STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA									
TEACHING AND EVALUATION SCHEME FOR 7th Semester (Electrical)(PT)(wef 2021-22)									
Subject Number	Subject Code	Subject	Periods/week			Evaluation Scheme			
			L	T	P	Internal Assessment/ Sessional	End Sem Exams	Exams (Hours)	Total
		Theory							
Th.1		Electrical Installation And Estimating	4	1	-	20	80	3	100
Th.2		Switch Gear And Protective Devices	4	1	-	20	80	3	100
		Total	*8*	*02*		*40*	*160*	-	*200*
		Practical							
Pr.1		Power Electronics & PLC Lab	-	-	5	75	100	3	175
Pr.2		Digital Electronics & Microprocessor Lab	-	-	5	50	100	3	150
P.3		Technical Seminar			2	50			50
Pr.4		Project Phase– I			5	50	-	-	50
		Student Centred Activities(SCA)		-	3	-	-	-	-
		Total	*-*	*-*	*20*	*225*	*200*	-	*425*
		Grand Total	**8**	**02**	**20**	**205**	**545**	**-**	**625**
Abbreviations: L-Lecturer, T-Tutorial, P-Practical . Each class is of minimum 55 minutes duration									
Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%									
SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM/Idea Tinkering and Innovation Lab Practice etc. ,Seminar and SCA shall be conducted in a section.									
There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester									

CURRICULLUM OF 7TH SEMESTER

For

DIPLOMA IN ELECTRICAL ENGINEERING(PT)

(Effective from 2021-22 Sessions)

STATE COUNCIL FOR TECHNICAL EDUCATION & VOCATIONAL TRAINING, ODISHA, BHUBANESWAR

Th1. ELECTRICAL INSTALLATION AND ESTIMATING

Name of the Course: Diploma in Electrical Engineering(PT)			
Course code:		Semester	7th
Total Period:	60	Examination	3 hrs
Theory periods:	4P / week	Class Test:	20
Tutorial:	1 P / week	End Semester Examination:	80
Maximum marks:	100		

A. RATIONALE:

Prior to implementation of a project in the power transmission and distribution sectors, a material estimate is required in various stages: like i) transmission line construction ii) distribution line construction iii) erection of domestic installation iv) service connection to industrial installation etc. In estimating, calculation of quantity of material is estimated by the estimator. This subject 'Electrical Installation and Estimating' is meant for learning the estimation process by the final semester students

B. OBJECTIVE:

After completion of this subject the student will be able:

1. To write down detailed specification and numbers required of different materials.
2. To determine the size and material of conductor and cable from electrical and mechanical consideration. As such to prepare a detailed list of materials with complete specifications.

C. Topic wise distribution of periods:

Sl. No.	Topics	Periods
1.	Indian electricity rules	06
2.	Electrical installations	12
3.	Internal wiring	12
4.	Over head installation	12
5.	Over head service lines	12
6.	Estimating for distribution substations	06
	Total	**60**

D. COURSE CONTENTS

1. INDIAN ELECTRICITY RULES

1.1 Definitions, Ampere, Apparatus, Accessible, Bare, cable, circuit, circuit breaker, conductor voltage (low, medium, high, EH), live, dead, cut-out, conduit, system, danger, Installation, earthing system, span, volt, switch gear, etc.

1.2 General safety precautions, rule 29, 30, 31, 32, 33, 34, 35, 36, 40, 41, 43, 44, 45, 46.

1.3 General conditions relating to supply and use of energy : rule 47, 48, 49, 50, 51, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 70.

1.4 OH lines : Rule 74, 75, 76, 77, 78, 79, 80, 86, 87, 88, 89, 90, 91

2. ELECTRICAL INSTALLATIONS

2. 1 Electrical installations, domestics, industrial, Wiring System, Internal distribution of Electrical Energy. Methods of wiring, systems of wiring, wire and cable, conductor materials used in cables, insulating materials mechanical protection. Types of cables used in internal wiring, multi-stranded cables, voltage grinding of cables, general specifications of cables.

2. 2 ACCESSORIES: Main switch and distribution boards, conduits, conduit accessories and fittings, lighting accessories and fittings, fuses, important definitions, determination of size of fuse – wire, fuse units. Earthing conductor, earthing, IS specifications regarding earthing of electrical installations, points to be earthed. Determination of size of earth wire and earth plate for domestic and industrial installations. Material required for GI pipe earthing.

