

STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA

TEACHING AND EVALUATION SCHEME FOR 6th Semester (Electrical)(wef 2020-21)

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
Th.3		Control System Engineering	4	1	-	20	80	3	100
Th.4		Elective (Any one to be opted) (a) Testing And Maintenance of Electrical Machine (b) Renewable Energy (c) Electric vehicle	4	1		20	80	3	100
		<i>Total</i>	16	04		80	320	-	400
Practical									
Pr.1		Electrical Workshop	-	-	6	50	100	3	150
Pr.2		Project Phase- II			8	50	100	3	150
Pr.3		Life Skill	-	-	2	50	-	3	50
		Student Centred Activities(SCA)		-	3	-	-	-	-
		<i>Total</i>	-	-	19	150	200	-	350
		Grand Total	16	04	19	205	545	-	750

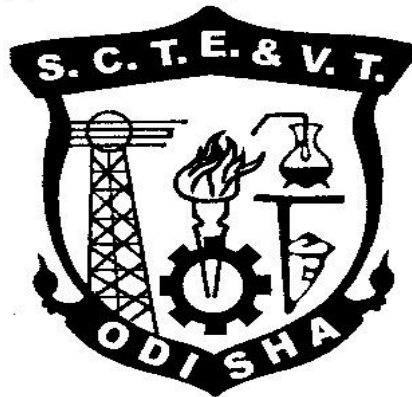
Abbreviations: L-Lecturer, T-Tutorial, P-Practical . Each class is of minimum 55 minutes duration

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 6TH SEMESTER
For
DIPLOMA IN ELECTRICAL ENGINEERING
(Effective from 2020-21 Sessions)



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

Th1. ELECTRICAL INSTALLATION AND ESTIMATING

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	6 th
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 grading 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 m² 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 m² 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 80m² 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 30m² 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			
Course code:		Semester	6 th
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) Lightning 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 lightning	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 Switcgear	Bhavesb 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

Th3.CONTROL SYSTEM ENGINEERING

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	6 th
Total Period:	75	Examination	3 hrs
Theory periods:	4 P / week	Class Test:	20
Tutorial:	1 P / week	End Semester Examination:	80
Maximum marks:	100		

A. RATIONALE:

Automatic control has played a vital role in modern Engineering and Science. It has become an indispensable part of modern manufacturing and industrial process. So knowledge of automatic control system is dreadfully essential on the part of an Engineer. Basic approach to the automatic control system has been given in the subjects, so that students can enhance their knowledge in their future professional carrier.

B. OBJECTIVE:

Study of 'Control System' enhances the ability of the student on:

1. Acquire knowledge about Mathematical modeling, Block diagram algebra, signal flow graphs and control system components.
2. Ability to deal with time response analysis of various systems.
3. Finding out steady state error and error constants.
4. Acquire knowledge about the analysis of stability in Root locus technique.
5. Learning about frequency response analysis of control system.
6. To use Bode plot and Nyquist plot for judgments about stability of a system.

C. Topic wise distribution of periods:

Sl. No.	Topics	Periods
1.	Fundamental of control system	04
2.	Mathematical model of a system	04
3.	Control system components	04
4.	Block diagram algebra & signal flow graphs	08
5.	Time response analysis	10
6.	Analysis of stability by root locus technique	10
7.	Frequency response of system	10
8.	Nyquist plot	10
	Total	60

D. COURSE CONTENTS

1. FUNDAMENTAL OF CONTROL SYSTEM

- 1.1. Classification of Control system
- 1.2. Open loop system & Closed loop system and its comparison
- 1.3. Effects of Feed back
- 1.4. Standard test Signals(Step, Ramp, Parabolic, Impulse Functions)
- 1.5. Servomechanism

2. MATHEMATICAL MODEL OF A SYSTEM

- 2.1. Transfer Function & Impulse response,
- 2.2. Properties, Advantages & Disadvantages of Transfer Function
- 2.3. Poles & Zeroes of transfer Function
- 2.4. Simple problems of transfer function of network.
- 2.5. Mathematical modeling of Electrical Systems(R, L, C, Analogous systems)

3. CONTROL SYSTEM COMPONENTS

- 3.1. Components of Control System
- 3.2. Gyroscope, Synchros, Tachometer, DC servomotors, Ac Servomotors.

4. BLOCK DIAGRAM ALGEBRA & SIGNAL FLOW GRAPHS

- 4.1. Definition: Basic Elements of Block Diagram
- 4.2. Canonical Form of Closed loop Systems
- 4.3. Rules for Block diagram reduction
- 4.4. Procedure for of Reduction of Block Diagram
- 4.5. Simple Problem for equivalent transfer function
- 4.6. Basic Definition in Signal Flow Graph & properties
- 4.7. Construction of Signal Flow graph from Block diagram
- 4.8. Mason's Gain formula
- 4.9. Simple problems in Signal flow graph for network

5. TIME RESPONSE ANALYSIS.

- 5 . 1 Time response of control system.
- 5 . 2 Standard Test signal.
 - 5.2.1. Step signal,
 - 5.2.2. Ramp Signal
 - 5.2.3. Parabolic Signal
 - 5.2.4. Impulse Signal
- 5 . 3 Time Response of first order system with:
 - 5.3.1. Unit step response
 - 5.3.2. Unit impulse response.
- 5 . 4 Time response of second order system to the unit step input.
 - 5.4.1. Time response specification.
 - 5.4.2. Derivation of expression for rise time, peak time, peak overshoot, settling time and steady state error.

- 5.4.3. Steady state error and error constants.
- 5.5 Types of control system.[Steady state errors in Type-0, Type-1, Type-2 system]
- 5.6 Effect of adding poles and zero to transfer function.
- 5.7 Response with P, PI, PD and PID controller.

