Five tuning, Technical up.
4. Gradation, Avoidable losses.
5. Case studies of energy audit of distribution system, AC motors, Industries.
6. Organisation of energy audit activities.

5. ENVIRONMENTAL IMPACT ASSESSMENT :

1. Need for Environmental Impact Assessment.
2. Standard format for assessment and its completion.
3. Evaluation of the assessment.

LIST OF BOOKS

1. Manual on energy efficiency at design stage-CII Energy Management Cell.
2. Manual on energy efficiency in pumping system-CII Energy Management Cell.
3. Manual on variable speed drives for energy efficiency -CII Energy Management Cell.
4. Energy conservation case studies in Ceramic industry, Sugar industry, Fertilizer industry, Cement industry-CII Energy Management Cell, etc.

SUBJECTS FOR ELECTRICAL ENGG. (INDUSTRIAL CONTROL)

5.7 INDUSTRIAL CONTROL-I

L T P
5 1 4

Rationale

Electric motors are extensively used in all types of industries because of high efficiency and easy control. Most of these motors for precise control use power electronics equipment. An Electrical Engineering diploma holder has to deal with manually operated old machines and automatic controlled modern machines and equipment. To deal successfully with wide spectrum of requirements in the industry, the pass out diploma holders should have adequate knowledge of control components, conventional electromagnetic controllers, conventional and solid state control of electric machines and electric drives. The study of this subject would certainly build up confidence among the students to face the challenges of industry.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Speed Control of D.C. Motors	9	2	-
2.	Speed Control of Three Phase Induction Motor.	15	4	-
3.	Solid State Control of Synchronous Motors.	10	2	-
4.	Solid State Control of Single Phase A.C. Motor	12	2	-
5.	Control Components	12	2	-
6.	Electromagnetic Controllers	12	2	-
		70	14	56

DETAILED CONTENTS

1. Speed Control of D.C. Motors:
 - (a) Conventional Control:

Methods of Speed control, Armature circuit resistance control, Field control, Motor voltage control (Ward Leonard methods only).
 - (b) Solid State Control:

Half controlled and fully controlled rectifier fed schemes (Single Phase and Three Phase) for D.C. separately excited and Series motors, Solid state ward leonard schemes, Chopper control scheme (Time Ratio Control Only), Block diagram speed feedbacks, Comparison, Current and Speed feedbacks, Comparison of proportional and proportional plus integral control (Simple Numericals Only).
2. Speed Control of Three Phase Induction Motors:
 - (a) Conventional Control:

Methods of speed control, Variable terminal voltage control, Variable frequency control, Pole changing control, Rotor resistance control, Concept of emf

injection in rotor circuit.

(b) Solid State Control:

Line A.C. voltage controller scheme, Voltage source fed scheme, Pulse width modulated fed inverter scheme, Comparison of VSI fed and CSI fed schemes, Cyclo Converter fed scheme, Static rotor resistance scheme, Slip power recovery scheme. Block diagram explanation of closed loop control scheme, Applications of various schemes.

3. Solid State Control of Synchronous Motor:

Self commutated inverter fed scheme, Voltage source inverter fed scheme, Block diagram explanation of closed loop scheme.

4. Solid State Control of FHP AC Motors/DC Motors:

D. C. Motor Control:

Half wave and Full wave single thyristor schemes.

A. C. Motor Control:

Triac Control Scheme, Single phase A. C. voltage controller scheme.

5. Control Components:

Relays (General purpose, Over load, Timing), Contactors (Solenoid Type, Clapper Type), Fuses and combination fuse switch units, Miniature circuit breaker, Push buttons, Limit switches, Phase failure relay, Selector switch, Master controller and Drum switches.

6. Electromagnetic Controllers:

Symbols for various components, Schematic control diagram, Wire control diagram.

Forward/reverse operation of three phase squirrel cage induction motor, Slip ring induction motor starter plugging of squirrel cage induction motor, dc shunt motor starter, Synchronous motor starter, Starter for capacitor type split phase motor, Reversal of universal motor.

INDUSTRIAL CONTROL-I LAB

List of Practicals

1. Speed control of D. C. shunt motor using Armature Voltage Control method (Ward Leonard method of speed control).
2. To plot speed - Torque characteristics of D. C. shunt motor at different firing angles when the motor is fed by a fully controlled/half controlled thyristor rectifier.
3. To plot speed- Torque characteristics of D.C. shunt motor fed by a chopper using time ratio control technique only.
4. To plot speed- torque characteristics of Three Phase cage induction motor at two different frequency with the help of cycloconverter.
5. Speed control of FHP motor using Solid State A. C. Voltage Controller.
6. Study of Dynamic braking of D. C. shunt/separately excited motor and to see the effect of resistance on braking time of the machine.
7. Study of Plugging method of Induction motor braking and to study the effect of variation of supply voltage on braking time.
8. Study of Y/D autotransformer starting methods of Three Phase induction motor starting.

5.8 MICROPROCESSORS DEVELOPMENT SYSTEM

L T P
5 1 4

Rationale :

Microprocessor has brought a revolution in the electronic field. Miniaturisation and reliability are two major factors which have made electronic appliances versatile. Computers, pocket calculators and precision instrumentation could become possible and popular only due to microprocessor. A student equipped with the basic knowledge of different types of microprocessors and their variety of applications will prove useful to the industry and he can also respond to entrepreneurial activities.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Introduction to Microprocessor based system	4	1	-
2.	Structure of 8085 Microprocessor	12	2	-
3.	I/O Operating (8085 Microcomputer)	12	2	-
4.	I/O Devices (8085 Microprocessor)	12	2	-
5.	Microprocessor Application	12	2	-
6.	Other Microprocessor & Micro controller	8	2	-
7.	Microprocessor Systems	5	2	-
8.	Testing & Debugging the Microprocessor based system	5	1	-
<hr/>		70	14	56

DETAILED CONTENTS

1. INTRODUCTION TO MICROPROCESSOR BASED SYSTEMS :
 - 1.1 Evolution of Microprocessors
 - 1.2 General applications of Microprocessor
 - 1.3 Programming Microprocessors

2. STRUCTURE OF 8085 MICROPROCESSOR:
 - 2.1 (a) Registers.
 - (b) Address/Data bus.
 - (c) Control bus.
 - (d) Interrupts.
 - 2.2 Time multiplexing of address/data bus.
 - 2.3 Concept of stack.
 - (a) LIFO structure.
 - (b) Safe for saving required data.

- (c) Role in calling subroutine.
- 2.4 Timing diagram.
 - (a) Memory cycles.
 - (b) Opcode fetch.
 - (c) Memory read cycle.
 - (d) Memory write cycle.
 - (e) I/O read/write cycle.
- 3. I/O OPERATING (8085 MICROPROCESSER):
 - 3.1 Programmed I/O
 - (a) Using I/O port on IC chips.
 - (b) Programming the ports on IC chips.
 - (c) No hand shaking in data transfer.
 - 3.2 Software interrupts.
 - (a) Restart interrupts.
 - (b) Vectored interrupts.
 - (c) Use of software interrupts.
 - 3.3 Interrupts.
 - (a) Interrupts levels.
 - (b) Interrupt circuits.
 - (c) Interrupt instructions.
 - (d) Extending interrupt system.
 - 3.4 Serial input/output.
 - (a) RIM and SIM instructions.
 - (b) How to transmit parallel data serially out.
 - 3.5 Direct memory access scheme.
 - (a) Need for DMA.
 - (b) Application of DMA transfer.
 - (c) Hardware logic used for DMA.
 - (d) Brief idea about DMA controller chips.
- 4. I/O DEVICES:
 - 4.1 Some read/write memory chips.

- (a) 8155/8156.
- (b) Use of I/O ports on these chips.
- (c) Use of Timer.
- (d) 2114,2148,2164

4.2 A/D and D/A Converters.

- (a) Use A/D and D/A converters
- (b) D/A converters using R-2R
- (c) Successive approximation
- (d) Up, Up/down counter type A/D converters
- (e) Basic concept of parallel A/D converters
- (f) Microprocessor compatible A/D and D/A converters DAC08, AD 7524, AD 7574.
- (g) Sample and Hold chip NE 5537

4.3 Programmable peripheral interface chip.

- (a) Structure of 8255.
- (b) Programming of 8255.
- (c) Selection of modes and hand shaking modes.
- (d) Use of BIT set/reset from of port c.

4.4 Other support chips.

- (a) Timer 8253.
- (b) Interrupt controller 8259.
- (c) Chip Like 8237 DMA controller

5. MICROPROCESSOR APPLICATION :

5.1 Microprocessor based Data Acquisition system.

- 5.1.1 Analog to Digital converters (0800,0808,0809) interfacing
- 5.1.2 Digital to Analog converters (0800,0808) interfacing
- 5.1.3 Seven segment display FND 500, 503, MAN 72
- 5.1.4 Display of alphanumeric characters.

5.2 Microprocessor based protective relays :

- Over Current
- Impedance
- Directional
- MHO relay

5.3 Measurement of electrical quantities using microprocessor :

- Voltage
- Current
- Frequency
- Phase Angle
- Power Factor
- Reactance
- KVA
- KVAR
- KWH

5.4 Measurement based control of firing circuit of thyristor.

- Temperature
- Strain
- Deflection
- Speed

5.5 Microprocessor based control of firing circuit of thyristor.

6. OTHER MICROPROCESSOR AND MICROCONTROLLER :

6.1 Comparison of 8085 with Z_80 and 8088, 68000 in terms of

- Bus structure.
- Architecture.
- Interrupts.
- Speeds.
- Memory Addressing

6.2 Single chip Micro Computer : 8748,8051,8096 and 8044

7. MICROPROCESSOR SYSTEMS :

- 7.1 Master/Slave distributed systems
- 7.2 Multiple Master distributed systems
- 7.3 IEEE 488/GPIB interface

8. TESTING AND DEBUGGING THE MICROPROCESSOR BASED SYSTEMS :

- 8.1 Tools for hardware checks.
- 8.2 In circuit emulators.
- 8.3 Common faults and rectification (use of debugger)

List Of Practicals

1. Assembly language programming :- Programming of simple problems.

2. Simple programming problems using 8085,8086 microprocessor. Trainer kit to gain competence in the use of
 - (a) 8085 Instruction set.
 - (b) Support chips or 8085.
 - (c) Interfacing ADC/DAC chips IS 8085
 - (d) Interfacing of Display Devices (Seven Segments)

5.9 ELECTRICAL & ELECTRONICS INSTRUMENTATION

L T P
5 1 4

Rationale:

Electrical and Electronics equipment and devices are widely used in industrial control because of their excellent performance in analysing storing and displaying. Therefore all the non-electrical quantities like temperature, pressure, speed etc. are converted in the form of equivalent electrical signals. These signals are conditioned and then either stored, displayed or used for control in real time systems. A passout diploma holder with specialization in Industrial Electronics and Control has to bear responsibility of handling and maintaining these equipment.

The course aims to develop appreciation and understanding of the use of transducers, signal conditioners, recorders and display devices.

Sl.No	Units	Coverage Time		
		L	T	P
1.	Instruments Transformers	9	2	-
2.	Transducers	16	3	-
3.	Data Acquisition System	9	2	-
4.	Recorders	15	3	-
5.	Display Devices	9	2	-
6.	Electronics Equipments	12	2	-
		70	14	56

DETAILED CONTENTS

1. Instruments Transformers:

Theory of current and Potential transformers, Ratio and Phase angle errors, Secondary burden, testing of C. T. and P. T.

2. Transducers:

Definition of transducers, Classification of transducers, Application of transducers for instrumentation and control, Selection criterion, Block diagram of a general instrumentation system. Description of practical circuits for the following.

(a) Temperature Measurement:

Concept of temperature measurement, Temperature measuring devices like thermo couples, Pyrometers, Resistance thermometers.

(b) Pressure Measurement:

Concept of pressure measurement, Pressure sensing devices like Diaphragm, Force balance, Bellows, Bourden tube, Pressure gauges, Pressure transmitters.

(c) Speed Measurement:

Tachometer, AC and DC tachogenerators, Stroboscope, Magnetic pick up, Shaft encoders.

(d) Strain Measurement:

Concept of strain measurement, strain gauges.

(e) Other Transducers:

Simple transducers for the measurement of magnetic flux, flow and level.

3. Data Acquisition System:

General concept, Importance of data acquisition system for instrumentation, Analog and digital data acquisition system. Introduction of microprocessor in data acquisition system.

4. Recorders:

Necessity of recorders, Basic requirements of a recording system, Classification of recorders, Strip chart and X-Y recorders, Ultra violet recorder, Magnetic tape recorder.

5. Display Devices:

Classification of display devices, working principle and typical use of various display devices like Cathode Ray Tube, Light Emitting Diode, Liquid crystal displays, Gas discharge plasma display, electro lumenscent displays.

6. Electronic Equipments:

Block diagram explanation of function generator and regulated power supply, Basic working principles of switched mode power supply and uninterupted power supply, Instrumentation amplifiers and its applications.

ELECTRICAL & ELECTRONICS INSTRUMENTATION LAB

DO ANY TEN EXPERIMENTS

1. Measurement of speed of a Motor/Fan by electronic Stroboscope method/Electronic Tachometer/Digital Indicator/Hand Tacometer and to compare the results.
2. Measurement of temperature by Dial thermometer, Bimetallic thermometer and Resistance thermometer.
3. A. Measurement of temperature by different thermocouple such as Iron Constautan, Cr/Al, Pt-Pt/Rh.
B. Calibration at Ice and Boiling Water Temperature.
4. Calibration of digital temperature indicator using Ice and Boiling Water.
5. To study the construction and operation of electromagnetic flow meter.
6. To study temperature recorder and temperature recording by temperature recorder.
7. Measurement of flow by rotameter.
8. To measure high voltage and current with the help of PT and CT.
9. To record the pressure by recording gauge.
10. To calibrate pressure gauge using Dead Weight Tester.
11. Measurement of pressure by Bourden Tube pressure gauge or any other method.
12. To measure liquid level by Float method and Air bubbler method.
13. To study the construction and operation of level limitting switches.
14. Determination of Ratio and Phase angle of a CT.
15. To fabricate a regulated power supply and to observe its output on a CRO.