2. 3 LIGHTING SCHEME: Aspects of good lighting services. Types of lighting schemes, design of lighting schemes, factory lighting, public lighting installations, street lighting, general rules for wiring, determination of number of points (light, fan, socket, outlets), determination of total load, determination of Number of sub-circuits.

3. INTERNAL WIRING

3 . 1 Type of internal wiring, cleat wiring, CTS wiring, wooden casing capping, metal sheathed wiring, conduit wiring, their advantage and disadvantages comparison and applications.

3 . 2 Prepare one estimate of materials required for CTS wiring for small domestic installation of one room and one verandah within 25 m^2 with given light, fan & plug points.

3 . 3 Prepare one estimate of materials required for conduit wiring for small domestic installation of one room and one verandha within 25 m^2 with given light, fan & plug points.

3 . 4 Prepare one estimate of materials required for concealed wiring for domestic installation of two rooms and one latrine, bath, kitchen & verandah within 80m^2 with given light, fan & plug points.

3 . 5 Prepare one estimate of materials required for erection of conduct wiring to a small workshop installation about 30m^2 and load within 10 KW.

4. OVER HEAD INSTALLATION

4.1. Main components of overhead lines, line supports, factors Governing Height of pole, conductor materials, determination of size of conductor for overhead transmission line, cross arms, pole brackets and clamps, guys and stays, conductors configurations, spacing and clearances, span lengths, overhead line insulators, types of insulators, lighting arresters, danger plates, anti-climbing devices, bird guards, beads of jumpers, jumpers, tee-offs, guarding of overhead lines.

4.2. Prepare an estimate of materials required for LT distribution line within load of 100 KW maximum and standard spans involving calculation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation consideration using ACSR.

4.3. Prepare an estimate of materials required for LT distribution line within load of 100

KW maximum and standard spans involving calculation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation consideration using ACSR.

4.4. Prepare an estimate of materials required for HT distribution line (11 KV) within 2 km and load of 2000 KVA maximum and standard spans involving calculation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation consider action using ACSR.

5. OVER HEAD SERVICE LINES

5. 1 Components of service lines, service line (cables and conductors), bearer wire, lacing rod. Ariel fuse, service support, energy box and meters etc.

5. 2 Prepare and estimate for providing single phase supply of load of 5 KW (light, fan, socket) to a single stored residential building.

5. 3 Prepare and estimate for providing single phase supply load of 3KW to each floor of a double stored building having separate energy meter.

5. 4 Prepare one estimate of materials required for service connection to a factory building with load within 15 KW using insulated wire.

5. 5 Prepare one estimate of materials required for service connection to a factory building with load within 15 KW using bare conductor and insulated wire combined.

6. ESTIMATING FOR DISTRIBUTION SUBSTATIONS

6. 1 Prepare one materials estimate for following types of transformer substations.

6.1.1 Pole mounted substation.

6.1.2 Plinth Mounted substation.

Syllabus coverage up to Internal assessment

Chapters: 1, 2 and 3.

Learning Resources:			
Sl.No	**Name of Authors**	**Title of the Book**	**Name of Publisher**
1	Surjit Singh	Electrical Installation and Estimating	Dhanpatrai and sons
2	J B Gupta	A course in Electrical Installation, Estimating and costing	S K Kataria and Sons
3	N. Alagappan S.Ekambaram	Electrical Estimating and Costing	TATA McGRAW HILL

Th2. SWITCH GEAR AND PROTECTIVE DEVICES

Name of the Course: Diploma in Electrical Engineering(PT)			
Course code:		Semester	7th
Total Period:	75	Examination	3 hrs
Theory periods:	4P / week	Class Test:	20
Tutorial:	1P / week	End Semester Examination:	80
Maximum marks:	100		

A. RATIONALE:

Switch gear and protection plays an important role in the protection of electrical power system. Since the demand of electrical power is increasing the job of generation, transmission & distribution of electrical energy is becoming very completed. To maintain the energy supply to the consumer switching producer with protection is to be maintained moreover new models of switch gear and protection circuits are also being developed. The use of interconnection bus with National power grid type of switch gear and protecting devices need to be trained in proper manners. In the subject information on above context has been included so that the updated knowledge can be given to the students.

B. OBJECTIVE:

After completion of this subject the student will be able to know:

1) The basic principles of protection of alternator, transformer and feeders.
2) Fuse and Circuit breaker.
3) Protective Relay.
4) Lighting Arrestor.
5) Calculation of symmetrical fault current.