6.1 ENVIRONMENTAL EDUCATION & DISASTER MANAGEMENT

L	T	P
4	-	-

RATIONALE:

A diploma student must have the knowledge of different types of pollution caused due to industrialisation and construction activities, so as he may help in balancing of eco-system and control pollution by providing controlling measures. They should be also aware of the environmental laws for effectively controlling the pollution of environment. The topics are to be taught in light of legislation Para-3.

TOPIC WISE DISTRIBUTION OF PERIODS:

SL. NO.	TOPIC	L	T	P
1.	Introduction	6		
2.	Pollution	4		
2.1	Water Pollution	8		
2.2	Air Pollution	8		
2.3	Noise Pollution	4		
2.4	Radio Active Pollution	6		
2.5	Solid Waste Management	6		
3.	Legislations	4		
4.	Environmental Impact Assessment	4		
5.	Disaster Management	6		
TOTAL		56	-	-

DETAILED CONTENTS

1. INTRODUCTION :

- Basics of ecology, Ecosystem, Biodiversity Human activities and its effect on ecology and eco system, different development i.e. irrigation, urbanization, road development and other engineering activities and their effects on ecology and eco system, Mining and deforestation and their effects.
- Lowering of water level , Urbanization.
- Biodegradation and Biodegradability, composting, bio remediation, Microbes .Use of biopesticides and biofungicides.
- Global warning concerns, Ozone layer depletion, Green house effect, Acid rain,etc.

2. POLLUTION :

Sources of pollution, natural and man made, their effects on living environments and related legislation.

2.1 WATER POLLUTION :

- Factors contributing water pollution and their effect.

- Domestic waste water and industrial waste water. Heavy metals, microbes and leaching metal.
- Physical, Chemical and Biological Characteristics of waste water.
- Indian Standards for quality of drinking water.
- Indian Standards for quality of treated waste water.
- Treatment methods of effluent (domestic waste water and industrial/ mining waste water), its reuse/safe disposal.

2.2 AIR POLLUTION :

Definition of Air pollution, types of air pollutants i.e. SPM, NOX, SOX, CO, CO₂, NH₃, F, CL, causes and its effects on the environment.

- Monitoring and control of air pollutants, Control measures techniques. Introductory Idea of control equipment in industries i.e.
 - A. Settling chambers
 - B. Cyclones
 - C. Scrubbers (Dry and Wet)
 - D. Multi Clones
 - E. Electro Static Precipitations
 - F. Bog Fillers.
- Ambient air quality measurement and their standards.
- Process and domestic emission control
- Vehicular Pollution and Its control with special emphasis of Euro-I, Euro-II, Euro-III and Euro IV.

2.3 NOISE POLLUTION :

Sources of noise pollution, its effect and control.

2.4 RADISACTIVE POLLUTION :

Sources and its effect on human, animal, plant and material, means to control and preventive measures.

2.5 SOLID WASTE MANAGEMENT :

Municipal solid waste, Biomedical waste, Industrial and Hazardous waste, Plastic waste and its management.

3. LEGISLATION :

Preliminary knowledge of the following Acts and rules made thereunder-

- The Water (Prevention and Control of Pollution) Act - 1974.
- The Air (Prevention and Control of Pollution) Act - 1981.
- The Environmental Protection (Prevention and Control of Pollution) Act -1986. Rules notified under EP Act - 1986

Viz.

- # The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000
- # The Hazardous Wastes (Management and Handling) Amendment Rules, 2003.
- # Bio-Medical Waste (Management and Handling) (Amendment) Rules, 2003.
- # The Noise Pollution (Regulation and Control) (Amendment) Rules, 2002.
- # Municipal Solid Wastes (Management and Handling) Rules, 2000.
- # The Recycled Plastics Manufacture and Usage (Amendment) rules, 2003.

4. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) :

- Basic concepts, objective and methodology of EIA.
- Objectives and requirement of Environmental Management System (ISO-14000) (An Introduction).

5. DISASTER MANAGEMENT :

Definition of disaster - Natural and Manmade, Type of disaster management, How disaster forms, Destructive power, Causes and Hazards, Case study of Tsunami Disaster, National policy- Its objective and main features, National Environment Policy, Need for central intervention, State Disaster Authority- Duties and powers, Case studies of various Disaster in the country, Meaning and benefit of vulnerability reduction, Factor promoting vulnerability reduction and mitigation, Emergency support function plan.

Main feature and function of National Disaster Management Frame Work, Disaster mitigation and prevention, Legal Policy Frame Work, Early warning system, Human Resource Development and Function, Information dissemination and communication.

6.2 INSTALATION,MAINTENANCE AND REPAIR OF ELECTRICAL MACHINES

RATIONALE:

L T P
4 1 4

Many of the electrical technicians employed in State Electricity Boards or other electrical industries are engaged in installation, maintenance and repair of a variety of electrical equipment. Such areas may include generation transmission and distribution systems, different types of electrical drives used with a variety of mechanical gadgets. Normally manufacturers of heavy electrical equipment provide service manuals instruction sheets for installation, maintenance and fault location. Indian electricity rules and Indian Standard Specification also provides enough guidelines. This syllabus has been designed to provide certain guidelines and broad principles regarding the above activities. appropriate field trips will reinforce the learning.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Scope of organisation	6	2	-
2.	Installation and commissioning	10	2	-
3.	Preventive maintenance	10	2	-
4.	Trouble shooting	10	2	-
5.	Earthing	6	2	-
6.	Insulation testing	6	2	-
7.	Electrical accidents & safety	8	2	-
		56	14	56

1. Scope and Organisation of Electrical Maintenance Department:

Requirement of electrical maintenance department, organisation of work of electrical m/c department, office work and record keeping of electrical maintenance department, history & plant maintenance log book & job cards.

2. Installation and commissioning:

General guidelines for loading and unloading of heavy electrical machines. Brief description of the accessories used for loading and unloading of heavy electrical equipment. List of precautions to be taken while executing such jobs. Handling & transport of electrical machine, equipment & line accessories to site. Installation of electrical equipment like induction motors, transformers, switch gears, transmission and distribution lines etc. Allignment of the equipment, testing and commissioning of different types of electrical equipment, transmission and distribution lines etc. Precautions while installation is in progress. Testing of installation before declaring it to be fit for energising.

3. Preventive Maintenance of Electrical Equipment and other installations:

Meaning of preventive maintenance, advantages of programmed preventive maintenance, preparation of preventive maintenance schedule for transformers, transmission lines, induction motors, circuit breakers, underground cables, storage batteries etc.

4. Trouble Shooting:

Causes for failure of electrical equipments, classification of faults under (i) electrical, (ii) magnetic (iii) mechanical, tool and instruments used for trouble shooting and repair. Use of trouble shooting charts. Diagnosis of faults in (i) d.c. machines (ii) Synchronous machines (iii) transformers, (iv) induction motors, (v) Circuit breakers, (vi) Overhead & underground distribution lines (vii) Storage batteries (viii) other appliances.

5. Earthing Arrangements.

Reasons for earthing of electrical equipment, earthing systems, permissible earth resistance for different types of installations, methods of improving the earth resistance, measurement of earth resistance. System earthing and equipment earthing.

6. Insulation Testing:

Classification of insulation as per ISS 1271/1958. Insulation resistance measurement, effect of temperature on resistance, reasons for determination of insulation resistance, methods of improving insulation resistance, vacuum impregnation, transformer oil testing and interpretation of the test results.

7. Electrical Accidents and Safety:

Classification of electrical accidents, statutory regulations (IS 5216-1969), treatment for electric shock, artificial respiration, types and use of different types of fire extinguishers. Dangerous currents and voltages, effect of current on human body. Step and touch potentials, R.C.Ds. and earth leakage circuit breakers. General ideas about protection against lightning, explosive safety against static and current electricity, important Indian electricity rules.

E. M. R. Lab:

1. Setting handling of tools and accessories for installing heavy equipment.
2. Commissioning of electrical equipment.
3. Measurement of earth resistance.
4. Testing of transformer oil.
5. Fault finding and repairing of different types of electrical wiring.
6. Disassembling and assembling of electrical machines e.g. electric iron, washing machines, geyser, submersible pumps, coolers etc.
7. Trouble shooting and repairing of different types of domestic and industrial electrical equipment.
8. Winding of small ac motor/transformers/chokes.
9. Cable jointing using epoxy resin kits.
10. Repair and maintenance of circuit breakers up to 11 kv.
11. Trouble shooting and repair of direct on line and star delta starter.

Rationale

A survey for job analysis of technician reveal that several times he has to solve many challenging problems. For solving such problems he may have to use both the theoretical knowlege and manipulative skills he has acquired during his studies. Project by definition means that for a given problem to identify the possible alternative solutions, to select one, to implement and evaluate. It should help in developing certain interpersonal skills, decision making skills, report writing etc. The evaluation of the project should not be based only on end product. The process is equally important and due recognition should be given for its evaluation. There could be different approaches to design a curriculum for 'project.' One possible approach is suggested here.

Introduction:

The project work is grouped under following three heads. A number of projects have been mentioned under each head (i.e. group). A student should take atleast two projects, both of which should not be from the same group.

Sr. No.	Units	Coverage Time		
		L	T	P
1.	Developmental projects	-	-	42 (any
2.	Fabrication projects	-	-	42 two)
3.	Estimating and costing projects	-	-	42
Total		84		

DETAILED CONTENTS

1. Developmental Projects:

Students are expected to design the item, identify the material and the manufacturing process, prepare one prototype and test it for its satisfactory operation. The report of such projects should be written as per requirement laid down by state. Department of industries may consider for sanctioning of loan and other subsidies for entrepreneurs. It should include feasibility report, costing, sales strategy, monetary requirements, design, manufacturing process, materials and testing.

2. Fabrication Projects:

Under these projects, students will fabricate the item or set up facilites for carrying out specific job. The report will include basic principles and concepts used in describing the working of the item/activity, specification of materials being used, detailed description of manufacturing process and specifications of machine tools used, testing procedure and test report, total cost of the item etc.

3. Estimating And Costing Projects:

Under such projects students will prepare an estimate of providing Electrical installations in the given building using standard norms and practices. The report should include: assumptions; designing of electrical layout, layout plan, detailed circuit diagram, list of material required and their specification, cost estimation, testing procedure etc. The project report should be prepared on the pattern it is prepared by state electricity board/PWD for similar jobs.

NOTE:

It is pointed out that the projects mentioned under each group are some suggestions only. Teachers may choose other similar projects under each group and get them approved by a committee headed by the Head of Electrical Engineering Department.

1. DEVELOPMENT PROJECTS:

- 1.1 Small transformers (upto 250 VA)
- 1.2 Tube light choke (40 W)
- 1.3 Automatic star-delta starter
- 1.4 Fan regulators (choke type)
- 1.5 Fan regulator (resistance type)
- 1.6 Desert cooler (using standard fan and pump)
- 1.7 Storage water heaters (geysers) 25 Lt.
- 1.8 Air blower type room heater (2 Kw)
- 1.9 Electroplating unit (nickel, chromium)
- 1.10 Repair and maintenance shop for domestic gadgets.
- 1.11 Voltage stabilizers for refrigerators (.5 Kw)
- 1.12 Emergency light
- 1.13 Thyristor control of electric motor.

2. FABRICATION PROJECTS:

- 2.1 Phase sequence indicator.
- 2.2 Inductive loading choke, 5 kw, 230 V.
- 2.3 Automatic curtain operator for a stage
- 2.4 Automatic water level controller for an overhead Tank
- 2.5 Rewinding of variac
- 2.6 Rewinding of FHP motor
- 2.7 Rewinding of ceiling/exhaust fan.
- 2.8 Rewinding of refrigerator motor (hermetically sealed)
- 2.9 Low cast intercom for home
- 2.10 Regulated power supply
- 2.11 Solid state fan regulator
- 2.12 Automatic battery charger
- 2.13 Burglar alarm
- 2.14 Hearing aid
- 2.15 Automatic street light controller (On/OFF only)
- 2.16 Inverter circuit (500 W)
- 2.17 Digital clock
- 2.18 2-band radio receiver (transistorised)
- 2.19 Stereo amplifier
- 2.20 Electronic door bell (chordless)
- 2.21 Light dimmer
- 2.22 Automatic control of water pump using timer
- 2.23 Object counter
- 2.24 Musical door bell with IN-OUT indication
- 2.25 Battery eliminator
- 2.26 Erection of overhead distribution over a small distance.

3. ESTIMATING AND COSTING PROJECTS
 - 3.1 Electrical installation in a domestic building including service mains, and earthing.
 - 3.2 Electrical installation in a small workshop including power wiring.
 - 3.3 To provide distribution system through under ground cable in a residential colony.
 - 3.4 5KVA, 3 phase, 11 KV/.415 V pole mounted substation for a farm house.
 - 3.5 Electrical installation in a public building such as school, hospital, community centre, cinema, library, auditorium, club, dispensary, polytechnic etc.
 - 3.6 Electrical installations in a high building.
 - 3.7 Electrical installations in a small govt. colony comprising of different category of houses.
 - 3.8 33 KV/.415 V, 3 ph, 1000 KVA, indoor substation for a bulk consumer.

SUBJECTS FOR ELECTRICAL ENGINEERING
6.4 ELECT. DESIGN DRAWING & ESTIMATING II

L T D
4 1 8

Rationale:

The importance of electrical engineering design, drawing and Estimating for electrical technician has already been explained in the rationale of the subject Electrical Engineering Design, Drawing & Estimating I. The aims of teaching Electrical Engineering Design, Drawing & Estimating II is to develop the following abilities.

- i. To read and interpret electrical engineering drawings
- ii. To communicate and correlate through sketches and drawings, the actual machine and to impart instructions to the workman.
- iii. To prepare working drawing of alternator panel, transmission and distribution system etc.
- iv. To design electrical gadgets and utility items for fabrication purposes.
- v. To prepare estimates of electrical repairs, transmission and distribution systems.

Sl.No	Units	Coverage Time		
		L	T	D
1.	Principle of estimating and costing	8	2	-
2.	Earthing	6	2	-
3.	Estimation of internal wiring circuits	10	2	-
4.	Estimation of power wiring	8	2	-
5.	Estimation of overhead and underground line	8	2	-
6.	Estimation of service connections	8	2	-
7.	Estimation of small substations	8	2	-
		56	14	112

DETAILED CONTENTS

1. Principles of Estimating and Costing:

Purpose of estimating and costing, essentials of estimating and costing-market survey, price list and net prices, preparation of list of materials, calculation of material and labour cost, contingencies, overhead charges, profit and total cost, quotations-comparative statement and orders, idea about tender forms. Use of E.S.R (state PWD and CPWD)

2. Earthing:

Need for earthing of electrical installations, advantages and disadvantages, effect of improper earthing, I.S. specifications regarding earthing of electrical installations, points to be earthed as per I.E. rules.

Methods of earthing-plate and pipe earthing. Determination of size of earth wires and earth plates for different capacities of electrical installations, specification of earthing materials and their cost, Earthing of power plant and grid substation.

3. Estimation of Internal Wiring Installation:

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

4. Estimation of Power Wiring

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

5. Estimation of Overhead and Underground Distribution Lines :

Main components of overhead lines-line supports, cross-arm, clamps, conductors and staysets, lightning arrestors, danger plates, anticlimbing devices, bird guards, jumpers etc., concreting of poles, earthing of transmission line, formation of lines, specification of materials for O.H. lines, I.S. specification and I.E. rules. Cost of material and work for overhead and underground lines upto 11 KV only.

6. Estimation of Service Connections:

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

7. Estimation of Small Sub-Station

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

DRAWING WORK :-

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

6.5 UTILISATION OF ELECTRICAL ENERGY

L T P
4 1 -

Rationale

This subject assumes importance in view of the fact that a technician has to work in a wide spectrum of activities. He has to make collections for alternative schemes from technical and economical considerations; i.e. to plan and design using basic principles and handbooks, to select equipments, processes and components in different situations.

Keeping the above objectives in view, besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements.

To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarise the students with the new developments in different areas.

Sl.No.	Units	Coverage Time		
		L	T	P
1.	Illumination	8	2	-
2.	Electric heating	8	2	-
3.	Electric Cooling	8	2	-
4.	Electric welding	8	2	-
5.	Electrochemical processes	6	2	-
6.	Electric Traction	6	2	-
7.	Economic consideration	6	1	-
8.	Energy Conservation	6	1	-
		56	14	-

DETAILED CONTENTS

1. Illumination:
 - (i) Nature of light, curve of relative sensitivity of human eye and wave length.
 - (ii) Definitions : flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor coefficient of utilisation, space to height ratio, reflection factor, laws of illumination.
 - (iii) Calculation of number of light points for interior illumination; calculation of illumination at different points; considerations, involved in simple design problems and illumination schemes; levels of illumination. Methods to increase illumination efficiency
 - (iv) Different sources of light: Difference in incandescent and discharge lamps - their construction & characteristics, fittings required for filament lamp, mercury lamp, fluorescent lamp sodium lamp, neon lamp.
 - (v) Main requirements of proper lighting; illumination level, absence of glare, contrast and shadow.
2. Electric Heating ;

- (i) Introduction.
- (ii) Advantages of electrical heating.
- (iii) Heating methods:
 - (a) Resistance heating (direct resistance heating, indirect resistance heating, electric ovens, their temperature range) salt bath heaters properties of heating elements, domestic water heaters and other heating appliances.
 - (b) Induction heating, principle, core type and coreless induction furnace.
 - (c) Electric arc heating, direct and indirect arc heating, arc furnace.
 - (d) Dielectric heating. Applications in various industrial fields, microwave ovens.
 - (v) Simple design problems of resistance heating element.
- 3. Electric Cooling
 - (i) Concept of refrigeration and airconditioning.
 - (ii) Brief description of vapour compression refrigeration cycle.
 - (iii) Description of electrical circuit used in
 - (a) Refrigerator,
 - (b) Airconditioner, and
 - (c) Water cooler.
- 4. Electric Welding:
 - (i) Welding methods, principles of resistance welding, welding equipment.
 - (ii) Electric arc welding principle, characteristics of arc; carbon and metallic arc welding, power supply, advantage of coated electrode, comparison of AC and DC arc welding; welding equipment.
- 5. Electrochemical Processes:
 - (i) Need of electro-deposition.
 - (ii) Faraday's laws in electrodeposition.
 - (iii) Objectives of electroplating.
 - (iv) Description of process for electroplating.
 - (v) Factors governing electro deposition.
 - (vi) Equipments and accessories for electroplating plant.

- (vii) Principle of anodising and its applications.
 - (viii) Electroplating on non-conducting materials.
6. Electric Traction:
- (i) Concept and configuration of Electric drive and types of electric drive.
 - (ii) Advantage of electric traction.
 - (iii) Different systems of electric traction, D.C. and A.C. system.
 - (iv) Different accessories for track electrification; such as overhead wires, conductor rail system, current collector-pentagraph.
 - (v) Electrical block diagram of an electric locomotive with description of various equipments and accessories.
 - (vi) Electric braking, plugging, rheostatic and regenerative braking.
 - (vii) Different types of battery driven vehicles and their application.
7. Economic Consideration
- 7(a) Load estimation, load curves, load duration curve, demand factor, load factor, diversity factor, Plant capacity factor, and utilisation factor, simple problems involving interpretation and application of above factors.
 - 7(b) Cost of generation, fixed cost, running cost, cost per unit, effect of load and diversity factor on overall cost of generation. Economic load division between power stations for a given load duration curve.
 - 7(c) Tariffs : meaning of different tariffs and their application, block rate, flat rate, max. demand, and two part tariffs. Bill preparation.
8. ENERGY CONSERVATION :
- Need for energy conservation, overview of energy management, Basic idea about energy audit.

SUBJECTS FOR ELECTRICAL ENGG. (INDUSTRIAL CONTROL)
6.6 INDUSTRIAL CONTROL-II

L T P
5 1 -

Rationale

The Present civilization is closely interwoven with the utilization of electrical energy. All the spheres of human life are greatly influenced by electrical energy. In industrial sphere too the use of electrical energy has become essential to convert it in the form of mechanical heat and light energy for the specific purposes with the advent of solid state technology. Old controllers and equipments are now being replaced in industry. A diploma holder in Electrical Engineering has to bear the responsibilities to plan and design to select equipments processes and installations in different situations. Keeping the above objectives in view, attempts have been made to ensure that the knowledge acquired be adequate in various fields as per the job requirements.

Sl.No.	Units	Coverage Time		
		L	T	P
PART - 'A'				
1.	Electric Drives	10	2	-
2.	Electric Traction	10	2	-
3.	Electric Braking	10	2	-
4.	Refrigeration & Air Conditioning	10	2	-
PART - B				
1.	Industrial Control Circuits	15	6	-
2.	A. C. Control Circuits	15	6	-
		70	14	-

DETAILED CONTENTS

1. Electric Drives:
 - (i) Definition of Electric drives, Block diagram explanation of conventional and Modern electric drives, Advantages of electric drive.
 - (ii) Types of electric drive - Group, Individual and Multimotor types and their applications.
 - (iii) One quadrant, Two quadrant and Four quadrant electric drive with their applications.
 - (iv) Constant torque and constant power control of electric drive and their use.
 - (v) Characteristics of different mechanical loads (Variation of torque/power with respect to speed and time only).

- (vi) Types of motors used in electric drive and their relative merits and demerits.
- (vii) Use of flywheels for fluctuating load (Only Physical Concept).
- (viii) Determination of motor rating for continuous, short time and intermittent duty (Constant speed application only), Simple Numerical Problems.
- (ix) Types of enclosure and their use.
- (x) Necessity of mechanical power transfer; Methods of power transfer by devices like belt drive, pulley drive and gear drive with their field of applications.
- (xi) Criteria for the selection of motors for particular loads; selection of motors for general workshop, crane and lift, textile mill, paper mill, steel mill and mine winders, printing press.
- (xii) Specification of commonly used motors.

2. Electric Traction:

- (i) Salient features of electric traction.
- (ii) Different accessories for track electrification, such as overhead wire, Conductor rail system, Current collector pantograph.
- (iii) Electrical block diagram of an electric locomotive with description of various equipments and accessories.

3. Electric Braking:

Concept of Electric Braking, Merits and Demerits of electric braking over mechanical braking, Methods of Electric braking.
 Plugging rheostatic and regenerative braking as applied to dc motors and three phase induction motors (Conventional and Solid state schemes), Relative comparison of merits and demerits.

4. Refrigeration and airconditioning;

- (i) Concept of refrigeration and airconditioning.
- (ii) Brief description of vapour compression refrigeration cycle.
- (iii) Description of electrical circuit used in
 - (a) Refrigerator,
 - (b) Airconditioner, and
 - (c) Water cooler.

PART - B

1. INDUSTRIAL CONTROL CIRCUITS:

- Heater control
- Compressor motor control
- Skip hoist control
- Walking beam
- Battery operated truck
- Conveyor system control
- Lift circuit

2. A.C.CONTROL CIRCUITS:

- Forward/reversing of 3 phase motors
 - With push-button inter-locking
 - With Auxillary contact inter-locking
- Sequence starting of motors
- Starting of multispeed squirrel cage motor
- Dynamic braking of squirrel cage induction motor
- Plugging of squirrel cage induction motor
- Over-load protection of motors
- Single phase protection
- Over-temperature protection

6.7 CONTROL SYSTEM & PROCESS APPLICATION

L T P
5 1 -

Rationale:

Control system has pronounced impact on the industrial processes almost all sophisticated automatic controls. A diploma holder with specialization in "Industrial Electronics and Control" has to bear the responsibilities of operation and maintenance of these plants and equipments in industry. Therefore the contents of this course have been selected on the basis of demand of modern industries. This subject deals with various control system devices and components, performance of control systems and various controllers used for improving the performance.

Sl. No.	Units	Coverage Time		
		L	T	P
1.	Introduction	6	1	-
2.	Components and Devices Used In Control System.	8	2	-
3.	Input Output Relationship of Simple Control System Components	8	2	-
4.	Performance of Control System	12	3	-
5.	Automatic Control Actions	8	2	-
6.	Controllers In Process Control	12	2	-
7.	Discrete Data System	8	1	-
8.	PLC	8	1	-
		70	14	-

Detailed Contents

1. Introduction:

Need of automatic control, Concept of open loop and closed loop control, Block diagram of feedback control system and its basic elements, definition and explanation of following control system.

- (i) Linear and Non-Linear Systems.
- (ii) Continuous and discrete Systems.
- (iii) Static and Dynamic Systems.
- (iv) Single Input Single Output (SISO) System and Multiinput Multioutput (MIMO) System.

Process and Process characteristics, Analogy with electrical system, Concept of process time delay.

2. Components & Devices Used In Control System:

Brief description and working of potentiometer, self balancing potentiometer, differential transformer, synchros, servomotors, tachogenerators, DC Servo motors and DC Tacho Generator.

3. Input Output Relationship of System & Control system Components:

- (i) Concept of transfer function and its use in control system.
 - (ii) Derivation of transfer function of following systems and components.
 - (a) Simple RC low pass network.
 - (b) First order thermal system and fluid level system.
 - (c) General Feedback Control System.
4. Performance of Control System:
- (i) Step, Ramp, Pulse and sinusoidal type of inputs and their Laplace Transforms.
 - (ii) Time domain response of First order and Second order system with step input.
 - (iii) Definitions of Rise time, Peak overshoot, Settling time, Natural frequency and Damping Ratio pertaining to second order system.
 - (iv) Initial value and final value theorems and their use in control systems.
 - (v) Types of feedback systems and error constants.
5. Automatic Control Actions:
- Control actions, Types of control actions, Two position control (On/Off action), Proportional, Proportional plus integral, Proportional plus derivative, Proportional plus integral plus derivative action.
7. Controllers In Process Control:
- i. Electronic Controller:
 - On-OFF controller, Proportional, Proportional plus integral, Proportional plus integral plus derivative.
 - ii. Hydraulic & Pneumatic Controllers:
 - Principle and working of hydraulic controllers (Proportional and Proportional integral), Pneumatic P-I-D controller comparison of electronic, Hydraulic and Pneumatic controllers.
7. Discrete Data System:
- Discrete signal system, Discrete line system, Block diagram explanation of digital data system, Representation of microprocessor controlled system, as a digital data system, Concept of sampling, Analog to digital converter, Sample and hold circuit, concept of desampling, Digital to analog converter.
8. PROGRAMMABLE LOGIC CONTROLLER (PLC) :
- Introduction, Principle of operation, Architecture of programmable controller, Programming the programmable controller, Application of programmable controller.

SUGGESTED TOPICS FOR ECOLOGY AND ENVIRONMENTAL AWARENESS CAMPS

- . Basics of ecology, ecosystems and sustainable development.
- . Conservation of land forms and preservation of species
- . Pollution of air, water, soil, food and food products
 - causes
 - effects
 - monitoring and control
- . Sources of energy, advantages of non-conventional energy sources and low path energy methods.
- . Conservation of energy including redesign of plant, machinery and processes
- . Industrial pollution
- . Measures for afforestation and arresting soil erosion
- . Prevention of advancement of deserts and lowering of water table.

DIPLOMA IN ELECTRICAL ENGINEERING
STAFF STRUCTURE

Intake of the course	60	
Pattern of the course	3yrs(Six Semester)	
1. Principal	1	
2. H.O.D.	1	
3. Lecturer Elect. Engg.	3	
4. Lecturer Electronics Engg.	1	
5. Lecturer Maths	1	Part time or common with other discipline if the intake is more than 180.
6. Lecturer Physics	1	
7. Lecturer Chemistry	1	
8. Lecturer Language	1	
9. Lecturer Computer	1	
10. Steno typist	1	
11. Accountant/Cashier	1	
12. Student/Library Clerk	1	
13. Store Keeper	1	
14. Class IV	6	
15. Sweeper	Part time as per requirement.	