C. Topic wise distribution of periods:

Sl. No.	Topics	Period
1	Introduction to switchgear	6
2	Fault calculation	10
3	Fuses	6
4	Circuit breakers	10
5	Protective relays	8
6	Protection of electrical power equipment and lines	6
7	Protection against over voltage and lighting	8
8	Static relay	6
	Total:	**75**

D. COURSE CONTENTS:

1. INTRODUCTION TO SWITCHGEAR

1.1 Essential Features of switchgear.
1.2 Switchgear Equipment.
1.3 Bus-Bar Arrangement.
1.4 Switchgear Accommodation.
1.5 Short Circuit.
1.6 Short circuit.
1.7 Faults in a power system.

2. FAULT CALCULATION

2.1 Symmetrical faults on 3-phase system.
2.2 Limitation of fault current.

2.3 Percentage Reactance.
2.4 Percentage Reactance and Base KVA.
2.5 Short – circuit KVA.
2.6 Reactor control of short circuit currents.
2.7 Location of reactors.
2.8 Steps for symmetrical Fault calculations.
2.9 Solve numerical problems on symmetrical fault.

3. FUSES

3.1 Desirable characteristics of fuse element.
3.2 Fuse Element materials.
3.3 Types of Fuses and important terms used for fuses.
3.4 Low and High voltage fuses.
3.5 Current carrying capacity of fuse element.
3.6 Difference Between a Fuse and Circuit Breaker.

4. CIRCUIT BREAKERS

4.1 Definition and principle of Circuit Breaker.
4.2 Arc phenomenon and principle of Arc Extinction.
4.3 Methods of Arc Extinction.
4.4 Definitions of Arc voltage, Re-striking voltage and Recovery voltage.
4.5 Classification of circuit Breakers.
4.6 Oil circuit Breaker and its classification.
4.7 Plain brake oil circuit breaker.
4.8 Arc control oil circuit breaker.
4.9 Low oil circuit breaker.
4.10 Maintenance of oil circuit breaker.
4.11 Air-Blast circuit breaker and its classification.
4.12 Sulphur Hexa-fluoride (SF6) circuit breaker.
4.13 Vacuum circuit breakers.
4.14 Switchgear component.
4.15 Problems of circuit interruption.
4.16 Resistance switching.
4.17 Circuit Breaker Rating.

5. PROTECTIVE RELAYS

5.1 Definition of Protective Relay.
5.2 Fundamental requirement of protective relay.
5.3 Basic Relay operation
  5.3.1. Electromagnetic Attraction type
  5.3.2. Induction type
5.4 Definition of following important terms
5.5 Definition of following important terms.
  5.5.1. Pick-up current.
  5.5.2. Current setting.
  5.5.3. Plug setting Multiplier.
  5.5.4. Time setting Multiplier.
5.6 Classification of functional relays
5.7 Induction type over current relay (Non-directional)
5.8 Induction type directional power relay.
5.9 Induction type directional over current relay.

5.10 Differential relay
5.10.1. Current differential relay
5.10.2. Voltage balance differential relay.
5.11 Types of protection

6. PROTECTION OF ELECTRICAL POWER EQUIPMENT AND LINES

6.1 Protection of alternator.
6.2 Differential protection of alternators.
6.3 Balanced earth fault protection.
6.4 Protection systems for transformer.
6.5 Buchholz relay.
6.6 Protection of Bus bar.
6.7 Protection of Transmission line.
6.8 Different pilot wire protection (Merz-price voltage Balance system)
6.9 Explain protection of feeder by over current and earth fault relay.

7. PROTECTION AGAINST OVER VOLTAGE AND LIGHTING

7.1. Voltage surge and causes of over voltage.
7.2. Internal cause of over voltage.
7.3. External cause of over voltage (lighting)
7.4. Mechanism of lightning discharge.
7.5. Types of lightning strokes.
7.6. Harmful effect of lightning.
7.7. Lightning arresters and Type of lightning Arresters.
7.7.1. Rod-gap lightning arrester.
7.7.2. Horn-gap arrester.
7.7.3. Valve type arrester.
7.8. Surge Absorber

8. STATIC RELAY:

8. 1 Advantage of static relay.
8. 2 Instantaneous over current relay.
8. 3 Principle of IDMT relay.

Syllabus coverage up to Internal assessment

Chapters: 1, 2, 3 and 4.

Learning Resources:

Sl.No	Title of the Book	Name of Authors	Publisher
1	Principle of power system	V. K. Mehta	S Chand
2.	Protection and Swwitchgear	Bhavesh Bhalja R.P Maheshwari Nilesh G. Chothani	OXFORD
2	Electrical power	Soni, Gupta and Bhatnagar	Dhanpat Rai & Sons
3	Power system protection & switch gear	Bhuvanesh Oza	TMH
4	Electrical Power	S. L. Uppal	Khanna Publisher
5	Protection and Switchgear	Raghuraman	SCITECH

Pr.1 POWER ELECTRONICS & PLC LAB

Name of the Course: Diploma in Electrical Engineering(PT)			
Course code:	Pr.1	Semester	7th
Total Period:	75	Examination	3 hrs
Lab. periods:	5 P / week	Term Work	75
Maximum marks:	175	End Semester Examination:	100

A. RATIONALE: The sole objective of the subject is to be familiar with solid state devices used in power system. To perform experiments for determining the characteristics of components and become fit to meet the challenges in practical implementation.

B. OBJECTIVE:

After completion of this laboratory the student will be able to:

1. Determine characteristic of semiconductor devices.
2. Develop ability to design drive circuit for above.
3. Design low voltage power circuit to be used in electronics circuit.

C. LIST OF EXPERIMENTS

(I) Power Electronics

1. Study of switching characteristics of a power transistor.
2. Study of V-I characteristics of SCR.
3. Study of V-I characteristics of TRIAC.
4. Study of V-I characteristics of DIAC.
5. Study of drive circuit for SCR & TRIAC using DIAC.
6. Study of drive circuit for SCR & TRIAC using UJT.
7. To study phase controlled bridge rectifier using resistive load.
8. To study series Inverter.
9. Study of voltage source Inverter.
10. To perform the speed control of DC motor using Chopper.
11. To study single-phase Cyclo-converter

(II) PLC Programming

1. Introduction/Familiarization PLC Trainer & its Installation with PC
   (a) Learn the basics and hardware components of PLC
   (b) Understand configuration of PLC system
   (c) Study various building blocks of PLC
   (d) Determine the No. of digital I/O & Analog I/O
2. Execute the different Ladder Diagrams
   (a) Demonstrate PLC and Ladder diagram-Preparation downloading and running
   (b) Execute Ladder diagrams for different Logical Gates
   (c) Execute Ladder diagrams using timers & counters
3. Execute the Ladder Diagrams with model applications
   (i) DOL starter (ii)Star- Delta starter
4. Execute Ladder diagrams with model applications (i) Stair case lighting (ii) Traffic light controller

Pr.3 DIGITAL ELECTRONICS & MICROPROCESSOR LAB

Name of the Course: Diploma in Electrical Engineering			
Course code:	Pr.3	Semester	7th
Total Period:	75	Examination	3 hrs
Lab. periods:	5 P / week	Term Work	50
Maximum marks:	150	End Semester Examination:	100

A.RATIONALE

In this practical work students knowledge about the Digital systems will be reinforced. They will become capable of developing and implementing Digital Circuits. They will also be able to acquire skills of operating A/D and D/A converters, counters and display system.

B. OBJECTIVE

On completion of the Lab course the student will able to

1. Understand and comprehended the simple the Digital design Circuits.
2. Assembly Language Program using 8085 instruction
3. Application of 8085 using interfacing

C.COURSE CONTENT IN TERMS OF SPECIFIC OBJECTIVES

(I) Digital Electronics

1. Verify truth tables of AND, OR, NOT, NOR, NAND, XOR, XNOR gates.
2. Implement various gates by using universal properties of NAND & NOR gates and verify truth table.
3. Implement half adder and Full adder using logic gates.
4. Implement half subtractor and Full subtractor using logic gates.
5. Implement a 4-bit Binary to Gray code converter.
6. Implement a Single bit digital comparator.
7. Study Multiplexer and demultiplexer.
8. Study of flip-flops.
   i) S-R flip flop ii) J-K flip flop iii) flip flop iv) T flip flop
9. Realize a 4-bit asynchronous UP/Down counter with a control for up/down counting.
10. Realize a 4-bit synchronous UP/Down counter with a control for up/down counting.
11. Implement Mode-10 asynchronous counters.
12. Study shift registers.

(II) Microprocessor

(A) General Programming using 8085A development board

1. a. 1'S Complement. b. 2'S Complement.
2. a. Addition of 8-bit number. b. Subtraction of 8-bit number resulting 8/16 bit number.
3. a. Decimal Addition 8-bit number. b. Decimal Subtraction 8-bit number
3. a. Compare between two numbers. b. Find the largest in an Array
5. Block Transfer.