The posts of Choukidar and Mali will be sanctioned according to the justification of institution. Services for existing staff in other disciplines of the institute may be utilised if possible.

The posts at serial number 4,5,6,7,8,9,10 and 11 are minimum common staff in the institute.

Staff qualifications will be as given in the service rules.

Staff development for teaching industrial management and entrepreneurship development may be done by the institute.

Guest lectures may be organised at suitable time.

SPACE REQUIREMENT

A. Total Land Area	No	M2
B. Administrative Block		
1. Principal's room	1	30
2. Steno room	1	6
3. Confidential room	1	10
4. Office room	1	80
5. Library (common with other disciplines)	1	150
6. Common room	1	80
7. Class rooms	2	150
8. Store	1	100
9. Model room	1	90
C. Laboratories/Workshops		
1. Drawing Hall @ 8 sq.m. per student	1	120
2. Basic Elect. Engg./Measurement lab @ 5 Sq.m. per student	1	75
3. Electrical M/c lab. @ 8 Sq.m. per student control.	1	120
4. Electrical maintenance & repair lab @ 8 Sq. m. per student.	1	120
5. Electronics lab @ 5 Sq.M. per student	1	75
6. Computer room	1	60
<p>Note: Labs of physics, chemistry and computer science will be common for all disciplines in the institute. Additional electronics lab will be needed in the institutions where electronics course is not running. However it will be more convenient and economical to run electrical Engg. and electronics engineering diploma courses in the same institution.</p>		
D. Common Facilities		
1. Dispensary	1	40
2. Canteen & tuck shop	1	50
3. Parking space/cycle stand with garrage	1	200% student 50% student
4. N.C.C. block	1	70
5. Guest room	1	30
E. Residential Facilities		
1. Hostel for students	1	for 40% student
2. Staff quarters		
Principal	1	Type IV
HOD/Warden	2	Type IV
Sr. Lect./Lect.	2	Type IV
Technical/Ministerial staff	2	Type II
Class IV	6	Type I
3. Play ground (common)	1	_____

LIST OF EQUIPMENTS

Only those of the equipments given below which are essentially required for the conduction of practicals mentioned in the curriculum are to be procured by the institutions.

"Machine/Equipments/Instruments of old BTE list which are not included below are to be retained in the Lab/Shop for Demonstration purpose but not to be demanded fresh for purchase."

NOTE : Equipment for different shop and lab of latest version should be purchased.

I. APPLIED PHYSICS LAB

S.No.	Name of Equipment	No.	@ Rs. Aprox.	Amt.in Rs. Aprox.
1.	Brass ball with hook dia 1.8 Cm to 2 Cm diameter	2	50	100
2.	Stop watch least count Least Count 0.1 Sec.(non-magnetic) 0.01 sec to 0.001 sec (Electronic Desirable)	4	750	3000
3.	Wall bracket with clamping arrangement 8" to 10" length	2	50	100
4.	Meter scale Least count 0.1cm, wooden 1meter	5	40	200
5.	Meter scale Least count 0.1cm, wooden 50 Cm	5	40	200
6.	Searl's conductivity apparatus with copper & steel rods 25 cm length 4 cm.diameter with all accessaries	2 set	1500	3000
7.	Constant Level Water Flow Container of one liter capacity vertical stand & rubber tubing	2	250	500
8.	Thermometer 0-110oC(Least count 0.1oC desirable)	4	100	400
9.	Potentiometer - 10 wires (1 meter length of each wire) with jockey, sunmoical top	4	750	3000
10.	Moving coil galvenometer 30-0-30 with moving mounting	5	300	1500
11.	Rheostat 50 ohm., 100 Ohm., 150 Ohm.16 capacity		300	4800
12.	Lead Accumulator 2V, 6V (1 No.Each)	2	250	500
13.	Meterbridge 1 meter length, sunmica top copper strips fitted with scale	2	300	600
14.	Resistance Coil (Standard) 1 ohm. to 10 ohm.	10	50	500
15.	Moving coil ammeter 0-1 amp., 0-2 amp., 0-5 amp. with mounting	8	250	2000
16.	Moving coil voltmeter 0-1 V., 0-2V 0-5 V., 0-10 V. with mounting	8	250	2000
17.	Denial cell with complete accessories	2	250	500
18.	Leclanche Cell with complete accessories	2	250	500

S.No.	Name of Equipment	No.	@ Rs. Aprox.	Amt. in Rs. Aprox.
19.	Standard Cadmium Cell with complete accessories	2	250	500
20.	Battery Charger with complete accessories	1set	1800	1800
21.	Battery Eliminator Multi range	2set	750	1500
22.	Multimeter(Digital)	1set	800	800
23.	Carey Foster Bridge (With all accessories)	2set	4500	9000
24.	Resistance Box (2 No. Each) 0-1 Ohm, 0-100 Ohm.	4	850	3400
25.	Fractional Resistance Box 0-1 Ohm.	2	1200	2400
26.	Post office box Key type	2	1200	2400
27.	Post office box Dial type	2	1200	2400
28.	Resistance Wire(100 Gm.) (Constanton/Maganin)	1 lacchi	100	100
29.	Connecting Wire Copper(1/2 Kg.) (Cotton Insulated)	1 lacchi	700	700
30.	Screw gauge L.c 1/100 mm	5set	150	750
31.	Vernier Callipers L.c. 1/10 mm	5set	100	500
32.	Appratus for determining character- stics of P-N junction diode complete with all accessaries	2 set	1500	3000
33.	Resonance Column of steel One Meter length and 3-4 Cm diameter fitted with scale & water level arrangement	2	1600	3200
34.	App. for determining coefficient of friction on a horrizontal plane (Complete with all accessories)	2 set	700	1400
35.	Tuning Fork's Sets Set of different frequency (with rubber pad)	3set	350	1050
36.	Physical balance with weight box Complete with Fractional weight	2	800	1600
37.	Anemometer with counter cup type	1	1000	1000
38.	Spring Force Constant Apparatus with graduated mirror & pointer, weight set with hanger	2	1200	2400
39.	Viscosity Apparatus (Stock law) with steel balls and viscous liquid & timer	2set	1600	3200
40.	Thermometer of different range Mercury thermometer 0-50oC to 0-110oC	10set	100	1000
41.	Wall Thermometer Alcohol Filled 0-50oC	2set	20	40
42.	Sprit Level Technical Type	1set	60	60
43.	Drilling Machine Electric with different size bits	1set	800	800
44.	LPG Gas Burner with Cylinder	1set	800	800
45.	Tool Kit with different tools Complete	1set	800	800
46.	Lab stools	30		
47.	Lab tables	8		

S.No.	Name of Equipment	No.	@ Rs. Aprox.	Amt.in Rs. Aprox.
48.	Plug Keys One Way	5	50	250
49.	Plug Keys Two Way	5	100	500
50	Helical Springs - Soft, 10 cm each	6	100	600

II. APPLIED CHEMISTRY LAB

S.No.	Name of Equipment	No.	@ Rs. Aprox.	Amt. in Rs. Aprox.
1.	Test tube stand (Plastic/Tafflon)	30	20	600
2.	Funnel stand (Plastic/Tafflon)	30	20	600
3.	Burette stand Stainless Steel/Wooden/Iron	30	50	1500
4.	Pipette stand Stainless Steel/Wooden/Plastic	30	20	600
5.	Chemical balances with analytical weights 1gm -200gms	5	1500	7500
6.	Fractional weights set with rider 10 mg to 500 mg with rider	5sets	25	125
7.	Kipp's apparatus 1000 ml. Plastic/ Tafflon	2	500	1000
8.	Reagents bottles			
	250ml	120	20	2400
	500ml	25	25	625
	1000ml	5	30	150
9.	Wide mouth bottle 250 ml Glass	50	15	750
10.	Winchester bottle 2.5 litre Plastic/Tafflon	15	30	450
11.	Test tubes 1/4" x 6"			
	i. Corning or Borosil	200	9	1800
	ii. Glass	200	2	400
12.	Boiling tube 1" x 6"			
	i. Corning or Borosil	100	16	1600
	ii. Glass	100	5	500
13.	Pestle and mortar Dia 10 cms 15 cms (Ceramics)	2	30	60
14.	Watch glass 5.0 cms, 7.5 cms glass	15	5	75
15.	Beakers (Glass/Brosil/Corning Plastic)			
	250 ml.	50	20	1000
	500 ml.	50	20	1000
16.	Weighing Tube 10 ml with lid (Plastic)	30	10	300
17.	Wash bottles (Plastic/Tafflon)	30	15	450
18.	Conical flask 250 ml. Glass (Brosil/Corning/Plastic) Transparnt	100	30	3000
19.	Flat bottom flask 500 ml. Glass	15	40	600
20.	Flat bottom flask 250 ml. Glass	15	25	375
21.	Burette 50 ml. (Plastic/Tafflon)	30	60	1800
22.	Pipette 25 ml. (Plastic/Tafflon)	30	20	600
23.	Measuring flask 250 ml. with stopper	30	50	1500
24.	Measring cylinder of various sizes (100 ml, 250 ml, 500 ml, 1000 ml) 3 no. of each	12	30	360
25.	Bunsen's burner of brass	30	50	1500
26.	Gas plant petrol/LPG 10 to 20 burners automatic	1	5000	5000
27.	Spirit lamp (Brass)	30	30	900
28.	Tripod stand (Steel/Iron) Large/Medium	30	30	900
29.	Wire gauge 15 X 15 cm. with asbestos	30	15	450
30.	Test tube holder wodden	50	10	500

S.No.	Name of Equipment	No.	@ Rs. Aprox.	Amt. in Rs. Aprox.
31.	Porcelain plates Ceramic	30	20	600
32.	Funnel 15 cm. Glass Borosil Corning/Plastic	60	16	960
33.	Spatula hard & nickel/steel	2 each	50	100
34.	Distilled water units (electrical)	1	10000	10000
35.	Distilled water units (solar)	1	5000	5000
36.	Open balance 1000 gms./10 mg.	1	600	600
37.	Brush for cleaning Hydro Fiber Acid & Alkali Resistant	100	10	1000
38.	Jars 20 Lit. for keeping distilled water	5	100	500
39.	Lab table 2 m. x 1.2 m. x 1 m. hight with central sink and cup boards (Teak wood) with drawers and two built in almirah on each side with reagent racks, better tile top	4	8000	32000
40.	Exhaust fans 18" (GEC make/Crompton)	4	2000	8000
41.	Side racks and selves for bench reagents made of teak wood for 24 bottels each set	4	2000	8000
42.	Digital balance electronic Electronics upto 2 decimal places	1	10000	10000
43.	Hot plates 7-1/2", 3" dia controled 2000 watts	1	1000	1000
44.	Hot air oven thermostatically controled with selves and rotary switches 350 x 350 x 25 high	1	8000	8000
45.	pH Meter (Digital)	1	1000	1000
46.	Glass Electrode	2	850	1700
47.	Reference Electro	2	850	1700
48.	Weight Box 1gm, 2gmX2, 5gm, 10 gm 20gmX2, 50gm, 100gm with for cep Miscellaneous	LS		15000

III. WORKSHOP PRACTICE

CARPENTRY SHOP

S.No.	Name of Equipment	No.	@ Rs.	Amt.in Rs.
1.	60 cm.rule	10	50	500
2.	Flexible steel rule 2 metre	2	75	150
3.	T square 23 cm. steel	10	50	500
4.	Bevel square 23 cm. steel	2	100	200
5.	Marking knife 25 cm. steel	10	100	1000
6.	Marking gauge wooden & brass 25 cm.	10	150	1500
7.	Mortise gauge wooden & brass 25 cm.	10	150	1500
8.	Caliper inside, steel 20 cm.	2	200	400
9.	Caliper outside , steel 20 cm.	2	200	400
10.	Compass steel 20cm.	2	100	200
11.	Deviver steel 20 cm.	2	100	200
12.	Plumb	2	75	150
13.	Wooden bench vice steel 20 cm.	10	500	5000
14.	Bench hold fast steel 30 cm.	10	300	3000
15.	Bar clamp 2 m.	2	500	1000
16.	G clamp of flat spring steel 20x30 cm.	4	150	600
17.	Rip saw 40-45 cm.	10	200	2000
18.	Cross cut saw 40-45 cm.	2	200	400
19.	Tennon saw 30-35 cm.	10	200	2000
20.	Dovetail saw 30-35 cm.	2	150	300
21.	Compass saw 35 cm.	4	150	600
22.	Key hole saw or pad saw 30-35 cm.	2	150	300
23.	Bow saw	2	200	400
24.	Frame saw	2	200	400
25.	Chisel fish brand 1" to 1/8" firmer	3 set	250	750
	Dovetail	3 set	250	750
	Mortise	3 set	250	750
26.	Gauge or Golchi 1" to 1/8"	3 set	300	900
27.	Wooden jack plane complete	10	100	1000
28.	Wooden smoothing plane	10	250	2500
29.	Iron jack plane complete	10	200	2000
30.	Iron rebate plane complete	3	200	600
31.	Iron grooving plane complete	3	300	900
32.	Iron compass plane complete	3	350	1050
33.	Wooden moulding plane complete	3	500	1500
34.	Bradawl	3	350	1050
35.	Gimlet drills set	1 set	300	300
36.	Center bit	2	250	500
37.	Twist bit	2	200	400
38.	Auger bit	2	200	400
39.	Dovetail bit	2	200	400
40.	Counter shank bit	2	200	400
41.	Ratchet brace machine	2	300	600
42.	Grand drill machine 1/4"	2	600	1200
43.	Wooden hand drill burmi	5	700	3500
44.	Wooden mallet	10	100	1000
45.	Claw hammer	3	100	300
46.	Carpenters hammer	10	100	1000
47.	Cutting tool for Universal wood working machine	3 set	1500	4500
48.	Screw driver 18" & 15"	6	100	600

S.No.	Name of Equipment	No.	@ Rs.	Amt. in Rs.
49.	Adze 500 gm.	10	100	1000
50.	Pincer 175 mm.	6	250	1500
51.	Plier 150 mm.	4	200	800
52.	Oil stone 8"	4	180	720
53.	Rasp file 12"	4	200	800
54.	Half round file 12"	4	200	800
55.	Round file 12"	4	200	800
56.	Triangular file 5", 4"	8	200	1600
57.	Water stone	4	80	320
58.	Carpentry work benches	4	4000	16000
59.	Band saw machine complete	1	60000	60000
60.	Circular saw machine	1	35000	35000
61.	Double Ended Electric Bench grinder	1	15000	15000
62.	Universal wood working machine	1	30000	30000
	misc. for foundation of machines	LS		20000
SMITHY SHOP				
1.	Anvil 150 Kg. with stand	5	5500	25500
2.	Swage block 50x30x8cm.&45x45x10cm.	2	3000	6000
3.	Hammers			
	Ball peen 0.8 Kg. (Approx.)	10	350	3500
	Cross peen 0.8 Kg. (Approx.)	10	350	3500
4.	Beak iron 25 Kg.	1	1000	1000
5.	Swages different types	6	100	600
6.	Fullers different types	6	100	600
7.	Leg vice 15 cms. opening	1	300	300
8.	Electric blower with motor	1	10000	10000
9.	Furnace chimney with exhaust pipe	5	10000	50000
10.	Sledge hammer - 5 Kg.	2	400	800
	Misc. tools		LS	5000
SHEET METAL, SOLDERING & BRAZING				
1.	Dividers - 15cm.	5	100	500
2.	Trammel 1 m.	1	80	80
3.	Angle protector	5	100	500
4.	Try square 30 cm.	5	80	400
5.	Centre punch	5	50	250
6.	Steel rule 30 cm. , 60 cm.,	5	25	125
7.	Sheet metal gauge	1	250	250
8.	Straight snips 30 cm.	2	500	1000
9.	Curved snips 30 cm.	2	600	1200
10.	Bench shear cutter 40 cm.	1	10000	10000
11.	Chisel 10 cm.	5	200	1000
12.	Hammer	5	300	1500
13.	Bench vice 13 cm.	5	2000	10000
14.	Plier	5	100	500
15.	Nose plier	5	120	600
16.	Sheet metal anvil/stakes	5	3500	17500
17.	Shearing machine 120 cm.	1	5000	5000
18.	Solder electric	2	1000	2000
19.	Solder furnace type	2	500	1000
20.	Brazing equipments and accessories	1	10000	10000
21.	Blow lamp	2	400	800
22.	Sheet bending machine	1	20000	20000
	Misc.		LS	10000

FITTING SHOP

S.No.	Name of Equipment	No.	@ Rs.	Amt.in Rs.
1.	Bench vice jaw 10 cm.	10	600	6000
2.	Surface plate 45x45 cm.	2	4500	9000
3.	V. Block 10x7x4 cm.	5	700	3500
4.	Try square	10	100	1000
5.	Bevel protractor 30 cm.	1	250	250
6.	Combination set	1	3000	3000
7.	Divider	5	100	500
8.	Centre punch	5	80	400
9.	Calipers (Different sizes)	12	100	1200
10.	Vernier calipers 30 cm.	2	1500	3000
11.	Micrometer 0-25, 25-50 m.m.	4	1500	6000
12.	Vernier depth gauge	1	700	700
13.	Feeler gauge--15 blades	1	100	100
14.	Radius gauge	1	200	200
15.	Angle gauge	1	200	200
16.	Thread gauge	1	200	200
17.	Bench drilling machine 13 mm.	1	10000	10000
18.	Double ended electric grinder	1	8000	8000
19.	Drill set	1set	2000	2000
20.	Reamer set	1set	3500	3500
21.	Tap set	1set	3500	3500
22.	Adjustable wrenches (15 cm., 20cm. 30 cm.)	1set	1200	1200
23.	Allen key set	1set	700	700
24.	Spanners	6	100	600
25.	Work benches	6	4500	27500
26.	Power hacksaw	1	8000	8000
	Misc. Files, Dieset, Hexa frames etc.		LS	20000

WELDING SHOP

1.	Ellectric welding set oil cooled	1	20000	20000
2.	Industrial regulator type oil cooled arc welder	1	25000	25000
3.	Air cooled spot welder 7.5 KVA	1	30000	30000
4.	General accssories for air cooled spot welder of 7.5 KVA			15000
5.	Gas welding set with gas cutting torch and complete with all accessories	1	30000	30000
6.	Misc. work benches		LS	35000

PAINTING & POLISHING SHOP

1.	Air compressor complete with 2 HP motor	1set	25000	25000
2.	Spray gun with hose pipe	1	1500	1500
3.	Stoving oven	1	6000	6000
4.	Buffing machine with leather and cotton wheels	1	8000	8000
5.	Electroplating Equipment for cromium Nikle plating.	1	20000	20000
	Misc.		LS	5000

PLUMBING SHOP

S.No.	Name of Equipment	No.	@ Rs.	Amt.in Rs.
1.	Pipe vice 5 cm.	4	500	2000
2.	Chain wrenches	5	500	2500
3.	Ring spanner Set	5	250	1250
4.	Wheel pipe cutter	2	600	1200
5.	Water pump plier	4	100	400
6.	Pipe die set 2" set	2 set	1200	2400
7.	Pipe bending device	1	5000	5000
8.	Work benches	4	6500	26000
9.	Set of various types of plumbing fittings e.g. Bib cock, Cistern, Stop cock, Wheel volve, Gat volve etc.		LS	4000
10.	Misc. Hacksaw frame and others		LS	4000

FOUNDRY SHOP

1.	Moulding boxes	25		12000
2.	Laddles	5		2000
3.	Tool kits	10 sets		5000
4.	Quenching tanks water or oil	2		2000
5.	Permiability tester	1		2000
6.	Mould hardness tester	1		12000
7.	Sand tensile testing equipment	1		15000
8.	Portable grinders	1		6000
9.	Temperature recorders/controllers	LS		10000
10.	Pit furnace with Blower	1		10000

MACHINE SHOP

1.	Lathe machine 4.5 feet "V" bed. Height of centres 8.5 inch. Dog chuck 8 inch complete 1 H.P. motor 440v, push button starter with coolent pump, tray and with standard accessories.	4		50000
2.	Shaper machine 12 inch stroke with 2 H.P. motor 440 volts push button starter with vice 6 inch (Swivel base)	2	20000	200000

NOTE:-

1. The institutes running mechanical engg. course need not purchase these two items sepreately because they will have one complete machine shop for the course
2. Above items are for 2 batches of 15 students each.

IV. INTRODUCTION TO COMPUTER (Common to all Trades)

COMPUTER CENTRE

S.No.	DESCRIPTION	QTY.	APPROX. COST (in Rs.)
1.	Core-2 Quad Processor, 4GB RAM 1 GB SATA HDD, 19" TFT Monitor/ Server of Latest Specification OS-Windows 2007/2008/Latest Version	02 Server	1,20,000=00
2.	General Desktop Computer-Intel i5 60 node or Higher(with latest Specification Pre loaded latest Anti Virus with Life time Subscription, Licence Media and Manual with UPS 660 VA with latest window OS Including licence OR Computer of latest Specification With latest window os including licence		36,00,000=00
3.	Software :((Latest Version)		
	i. MS OFFICE 2010/Latest Version		LS LS
	ii. COMPILER 'C', C++, JAVA-7		LS LS
4.	Hardware		4,50,000.00 LS
	i. Switch-32 Port		02
	ii. Router		02
	iii. Hub		04(8 Port)
	iv. Ext. Modem		02
	v. Wireless N/W Adaptor		02
	vi. Series Access Point		02
	vii.LAN Cable Meter		05
	viii. LAN Cable Analyzer		05
	ix. Crimping Tool		15
	and all other accessories related to Networking		
5.	Scanner- Flat Bed A4/Auto Lighter (Bit depth 48)		02 20,000
6.	132 Column 600 CPS or faster 9 Pin dot matrix printer with 500 million character head life		02 50,000
7.	Laser Jet-A4 All In one 20 page per min (2 Each)		04 50,000
8.	Desk Jet-A4 Photo Smart (2 Each)		04 40,000
9.	5 KVA on line UPS with minimum 30 minute battery backup along with sealed maintenance free batteries. Provision for connecting external batteries with network connectivity.(For 2 Labs)		04 8,00000

10.	Split Air Conditioner 1.5 tones capacity with ISI mark along with electronic voltage stabilizer with over voltage and time delay circuit	08	35,0000
11.	Room preparation and furniture	LS	
12.	19" rack, 24-port switch. connector RJ-45 Cat-6 cabling for network	LS	10,0000
13.	2 KVA Inverter Cum UPS	02	6,0000
14.	Fire Extinguisher (2 Kg.)	04	15000
15.	Fire Extinguisher (5 Kg.)	04	25000
16.	Vacuum Cleaner	02	25000
17.	LCD Projector 3000 Lumen with all Accessories	02	350000
18.	Pen Drive 16 GB	10	10000
19.	DVD Writer External	02	10000
20.	HDD External 500 GB	02	15000
21.	PAD (Latest Configuration)	02	15000
22.	Broadband For Internet(Speed Min. 8mbps)	04	LS
23.	USB Modem	02	8000
24.	Generator 15 KVA Water Coolant	01	450000

Sl. No.	Equipment	Qty.	Total Price
1A.	Ammeter - portable, moving coil, permanent magnet 150 mm uniform scale		
	a. Range 0 - 2.5 - 5 Amp.	2	1000
	b. Range 0 - 50 m A	2	500
	c. Range 0 - 500 mA	2	1000
B.	Dynamometer, Type M/C, 150 mm uniform scale		
	a. Range 0 - 2.5 - 5 Amp.	2	2000
	b. Range 0 - 50 m A	2	2000
	c. Range 0 - 500 mA	2	2000
2.	Ammeter - moving iron type Portable moving iron permanent magnet, 150 mm uniform scale		
	a. Range 0 - 5 Amp.	4	2000
	b. Range 0 - 10/20 Amp.	4	2000
	c. Range 0 - 500 mA/1000 mA	4	2000
3.	Voltmeter- portable moving coil permanent magnet 150 mm uniform scale		
	a. Range 0 - 1 V	2	2000
	b. Range 0-5-10 V	2	2000
	c. Range 0-15-30 V	2	2000
	d. Range 0 - 50 mv-100 mv	2	2000
	e. Range 0-250-500 V	2	2000
B.	Dynamometer, Type M/C, 150 mm uniform scale		
	a. Range 0 - 1 V	2	2000
	b. Range 0-5-10 V	2	2000
	c. Range 0-15-30 V	2	2000
	d. Range 0 - 50 mv-100 mv	2	2000
	e. Range 0-250-500 V	2	2000
C.	Additional Moving Iron Type		
	a. Range 0 - 1 V	2	2000
	b. Range 0-5-10 V	2	2000
	c. Range 0-15-30 V	2	2000
	d. Range 0 - 50 mv-100 mv	2	2000
	e. Range 0-250-500 V	2	2000
4.	Digital multimeter 3.5 digit - display D.C. voltage 0 - 1000 V in 5 steps A.C. voltage 0 - 750 V in 5 steps Resistance 0 - 20 M ohm in 6 steps D.C. 0 - 10 A in 6 steps A.C. 0 - 10 A in 6 steps Power supply 9 V.	4	8000
5.	Analog multimeter (Portable) D.C. Voltage 0 0 1000 V AC Voltage 0 2/5/10/25/100/250/1100 V.	2	4000

Resistance 0 200 M ohm
 DC 0 - 50 micro Amp./1 mA/10 mA/100mA/1A/10A
 AC 0 - 100 mA/1A/25 A/10A

6.A.	Wattmeter single phase (LPF= 0.2) portable dynamometer type, scale 150 mm current range 0 - 5/10 Amps voltage Range 0 - 250/500 V	4	20000
B.	Wattmeter Three phase (LPF= 0.2) portable dynamometer type, scale 150 mm current range 0 - 5/10 Amps voltage Range 0 - 250/500 V	2	12000
7.	Decade resistance box constantan coils, single dial 10x10, 10x100, 10x1000, 10x10,000 ohms	2	2000
8.	Capacitance Box 0-250 uf, 250 V	2	2000
9.	Energymeter single phase (Standard)		
A.	Induction type, industrial grade 5 A or 10 A, 250 V, 50 Hz.	1	2000
B.	Digital Type	2	8000
10.A	Energymeter(Substandard) single phase, induction type 5 A/10A, 250 V, 50 Hz.	2	6000
B.	Digital Type	2	8000
11.	Power factor meter dynamometer type, eddy current damping, 50 Hz, scale length 150 mm range upto 20 amp, voltage range 300 V 10 F. range 0.5 log, unity 0.5 load.	2	10000
12.A	Frequency meter (Reed type) 230 V, range for having 21 reeds for 40-60 Hz range.	2	4000
B.	Frequency meter (Digital)	2	6000
C.	Pointer Type Frequency Meter	2	5000
13.	Rheostat sliding rheostats wound with evenly oxidised iron free nickel copper on vitreous enamelled round steel tube 150 ohms 2 Amps. 110 ohms 2.5 Amps.	2 2	1200 1200
14.	Variable inductor single phase, 250 V, 2.5 KVA continuously variable	2	4000
15.	Cathode ray oscilloscope 10 MHz dual beam oscilloscope vertical defection band width DC-10 MHz (-3db) rise time 30 ms defection coefficient 12 horizontal defection band width 1 MHz (+6db) 20 MHz dual beam	2	20,000