(B) Interfacing using 8085

1. Traffic light control using 8255.
2. Generation of square wave using 8255

Learning Resources:

Electronics Lab premier by Sacikala - (S. Chand)

Pr.3 -TECHNICAL SEMINAR

Total Periods	**02**	**Maximum Marks**	**50 Marks**
Lab. Periods:	**02Periods /week**	**Term Works**	**50Marks**
Examination		**End Semester Examination**	**--**

A. Objective:

Each student has to select a recent topic of latest technology in the area of Computer Science and present a seminar in front of all students of the class. He/She has to prepare a PowerPoint presentation of the selected topic of minimum 10 slides are the total presentation will be approximately 10 minutes duration .There will be interactive session between the presenter and rest of the students including the faculty members of the dept at the end of presentation .A student has to present at least 2 nos.of seminar during a semester and to submit the report for evaluation.

Pr.4 PROJECT WORK (Phase-I)

Name of the Course: Diploma in Electrical Engineering			
Course code:	Pr.3	Semester	7th
Total Period:	75	Examination	----
Lab. periods:	5 P / week	Term Work	50
Maximum marks:	50	End Semester Examination:	---

A. RATIONALE

Students' Project Work aims at developing innovative skills in the students whereby they apply the knowledge and skills gained through the course covered in many subjects and Labs, by undertaking a project. The individual students have different aptitudes and strengths. Project work, therefore, should match the individual strengths of students. The prime emphasis of the project work is to understand and apply the basic knowledge of the principles of software engineering/ Hardware design and practices in real life situations, so as to participate and manage a large software engineering projects and /or appropriate Hardware with embedded software in future.

Entire Project shall spread over 7th and 8th Semester. Part of the Project covered in 7th Semester shall be named as *Project Phase-I* and balance portion to be covered in 8th Semester shall be named as *Project Phase-II*.

B. OBJECTIVES

After undergoing the Project Work, the student will be able to:

- Implement the theoretical and practical knowledge and skills gained through various subjects/courses into an application suitable for a real practical working environment, preferably in an industrial environment.
- Develop software packages or applications and implement these for the actual needs of the community/industry.
- Identify and contrast gap between the technological knowledge acquired through curriculum and the actual industrial need and to compensate it by acquiring additional knowledge as required.
- Carry out cooperative learning through synchronous guided discussions within the class in key areas, asynchronous document sharing and discussions, as well as prepare collaborative edition of the final project report.
- Field computing and to achieve real life experience in software/hardware design.

C. GENERAL GUIDELINES

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (right from beginning of 5th semester). Students should be allotted a problem of interest to him/her as a project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. Preferably there should not be more than 5 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

Following are the broad suggestive areas of project work

- ✓ Speed control techniques using thyristor.
- ✓ Battery design & its maintenance.
- ✓ Energy management Techniques.
- ✓ Dynamic models of Electrical machine.
- ✓ Solar based cooker, lamp, water heater etc. & Solar operated vehicles.
- ✓ Remote control operated Electrical devices.
- ✓ Advanced energy meter.
- ✓ Design of Illumination techniques using advanced luminaries etc.
- ✓ Dynamic models of Electrical Machine.
- ✓ PLC & Microprocessor based project.
- ✓ Any other related area found worth.

A suggestive criterion for assessing student performance by the external (preferably person from industry) and internal (teacher) examiner is given in table below:

Sl. No.	Performance Criteria
1.	Selection of project assignment
2.	Planning and execution of considerations
3.	Quality of performance
4.	Providing solution of the problems or production of final product
5.	Sense of responsibility
6.	Self-expression/ communication/ Presentation skills
7.	Interpersonal skills/human relations
8.	Report writing skills
9.	Viva voce

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.
It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations to such an exhibition.

D. PROJECT PHASE-I AND PHASE-II

The Project work duration shall cover two semesters (7^{th} and 8^{th} sem). The Grouping of students, selection of Project, assignment of Project Guide to the Group shall be done in the beginning of 5^{th} sem under Project Phase-I. The students may be allowed to study literature, any existing system and then define the Problem/objective of the Project. Requirements specification, Circuit Diagram with brief description and Design of the system have to be complete in Phase-I. Preliminary analysis/modelling/simulation/experiment/feasibility can also begin in this phase. Project Milestones are to be set so that progress can be tracked. In Phase-II Design, Testing, Documentation have to be complete. Project Report have to be complete in Phase-II. All Project reports should be organized uniformly in proper order, irrespective of group. Teacher Guides can make suitable alteration in the schedule.
At the end of Project Phase-I in 5^{th} semester there shall be one presentation by each group to mark to progress and also to judge whether the Project is moving in right direction as per the objective of the Project.