16.	Battery charger 12 V silicon bridge rectifier AC input 230 V, DC output suitable for charging 6 V And 12 V batteries provided with MC voltmeter 0 - 20 V and ammeter 0 - 5 A	2	4000
17.	Capacitors 2.5 microfarad,	10	500
A.	36 uF Electrotype	5	500
B.	Capacitor 2.5 uF electrotype	10	500
18.	Q Meter frequency 0 - 30 MHz Q 0 to 500	2	8000
19.A	LCR meter (digital) Battery Operated 3.5 digit display capacitance 0 to 20,000 microfarad inductance 0 to 200 Henry resistance 0 to 20 M ohms	2	16000
B.	A.C Operated	2	7000
20.	LCR/Q bridge capable of measuring resistance, inductance and capacitance of range 8 amps, 0.012 to 10 M ohms, 4 to 10,000 H, 0.5 pico farad to 10 F.	2	10000
21.	Kelvin double bridge 10 x 0.1 ohms circular slide wire devided into 200 equal parts	2	4000
22.	Energy meter 3 phase induction type, 4 wire, industrial grade, 50 Hz, 10 A, 440 Volt	2	5000
23.	Energy meter (Sub standard) 3 phase, 4 wire, 440 V, 10A, 50 Hz induction type.	2	12000
24.	Transformer Three phase core type, 230/110 V, 1 KVA, 50 Hz.	2	10000
25.	Universal shunt 0 - 75 A	2	4000
26.	Current transformer 10/25/50/5A as per IS 4201/1967 and 2705/1981	2	4000
27.	Potential transformer 10 VA, 415/110 V as per IS 4201/1967 and 2705/1981	2	4000
28.	Strain guage	2	2000
29.	Maxwells bridge	2	2000
30.	Weins bridge	2	2000
31.	Schering bridge	2	2000
32.	Single Phase AC Watt Hour Meter	2	2400

(Electronic Energy Meter) 240V,50 C/s
10 Amp.,

33.	3 Phase Four Wire (3X240V between Line To Nuetral) AC static Watt Hour Meter (Electronic Energy Meter) 10A	2	5000
34.	Trivector Meter	2	5000

ELECTRICAL WIRING & FABRICATION SHOP

1.	Portable drilling machine drilling 10 mm no load speed 700 rpm 435 W capacity supply voltage 230 V, 50 Hz (Fully Automatic)	2	10000
2.	Megger	2	3000
A.	having hand driven generator to generate 500 V d.c. range of measuring insulation resistance from 0 - 100 M ohms IS 2992/1965		
B.	Megger-Digital 500/1100 V Dual Range Resistance 100n	1	4000
3.	Murcury vapour lamp M.L. Type, 125 W, 230 V, 50 Hz	2	400
4.	Murcury vapour lamp 125 W, 230 V, 50 Hz, AC supply complete with choke, lamp holder and power factor capacitor	4	1000
5.	Sodium vapour lamp 125W/250W, 230 V, 50 Hz. with choke	2	8000
6.	Fluorescent tube 230V, 50 Hz, 1 phase with Electronic choke and starter, various sizes and types 20 - 40 W	10	4000
7.	Screw driver set insulated handle with following blade sizes a. 2.5 x 10 mm b. 3.0 x 80 mm c. 4.0 x 120 mm d. 5.0 x 160 mm e. 5.0 x 200 mm	10	2500
8.	Combination plier 205 mm length with thick plastic insulated handle	12	2500
9.	Long nose plier 150 mm length, insulated for 500 V	12	2000
10.	Diagonal plier 150 mm length insulated for 500 V suitable for cutting hard wires	12	2000
11.	Adjustable wrench 205 mm chromium plated adjustable wrench lengths from 25 mm to 30 mm	12	2000
12.	Flat nose plier plastic insulated handles length 130 mm	6	1000

13.	Ball pean hammer wooden handle wts. 500 gms.	12	1200
14.	Adjustable hacksaw frame tubular steel frame, adjustable for hacksaw blade from 250 - 300 mm with set of 10 spare blades	8	1600
15.	Hand drill machine two speed with self centering chuck for straight shank drills upto 10 mm.	2	400
16.	Bench vice jaw width 100 ,, jaw opening 120 mm, jaw depth 75 mm.	2	4000
17.	Wire gauage to measure gauages of wires in MKS system	2	200
18.	Measuring tape pocket measuring tape of steel spring return device. flexible graduated in metric readings, 2 meter long.	6	600
19.	File set hand files with plastic handle 200/350 mm long a. Flat smooth cut b. Flat second cut c. Half round d. Half round second cut e. Round smooth cut f. Triangular file 200 mm	1	1000
20.	Screw driver mains voltage tester suitable upto 400 V overall length 180 mm.	2	200
21.	Cable kinfe plastic handle 50 mm overall length 180 mm.	6	300
22.	Rubber mallet wooden handle with wt. 200 gms	6	1000
23.	Hand saw hand saw 10" size 10 teeth per inch with teak wood handle	6	1000
24.	Bench steel construction with wooden bench top not less than 50 mm thick with two steel drawers both lockable. Approx size 1200 x 600 x 850 mm	2	6000
25.	Electrical fittings	L.S./yr.10000	
26.	MCB 6A, 16A, 32A,250V	150 Each	
27.	Earth Line Circuit Braker (ELCB) 15 A.	300	

ELECTRICAL MACHINE LAB

1.	Laboratory D.C. power supply (220 V) static converter input from 3 phase 50 Hz, 415 volts A.C., output rating of 200-260 V, 50 amps, continuously varibale.	1	30,000
2.	Diesel generator set 3 phase, 415 volts, 15 kva, 50 Hz, diesel generator set, with suitable control pannel, for a stabilized supply including metering for voltage, current frequency, fuel level storage fuel tank of 200 litre capacity 12/24 volt battery for starting the engine, battery charger mounted on trolley wheels. (Silent Type)	1	35,00,00
3.	D.C. motor generator set two identical 220 V, 1 KW 1500 rpm. compound d.c. machines with all terminals of armature, series field, shunt field separately mounted for independent connections. D.C. motor starter, field control rheostat suitable for above machines. brushes, commutator should he vissible for study purposes.	1	15,000
4.	D.C. shunt motor 220 V, 3 KW, 1500 rpm dc shunt motor with 3 point starter and ponybrake loading arrangement with loading drum, spring balance with belt.	1	10,000
5.	D.C. series motor 220 V, 3 KW, 1450 rpm dc series motor with drum controller starter and pony brake loading arrangement with loading drum spring balance with belt.	1	10,000
6.	Compound motor 220 V, 3 KW, dc 1500 rpm compound motor with 4 point starter and pony brake loading arrangement with loading drum, spring balance with belt.	1	10,000
7.	Single phase transformer 1 KVA, 50 Hz, Pr 230 V with a tapping at 50% and 86.6% secondary - 230 V with tappings at 50% and 86.6%	1	5000
8.	3 Phase variable inductive loading unit rating 400 V, 50 Hz, 0-10 Amps.	1	8000

9.	3 Phase variable capacitive loading unit: rating 400V, 50 Hz, 0-10 Amps.	1	5000
10.	3 Phase squirrel cage induction motor rating 415 V, 50 Hz, 1440 rpm 3 KW with star/Delta starter, Automatic Y/D, Starter & with Single Phase Preventor	1	1,2000
11.	Starters for squirrel cage induction motor suitable for 3KW, 415V, 50 HZ, 1440 rpm		
	a. Star/delta automatic	1	5000
	b. Star/delta manual	1	3000
12.	Starter for squirrel cage induction motor 3KW, 415 V, 50 Hz, 1440 rpm direct on line	1	3000
13.	Starter for slip ring induction motor 3 KW, 415 V, 50 HZ, 1440 rpm auto transformer starter with automatic protection for over loading and single phasing with roter resistance Starter	1	5000
14.	Static speed control unit for 3 phase induction motor 3 KW, 425, 0-1500 rpm.	1	5000
15.	3 Phase alternator coupled to d.c. compound motor 3 phase 415 V, 50 Hz, 1500 rpm, 3 KVA star connected alternator, field excitation 110 V dc with field regulator prime mover d.c. compound wound motor, 220 V, 3.5 KW, 1500 rpm with starter and shunt field regulator	2	50,000
16.	3 Phase synchronous motor (induction start) rating 3 KW, 3 phase, 1500 rpm, 50 Hz 415 v A.C. supply with d.c. exciter mounted on the shaft of motor with suitable starter.	1	15,000
17.	Capacitor start single phase induction motor 230 V, 50 Hz 1440 rpm, 500 watts.	1	2500
18.	Repulsion induction motor 230 V, 50 Hz, 1440 rpm, 500 W	1	2500
19.	Universal motor 230 V, 50 Hz, 1440 rpm, 500 w.	1	2500
20.	Shaded pole induction motor 230 V, 50 Hz, 1440 rpm, 500 W	1	2000
21.	Analog multimeter moving coil, input impedance 1 M ohm per volt, frequency 40-400 Hz, d.c. voltage 30 mv - 1000 V a.c. voltage 100 mv - 1000 V, ac and dc	1	1000

	current 10mA - 10 A resistance 0 - 10 M Ohms with power supply battery and connecting leads.		
22.	Clipon ammeter/voltmeter measuring ranges current 0 - 12 - 50 A voltage 0 - 500 V	2	4000
23.	Clipon watt meter for measurement of active and reactive power with ranges current 10/30 A voltage 30/150/1500 V power 1 Kw	1	3000
24.	Clip on power factor meter measuring ranges capacitive 0.5 - 1.0 inductive 0.5 - 1.0 rated voltage 100/200/400 V rated current 5 A - 25 A	1	3000
25.	Moving iron ammeter-portable scale length 150 mm range		
	a. 0 - 2.5 - 5 A	2	2000
	b. 0 - 5 - 10 A	2	2000
	c. 0 - 10 - 20 A	2	2000
26.	Moving coil ammeter portable scale length 150 mm range		
	0 - 1 - 2 A	2	2000
	0 - 2.5 - 5 A	2	2000
	0 - 5 - 10 A	2	2000
	0 - 10 - 20 A	2	2000
27.	Moving iron volt meter portable		
	a. 0 - 10 V	1	1000
	b. 0 - 15 V - 30 V	1	1000
	c. 0 - 75 V - 150 V	1	1000
	d. 0 - 150 - 300 V	2	2000
	e. 0 - 300 - 600 V	2	2000
28.	D.C. moving coil voltmeter - portable		
	a. 0 - 5 - 10 V	1	1000
	b. 0 - 15 -30 V	1	1000
	c. 0 - 75 -150V	1	1000
	d. 0 - 150-300V	2	2000
	e. 0 - 300-600V	2	2000
29.	Wattmeter single phase dynamometer type portable suitable for 45-55 Hz range		
	a. 75/300/600 V 2.5/5 A	2	5000
	b. 75/150/300 V 5.0/10 A	2	5000
	c. 150/300/600 V 15/30 A	2	5000
	d. 0 -150 - 300 V 0 - 2.5/5 A	2	4000
30.	Watt meter 3 phase induction type 2 element voltage range 0/300/600 V current range 0/5/10 A	2	2000

31.	Frequency meter - portable (pointer type) 45-55 Hz	2	2000
32.	Frequency meter - portable (Reed type) 45-55 Hz with 21 reeds	2	2000
33.	Frequency meter digital portable 3.5 digit LED display range 20-99 Hz	2	2000
34.	Phase sequence indicator (Rotary) 3 phase, 415 V, 50 Hz	2	1000
35.	Phase sequence indicator (Indicating type) 3 phase, 400 V, 50 Hz	2	1000
36.	Galvanometer centre zero response time 1.8 sec.	2	1000
37.	Power factor meter - single phase low current portable 0.5 capacitive to 0.5 inductive current - 20 amps voltage - 250 V frequency - 50 Hz	2	2000
38.	P.F. meter - single phase portable range 0.1 capacitive to 0.1 inductive current 2.5 amps voltage 230 V frequency 50 Hz	2	2000
39.	Power factor meter 3 phase range 0.5 capacitive to 0.5 inductive current - 10 amps, Voltage 414 V, 50 Hz	2	2000
40.	VAR meter 1/5 A, 300/600 V	2	2000
41.	Synchroscope - portable 230 V, 50 Hz	2	3000
42.	Loading rheostat single phase a. 240 V, 2.5 KW, trolley type resistance type b. 240 V, 6 KW insteps of 0.25	2 2	3000 3000
43.	Lamp load 3 phase 415 V, 6 KW	2	2000
44.	Water load 3 phase 415 V, 5 KW	2	2000
45.	Variable inductive load 415 V, 0-10 A, 50 Hz	2	5000
46.	Capacitor bank 415 V, 0-10 A, 50 Hz trolley mounted	2	4000
47.	Wire wound rheostats 15 ohms, 10 A 100 ohms, 5 A	3 3	1200 1200

	250 ohms, 5 A	3	1200
	1000 ohms, 0.5 A	3	1200
	2500 ohms, 0.1 A	3	1200
48.	Stop watch least count 0.01 Sec.	3	2000
49.	Stop watch (digital) LED	3	2000
50.	Single Phase Induction Motor 1/2 HP,230V 50 Cyl., 1400 RPM	3	3000
51.	3 Phase Slip ring type induction motor (Wound Rotor Type), 440V, 50 C/S,5 HP with manually operated variable rotor resistance starter,suitable star connector variable resister	1 set	20000
52.	Break drum loading arrangement suitable for 5 HP motor with spring balance, belt fitted on iron frame, etc, complete with pannel board consisting amp. meter(MI) 10A, Voltmeter(MI) 600V and suitable TPICNL switch .	1	10000

INSTALLATION, MAINTENANCE & REPAIR OF ELECTRICAL MACHINES LAB

1.	Earth tester (Portable) 500 V, 0 - 10 - 100 ohms, complete with all assessaries, (hammer, screw driver, 3 spikes) housed in a teak wood/abonite case	2 Each	20000
2.	Transformer oil testing kit	1	20,000
3.	Coil winding machine (Automatic) bench mounted, power driven with clutch and brake, electro- magnetic traverse clutch system. Max. winding speed 250 to 5500 rpm.	1	50,000
4.	Portable drilling machine drilling 10 mm, no load speed 700 rpm, 435 W, 230 V, 50 Hz.	1	5000
5.	Multimeter ac/dc 0 to 600 V ac 50 mA to 10 A dc 10 mA to 10 A ohm meter 2 ohm - 20 K ohm	2	2400
6.	Megger having hand driven generator 500 V, resistance 0 - 100 M ohms.	1	1500
7.	Ceiling fan 230 V, 1 phase, 50 Hz.	1	1600
8.	Table fan 230 V, 1 phase, 50 Hz	1	2000
9.	Exhaust fan 375 mm sweep, 230 V, 50 Hz	1	4000
10.	Desert cooler 375 mm sweep, 1400 rpm, 1/4 HP 230 V, 50 Hz.	1	6000
11.	Electric kettle 750 W, 230 V, 50 Hz	1	1500
12.	Electric iron (Automatic) 500 W, 230 V, 50 Hz	1	500
13.	Electric toaster 500 W, 230 V, 50 Hz. (Automatic)	1	2000
14.	Geyser (Automatic) 10 Lit. capacity, 2 Kw, 230 V, 50 Hz	1	5000
15.	Immersion rod 1000 W, 230 V, 50 Hz.	1	300
16.	Room heater 1000 W, 230 V, 50 Hz.	1	2500
17.	Room heater (rod type)	1	1500
18.	Air convector 2000 W, 230 V, 50 Hz	1	1000

19.	Mixer cum grinder 250 W, 230 V, 50 Hz	1	3000
20.	Hot plate 1500/2000 W. 230 V, 50 Hz	1	1500
21.	Electric oven 2 KW, 230 V, 50 Hz	1	8000
22.	Washing machine (8 Kg) 230 V, 50 Hz, 20 Lit. capacity (For Demonstration Purpose)	1	10000
23.	Electric shaver 40-60 W, 230 V, 50 Hz	1	1500
24.	Electric lighter	1	100
25.	Armature growler	1	2000
26.	Electric blower	1	1000
27.	Miniature circuit breaker	1	500
28.	Emergency light 55 cm long with 6 V battery	1	2500
29.	Voltage stabilizers 500 VA, input 172/260 V output 210/240 V automatic	1	4000
30.	Screw driver set	6	1200
31.	Combination plier	6	2400
32.	Long nose plier	6	2400
33.	Adjustable wrench	3	900
34.	Flat nose plier	3	900
35.	Slip nose plier	3	900
36.	Round nose plier	3	900
37.	Ball pean hammer wt. 250 gms 500 gms 800 gms	3 3 3	50 50 50
38.	Spring holding screw driver set 4 x 50 mm 4 x 75 mm 4 x 100mm	2 2 2	50 50 50
39.	Hand drill machine	1	1000
40.	Bench vice with 100 mm jaw opening	2	1600
41.	Bearing Puller 100/200 mm.	2	200
42.	Files set a. Flat smooth cut	1	1000

	b. Flat second cut		
	c. Half round		
	d. Half round smooth cut		
	e. Round second cut		
	f. Round smooth cut		
	g. Square second cut		
	h. Square smooth cut		
	i. Triangular cut		
43.	Screw driver mains voltage tester	2	200
44.	Cable knife	6	600
45.	Soldering gun kit	1	200
46.	Rubber mallet	3	450
47.	Letter stamp set	1	200
48.	Box spanner set	1	800
49.	Open ended spanner set	1	800
50.	Blow lamp	1	400
51.	Wrench set	1	400
52.	Pipe wrench	1	500
53.	Battery charging equipment	1	2000
54.	Oil circuit breaker system voltage 33 KV highest system voltage 36 KV interrupting capacity 500 KVA operating duty 0-3 min. breaking time 5 cycles continuous current rating 400 A.	1	10,000
55.	Air circuit breaker rating 600 A, 660 V, 50 Hz breaking capacity 35 KA, 40 KA		
56.	Differential relay 5 A, 50 Hz	1	12,000
57.	Buchholz relay	1	3000
58.	Cable testing and fault finding kit	1	20,000
59.	Cable joints and termination Kit	1	10000
60.	Distance relay	1	5000

ELECTRONICS LAB

(Electronics I, Electronics II & Industrial Electronics & Control,
Industrial control, Microprocessor Development System Lab)

1.	Audio oscillator	2	4000
2.	Multimeter (Analog)	2	2000
3.	Multimeter (Digital)	4	12000
4.	Regulated power supply 0-30V, .5/1A	4	8000
5.	Dual power supply 0-30V,1A	2	5000
6.	Power supply 0-300 V	2	4000
7.	C.R.O. (0-10 MHz)	2	20000
8.	Dual trace C.R.O.(0-10 MHz)	1	15000
9.	R.F. signal generator	1	5000
10.	A.C. milli voltmeter	2	4000
11.	Output audio power meter	1	1500
12.	A.C. milli ammeter/ A.C. micrometer & A.C. millivoltmeter (suitable range)	4	800
13.	D.C. voltmeter/milliammeter/micrometer (suitable range)	10	2000
14.	Decade resistance box	2	1200
15.	Component storage rack	5	25000
16.	Consumable items	L.S.	20000
17.	Miscellaneous	L.S.	20000
18.	Logic probe	8	2400
20.	Logic board/trainer including bread board & flexible leads	2	7000
21.	Microprocessor trainer kit with 8085 & 8086 systems	1	20000
22.	Semiconductor data book	1	-
23.	Half wave & full wave rectifier kit	2	1000
24.	Bread board	10	1000
25.	Digital trainer kit	1	2500
26.	8085 Microprocessor kits with interfaces for- i) Stepper motor & Associated Supply ii) A/D & D/A iii) Digital I/O iv) With temperature Sensor v) With strain gauge Sensor	2	600
27.	ICs TTL,CMOS,Microprocessor & support chips	L.S.	10000
28.	Tool set	10	6000
29.	A.F. generator	1	3000
30.	Microcontroller 8051 trainer kit	1	8000
31.	D. C. Servomotor	1	1000
32.	Synchrosystem (pair)	1	5000

NOTE

- Item no. 26 (iv) & (v) and Item 30 are required only for Microprocessor Development System lab only.
- Item no. 31 and 32 are required for Industrial Electronics and Control lab & Industrial Control-I lab.

ELECTRICAL AND ELECTRONICS INSTRUMENTATION LAB

NOTE: Electrical and Electronic Instrumentation lab requires equipments and its erection, installation & maintenance which is costly hence it is suggested that practicals should be shown in the nearest process industry or educational institute having instrumentation & process control lab interaction and real life experience.

ELEMENTARY MECHANICAL & CIVIL ENGG LAB

1.	Diesel engine 5HP single cylinder,4 stroke,horizontal	1	10000
2.	Petrol engine 150cc single cylinder,2 stroke	1	10000
3.	Hand tachometer	2	1000
4.	Stop watch	2	1000
5.	Screw jack	1	500
6.	Apparatus for verification of Bernoullies theorem	1	8000
7.	Apparatus for determining friction loss in pipes and fittings	1	10000
8.	Cut section models of Pelton & Francis turbines.	1	30000
9.	Tensile testing machine	1	10000
10.	Motor generator set	1	30000
11.	Measuring chain 30m long IS 492	2	200
12.	Measuring chain 20m long IS 492	1	150
13.	Steel arrows	20	200
14.	Metallic tape 30/20m long	5	500
15.	Ranging rod of NS conduit	15	750
16.	Optical square	2	200
18.	Cross staff	2	200
19.	Line ranger	2	150
20.	Prismatic compass 100mm	1	500
21.	I.O.P. level 230mm with stand and other accessories	2	3000
22.	Dumpy level 350mm with stand	2	2000
23.	Levelling staves 4m		
	a.Telescopic	1	250
	b.Folding	1	250
	c.Single length	4	600
24.	Miscellaneous for pegs,mallet steel bend etc.	L.S.	2000

INDUSTRIAL CONTROL LAB
(For Electrical Engg. (Industrial Control))

1.	D.C. Shunt Generator 1 KW, 220 V Coupled with 3 Phase Induction Motor of identical power	1 Set	5000
2.	D.C. Shunt Motor 1 KW, 220 V	1	3000
3.	Fully Controlled/Half Controlled Thyristor rectifier 600 V, 10A	1	1000
4	Thyristor Chopper 10A,600 V with T-on Control	1	1000
5.	Cyclo Converter for 3:1 Frequency Conversion 600 V, 10A	1	1200
6.	SCR/Triac phase Controller, 600 V, 5A	1	100
7.	Star/Delta Starter,3 phase, 400 V, 5A	1	800
8.	Auto Transformer Starter, 3 phase 400 V, 10A	1	2000

7. LEARNING RESOURCE MATERIALS

1.	LCD Projector with Screen	1	--	20000
2.	Handicam	1	--	30000
3.	Cutting, Binding & Stitching equipment.	1	--	30000
4.	Desk Top Computer with Internet Core i5/i7- 760, Processor, Genuine Windiw 7, Professional 18 inch HD, Flat Panel Monitor Optical Mouse, Key Board & all related media or latest version	1	--	40000
5.	Home Theater Support Disc type CD. CDR/CDRW DVDR/DVDRW, VCD Supported with USB Port Support-DIVX/JPEG/MP3	1	--	25000
6.	Commerical P A System 16 W-220W output, AC & 24V DC Operated, 5 Mic. & 2 Auxilary input, Speaker output 4 Ohm, 8 Ohm, 17 V & 100 V	1	--	20000
7.	Interactive Board	1	--	50000

ote :

1. This center will be only one at the institute level irrespective of all branches.

ANNEXURE - I

FIELD EXPOSURE

The second year students after annual exam. will have a four week hands on Industrial Training in any industrial unit engaged in manufacturing electrical machines/Electrical goods/Production and distribution of Electricity. They will work and focus their attention there on following points to incorporate them in their reports.

1. Name and Address of the unit

2. Date of

- i. joining.
- ii. Leaving

3. Nature of Industry

- i. Product.
- ii. Services
- iii. Working Hrs.

4. Sections of the unit visited and activities there in.

5. Details of machines/Tools & instruments used in working in the section of the unit visited.

Work procedure in the section visited.

Specification of the product of the section and materials used.

Control of work & Quality.
Inspection procedures packing storing and dispatching of products.

Use of computer - if any
Visit of units store, Manner of keeping store items, Their receiving and distribution.
Safety measures on work place & working conditions in general comfortable, convenient and hygienic.
Pollution, professional diseases and hazards if any.
Precautionary measures.

RECOMMENDED BOOKS

List of standard Text Books recommended for diploma level institutions of Uttar Pradesh

1. DISCIPLINE : APPLIED PHYSICS

S1.No.	TEXT BOOK	AUTHOR	MEDIUM	EDITION YR	COST	FULL ADDRESS OF PUBLICATION
1.	ANUPRAYUKT BHAUTKI	GUPTA & GUPTA	HINDI	1995	75.00	ASIAN PUBLISHERS, 85-C NAI MANDI, MUZAFFAR NAGAR
2.	ENGINEERING BHAUTKI	Dr. BHARGAVA	HINDI	1995	60.00	DHANPAT RAI & SONS
3.	ANUPRAYUKT BHAUTKI	KUMAR & TYAGI	HINDI	1995	75.00	NAV BHARAT PRAKASHAN, BEGUM BRIDGE ROAD, MEERUT
4.	ANUPRAYUKT BHAUTKI	Dr. R.C.PANDEY	HINDI	1994	75.00	NAV BHARAT PRAKASHAN, BEGUM BRIDGE ROAD, MEERUT
5.	APPLIED PHYSICS-I (Vol - I)	Dr. H.H.LAL	ENGLISH	1993	45.00	TATA McGRAW HILL
6.	APPLIED PHYSICS-II(Vol - II)	Dr. H.H.LAL	ENGLISH	1993	54.00	TATA McGRAW HILL
7.	MODERN COLLEGE PHYSICS	WHITE	ENGLISH	1995	110.00	C. B. S.
8.	PHYSICS Vol - I & II	HOLLIDAY AND RESNIC	ENGLISH	1993	100.00	WILEY EASTERN

1. DISCIPLINE : APPLIED MATHEMATICS

S1.No.	TEXT BOOK	AUTHOR	MEDIUM	EDITION YR	COST	FULL ADDRESS OF PUBLICATION
1.	APPLIED MATHEMATICS (Math-I & Math-II)	KAPOOR & TARAMAN	HINDI	1994	75.00	NAV BHARAT PRAKASHAN, MEERUT
2.	APPLIED MATHEMATICS (Math-I & Math-II)	Dr KAILASH SINHA	HINDI	1994	60.00	BHARAT BHARATI PRAKASHAN, MEERUT
3.	APPLIED MATHEMATICS (I & II)	LUTHERA	HINDI	1994	65.00	B. Tec. PRAKASHAN, LUCKNOW
4.	APPLIED MATHEMATICS (I & II)	P. GUPTA	HINDI	1994	65.00	ASIAN PUBLISHERS, MUZAFFAR NAGAR
5.	ADVANCE Engg. MATHS	H. K. DAS	ENGLISH	1994	125.00	S. CHAND & CO., RAM NAGAR NEW DELHI

1. DISCIPLINE : COMMUNICATION TECHNIQUES

S1.No.	TEXT BOOK	AUTHOR	MEDIUM	EDITION YR	COST	FULL ADDRESS OF PUBLICATION
1.	ENGLISH FOR COMMUNICATION	V. SHASHIKUMAR M. N. K. BOSE	ENGLISH	1987	21.00	I. R. D. T. U. P., KANPUR
2.	SAMPRESHAN TAKNIK	Prof. R. PAL Dr. Smt NEERAJ SHUKLA Dr. SUBHASH GARG	HINDI	1989	15.00	I. R. D. T. U. P., KANPUR

1. DISCIPLINE : APPLIED CHEMISTRY

S1.No.	TEXT BOOK	AUTHOR	MEDIUM	EDITION YR	COST	FULL ADDRESS OF PUBLICATION
1.	ANUPRAYUKT RASAYAN	KHANNA & KHANNA & BOUNTRA	HINDI	1994	60.00	BHARAT BAARTI PRAKASHAN, MEERUT
2.	PRAYUKT RASAYAN	MAHENDRA AND SRIVASTAVA	HINDI	1994	58.00	B.TECH. PUBLISHERS, AMMINABAD LUCKNOW
3.	PRAYUKT RASAYAN SHASTRA	S. CHANDRA	HINDI	1994	60.00	NAV BHARAT PRAKASHAN, BEGUM BRIDGE ROAD, MEERUT
4.	APPLIED CHEMISTRY	V. P. MEHITA	HINDI	1993	60.00	ASIAN PUBLISHERS, 85-C NAI MANDI, MUZAFFAR NAGAR
5.	ENGINEERING RASAYAN	Dr. LALIT	HINDI	1994	45.00	DHANPAT RAI & SONS, 1682 NAI SARAK, DELHI
6.	ENGINEERING CHEMISTRY	P. C. JAIN	ENGLISH	1994	100.00	DHANPAT RAI & SONS, 1682 NAI SARAK, DELHI

1. DISCIPLINE : ELECTRICAL ENGINEERING

S1.No.	TEXT BOOK	AUTHOR	MEDIUM	EDITION YR	COST	FULL ADDRESS OF PUBLICATION
1.	BASIC ELECTRICAL ENGINEERING VOLUME-1 VOLUME-2	P. S. DHOGAL P. S. DHOGAL	ENGLISH ENGLISH	1994 1994	70.00 70.00	TATA MCGRAW HILL PUBLISHING TATA MCGRAW HILL PUBLISHING
2.	VEDUATE ENGINEERING -I VEDUATE ENGINEERING -II	U. B. SINGH U. B. SINGH	HINDI HINDI	1993-94 1993-94	65.00 70.00	B. TECH. PUBLISHERS B. TECH. PUBLISHERS
3.	ELECT. ENGG. DESIGN DRAWING AND ESTIMATING	K. B. RAINA & S. K. BHATTA- CHARYA	ENGLISH	1991	55.00	WILLEY EASTERN
4.	ELECTRICAL TECHNOLOGY	B. L. THERAJA	ENGLISH	1990	150.00	S. CHAND & CO. N. DELHI
5.	ELECTRICAL ENGG. DRAWING DESIGN & ESTIMATING	JAGGI & PAL & LAL	HINDI	1994	85.00	NAV BHARAT PRAKASHAN MEERUT
6.	ELECTRICAL MACHINES	S. K. BHATTA- CHARYA	ENGLISH	1990	45.00	T. M. H. NEW DELHI
7.	A COURSE IN ELECTRICAL & ELECTRONICS MEASUREMENTS & INSTRUMENTATION	A. K. SAHNEY	ENGLISH		155.00	DHANPAT RAI & SONS
8.	ELECTRICAL INSTRUMENTS	T. D. BISHIT	HINDI	1994-95	60.00	ASIAN PB MUZZAFFAR NAGAR
9.	ELECTRICAL ENGINEERING MATERIAL	K. B. RAINA & S. K. BHATTACH- ARYA & T. JUNEJA	HINDI	1992	35.00	S. K. KATARIA & SONS
10.	GENERATION, DISTRIBUTION AND UTILISATION OF ELECT. ENERGY	C. L. WADHWA	ENGLISH	1990	65.00	WILEY EASTERN
11.	ELECT. ENGG. DESIGN DRAWING & ESTIMATING	T. D. BISHT	HINDI	LATEST	125.00	ASIAN PUB. MUZZAFFAR NAGAR
12.	GENERATION & UTILISATION OF ELECTRICAL POWER	Dr. M. H. RAI	HINDI	LATEST	125.00	DEEPAK PRAKASHAN KHULA SANTAN MORAR (M.P.)
13.	INDUSTRIAL ELECTRONICS	D. C. GUPTA	HINDI	LATEST	150.00	-DO-
14.	INSTRUMENTATION	KIRK & RIM RAI	ENGLISH	LATEST	120.00	D. B. TARAPOREBALA
15.	AUTOMATIC PROCESS CONTROL	D. ECKMEN	ENGLISH	LATEST	50.00	WILLEY-EASTERN
16.	INDUSTRIAL INSTRUMENTATION	D. ECKMEN	ENGLISH	LATEST		WILLEY EASTERN
17.	UTILIZATION OF ELECTRICAL ENERGY	SHRMA. K. NATH	HINDI	LATEST	70.00	NAV BHARAT PRAKASHAN MERUTT
18.	POWER PLANT ENERGY	B. L. HARZAI S. R. SINGH	HINDI	LATEST	60.00	B. TECH PUBLISHERS LUCKNOW -226018
19.	INSTALLATION, MAINTENANCE & TESTING OF ELECT. ENGG EQUIPMENT	BASANT KUMAR	HINDI	LATEST	80.00	NAV BHARAT PRAKASHAN MERUTT
20.	TRANSMISSION & DISTRIBUTION	K. B. RAINA	ENGLISH	LATEST	40.00	TATA Mc GRAWHILL NEW DELHI
21.	ELECTRICAL MACHINERY FUNDAMENTAL	S. J. CHAPMAN	ENGLISH	LATEST	80.00	-DO--
22.	ELECTRICAL ENGINEERING DRAWING DESIGN & ESTIMATING	S.K.BHATTACHA- RYA	ENGLISH	LATEST	70.00	WILEY EASTERN Ltd. NEW DELHI
23.	NON-CONVENTIONAL SOURCE OF ENERGY & APPROPRIATE TECHNOLOGY	AGRAWAL & BHATNAGAR	HINDI	LATEST	70.00	NAV BHARAT PRAKASHAN MERUTT
24.	ELECTRICAL POWER SYSTEM	C. L. WADHWA	ENGLISH	LATEST	100.00	WILEY EASTERN Ltd. NEW DELHI
25.	ELECTRICAL TECHNOLOGY -I	E. HUGES	ENGLISH	LATEST	55.00	8-2 PUBLICATION PVT. 13, DARYAGANG NEW DLHI
26.	ELECTRICAL TECHNOLOGY -II	E. HUGES	ENGLISH	LATEST	90.00	-DO-
27.	POWER ELECTRONICS	HARISH C. RAI	ENGLISH	LATEST	100.00	DHANPAT RAI & SONS
28.	SWITCH GEAR & PROTECTION	S. S. RAO	ENGLISH	LATEST	100.00	-DO---
29.	SWITCH GEAR & PROTECTION	M. V. DESH PANDEY	ENGLISH	LATEST	78.00	TATA Mc GRAW HILL
30.	POWER SYSTEM PROTECTION & SWITCHGEAR	B. RAVINDRANATH	ENGLISH	LATEST	35.00	WILLEY EASTERN Ltd.
31.	BASIC ELECTRICAL ENGINEERING	V. K. MEHTA	ENGLISH	LATEST	35.00	S. CHAND & COMPANY
32.	ELECTRICAL DESIGN & DRAWING	SURJEET SINGH	ENGLISH	LATEST	30.00	S.K.KATARIA & SONS NEW DELHI
33.	ELECTRICAL ENGINEERING DRAWING	S. K. BHATTAC- HARYA	ENGLISH	LATEST	99.00	WILLEY EASTERN Ltd.
34.	HAND BOOK OF ELECT MOTOR CONTROL SYSTEM	ESHWAR	ENGLISH	LATEST	99.00	TATA Mc GRAWHILL
35.	HAND BOOK OF ELECTRICITY	S. V. BHATIA	ENGLISH	LATEST	21.00	KHANNA PUBLISHERS

Sl.No.	TEXT BOOK	AUTHOR	MEDIUM	EDITION YR	COST	FULL ADDRESS OF PUBLICATION
36.	ELECTRICAL ENGG. DESIGN & DRAWING	O. P. SONI	ENGLISH	LATEST	65.00	SATYA PRAKASHAN DELHI
37.	A COURSE IN ELECTRICAL MACHINES DESIGN	A. K. SAWHNEY	ENGLISH	LATEST	70.00	RAM NAGAR NEW DELHI DHANPAT RAI & SONS
38.	TESTING, COMMISSIONING OPERATION & MAINTENANCE OF ELECTRICAL & EQUIPMENT	S. S. RAO	ENGLISH	1987	70.00	KHANNA TECH. PUB. DELHI
39.	A TEXT BOOK OF LABORATORY COURSES IN ELECT ENGG.	KHARBANDA	ENGLISH	1990	50.00	S. CHAND & CO. DELHI
40.	A COURSE IN GENERAL ELECTRICAL DESIGN & DRAWING	SURJEET SINGH	ENGLISH	LATEST	85.00	KATSON PUBLISHING HOUSE NEW DELHI
41.	ELEMENTS OF ELECTRICAL POWER STATE ON DESIGN	M. V. DESH PANDEY	ENGLISH	LATEST	52.00	RAM NAGAR NEW DELHI A.H. WHEELERS & CO. ALLAHABAD
42.	GENERAL ELECTRICAL DRAWING	SURJEET SINGH	ENGLISH	LATEST	80.00	S. K. KATARIA & SONS LUDHIYANA
43.	ELECTRICAL ENGG. & BASIC TECHNOLOGY	HUBSCHIR KLANE	ENGLISH	LATEST	25.00	WILEY EASTERN Ltd. N. DELHI
44.	A TEXT BOOK OF ELECTRICAL M/C	P. C. ARORA	ENGLISH	LATEST	25.00	B. D. KATARIA & SONS LUDHIYANA
45.	THYRESISTOR & THEIR APPLICATION	M. RAMAMURTI	ENGLISH	LATEST	60.00	TATA Mc GRAW HILL
46.	POWER ELECTRONICS LABORATION SWITCHGEAR	O. P. ARORA	ENGLISH	1993-94	70.00	A. H. WHEELERS PVT. Ltd. ALLAHABAD, NEW DELHI
47.	RENEWABLE SOURCES OF ENERGY	BANSAL	ENGLISH			
1.	VEDUATE ENGINEERING -I	U. B. SINGH	HINDI	1993-94	65.00	B. TECH. PUBLISHERS
	VEDUATE ENGINEERING -II	U. B. SINGH	HINDI	1993-94	70.00	B. TECH. PUBLISHERS
2.	ELECTRICAL ENGG. DRAWING DESIGN & ESTIMATING	JAGGI & PAL & LAL	HINDI	1994	85.00	NAV BHARAT PRAKASHAN MEERUT
3.	ELECTRICAL INSTRUMENTS	T. D. BISHIT	HINDI	1994-95	60.00	ASIAN PB MUZZAFFAR NAGAR
4.	ELECTRICAL ENGINEERING MATERIAL	K. B. RAINA & S. K. BHATTACH- ARYA & T.JUNEJA	HINDI	1992	35.00	S. K. KATARIA & SONS
5.	ELECT. ENGG. DESIGN DRAWING & ESTIMATING	T. D. BISHT	HINDI	LATEST	125.00	ASIAN PUB. MUZZAFFAR NAGAR
6.	GENERATION & UTILISATION OF ELECTRICAL POWER	Dr. M. H. RAI	HINDI	LATEST	125.00	DEEPAK PRAKASHAN KHULA SANTAN MORAR (M.P.)
7.	INDUSTRIAL ELECTRONICS	D. C. GUPTA	HINDI	LATEST	150.00	-DO-
8.	UTILIZATION OF ELECTRICAL ENERGY	SHRMA. K. NATH	HINDI	LATEST	70.00	NAV BHARAT PRAKASHAN MERUTT
9.	POWER PLANT ENERGY	B. L. HARZAI S. R. SINGH	HINDI	LATEST	60.00	B. TECH PUBLISHERS LUCKNOW -226018
10.	INSTALLATION, MAINTENANCE & TESTING OF ELECT. ENGG EQUIPMENT	BASANT KUMAR	HINDI	LATEST	80.00	NAV BHARAT PRAKASHAN MERUTT
11.	NON-CONVENTIONAL SOURCE OF ENERGY & APPROPRIATE TECHNOLOGY	AGRAWAL & BHATNAGAR	HINDI	LATEST	70.00	NAV BHARAT PRAKASHAN MERUTT
1.	SOLAR ENERGY	DUFFIE & BACKMANN	ENGLISH			
2.	PRINCIPLES OF SOLAR ENERGY	FRANK KREITH & JAN F. KREIDER	ENGLISH			
3.	SOLAR ENERGY	MEINELL & MEINELL	ENGLISH			
4.	SOLAR ENERGY THEORY AND DESIGN OF SOLAR THERMAL SYSTEMS	W.S. WILLIAMS ET.AL.	ENGLISH			
5.	RENEWABLE ENERGY RESOURCES	TWIDELL & WEIR	ENGLISH			
6.	RENEWABLE ENERGY POWER FOR A SUSTAINABLE FUTURE	GODPEY BOYLE	ENGLISH			

S1.No.	REFERENCE BOOKS	AUTHOR	MEDIUM	EDITION YR	COST	FULL ADDRESS OF PUBLICATION
7.	NON-CONVENTIONAL ENERGY SOURCES	RAI G. D.	ENGLISH			
8.	SOLAR ENERGY	SUKHATME	ENGLISH			
9.	ENERGY FROM BIOMASS	DAVID HOFF	ENGLISH			
10.	ENERGY FROM BIOMASS	PALZ	ENGLISH			
11.	DIRECT ENERGY CONVERSION	STANLEY W. ANGRIST	ENGLISH			
12.	A GUIDE TO SMALL WIND ENERGY CONVERSION SYSTEMS	JOHN TWIDELL	ENGLISH			
13.	SOLAR ENERGY UTILISATION	ROY G. D.	ENGLISH			
14.	WATER POWER ENGINEERING CONVERSION SYSTEMS	BARROWS	ENGLISH			
15.	HAND BOOK ON SOLAR ENERGY	DR. ANNAMANI	ENGLISH			