6. ANALYSIS OF STABILITY BY ROOT LOCUS TECHNIQUE.

- 6.1 Root locus concept.
- 6.2 Construction of root loci.
- 6.3 Rules for construction of the root locus.
- 6.4 Effect of adding poles and zeros to G(s) and H(s).

7. FREQUENCY RESPONSE ANALYSIS.

- 7.1 Correlation between time response and frequency response.
- 7.2 Polar plots.
- 7.3 Bode plots.
- 7.4 All pass and minimum phase system.
- 7.5 Computation of Gain margin and phase margin.
- 7.6 Log magnitude versus phase plot.
- 7.7 Closed loop frequency response.

8. NYQUIST PLOT

- 8.1 Principle of argument.
- 8.2 Nyquist stability criterion.
- 8.3 Niquist stability criterion applied to inverse polar plot.
- 8.4 Effect of addition of poles and zeros to G(S) H(S) on the shape of Niquist plot.
- 8.5 Assessment of relative stability.
- 8.6 Constant M and N circle
- 8.7 Nicholas chart.

Syllabus coverage up to Internal assessment

Chapters: 1, 2, 3, 4 and 5.

Learning Resources:			
Sl.No	Title of the Book	Name of Authors	Name of Publisher
1.	Control System	A. Ananda Kumar	PHI
3.	Control System	K. Padmanavan	IK
2.	Control system Engineering	I. J. Nagarath, M. Gopal	WEN
4.	Control system Engineering	A Natrajan,Ramesh Babu	Scientific
5.	Control Systems	D N Manik	Cengage
6.	Control Systems	S P Eugene Xavier, J Joseph Cyril Babu	S Chand

Th4.TESTING AND MAINTENANCE OF ELECTRICAL MACHINE

(Elective- A)

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	6 th
Total Period:	75	Examination	3 hrs
Theory periods:	4 P / week	Class Test:	20
Tutorial:	1 P / week	End Semester Examination:	80
Maximum marks:	100		

A. RATIONALE:

This subject intends to be acquainted with application level technology, normally adopted in Industries, commercial, public utility departments such as Electrical transmission and distribution, Irrigation, Water supply etc. The knowledge in this subject will make the readers able for inspection, testing, installation and commissioning of electrical machines as per IS standards. This will help him to initiate total productive maintenance.

B. OBJECTIVE:

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

1. To acquire knowledge on safety measures and precautions.
2. Testing of DC and AC rotating machines and transformers.
3. Identify common troubles in Electrical machines and switch gear.
4. Plan and carryout routine and preventive maintenance.
5. Install LV switch gear and maintain it.
6. Ascertain the condition of insulation and varnishing. (if necessary)
7. Initiate total productive maintenance.

C. Topic wise distribution of periods:

Sl. No.	Topics	Periods
1.	Installation, Commissioning and Testing of Machine	15
2.	Installation, Commissioning and Testing of Transformer	15
3.	Installation, Commissioning & Testing of Sub-station.	15
4.	Maintenance	15
Total		60

D. COURSE CONTENTS

- 1. Installation, Commissioning and Testing of Machine:**
 - 1.1. Inspection of arrival of machine and inspection procedure before its installation.
 - 1.2. Generalized procedure of installation of Electrical machines.
 - 1.3. Electric wiring for motors and switch gears.
 - 1.4. General requirement for Electric Installation according to Indian Electricity rules.
 - 1.5. Necessity of starters and relays for both DC and AC machines.
 - 1.6. Testing before giving supply and testing report.

- 2. Installation, Commissioning and Testing of Transformer:**
 2. 1 Basic idea on dispatch, inspection, storage and handling of transformer.
 2. 2 Civil construction feature regarding connection like ventilation, noise level, space for free movement.
 2. 3 Foundation and drainage of oil.
 2. 4 Cabling and cable box for transformer.
 2. 5 Provision for fire protection.
 2. 6 Provision for bushing support location of switch gear.
 2. 7 Steps for commissioning fitting of all accessories.
 2. 8 Filling of oil, drying out.
 2. 9 Charging the breather with fresh silica gel.
 2. 10 Cleaning of bushing, fixing of conductor & cables, earthing of tank and cover, neutral earthing.
 2. 11 Fixing of protection circuits and setting of relays.

- 3. Installation, Commissioning & Testing of Sub-station.**
 - 3 . 1 Design and planning of indoor substation.
 - 3 . 2 General requirement of layout of indoor substation with key diagram.
 - 3 . 3 Consideration of safe operation of substation
 - 3 . 4 Installation of outdoor substation:
 - 3.4.1 Selection of site, transport & receipt of transformer, checking of insulation resistance of the winding, testing of transformer oil, protection fittings, construction of mounting, earthing arrangement and final commissioning.
 - 3 . 5 Testing and commissioning of substation.
 - 3.5.1. Installation of control and relay panels.
 - 3.5.2. Preliminary preparation.
 - 3.5.3. Sequence card for erection of switch gear equipments.
 - 3.5.4. Location of place
 - 3.5.5. Unpacking
 - 3.5.6. Foundation
 - 3.5.7. Erection
 - 3.5.8. Relays
 - 3 . 6 Bus-bar earthing connection, Earthing.
 - 3.6.1. Connection to main cable.
 - 3.6.2. Safety precaution
 - 3 . 7 Installation of outdoor circuit breaker:
 - 3.7.1. Receipt and storage.

- 3.7.2. Civil works.
- 3.7.3. Various steps for installation.
- 3.8 Pre-commissioning tests.

4. Maintenance:

- 4.1 Fundamental of maintenance.
- 4.2 Preventive maintenance and planning.
[Daily, Weekly, Monthly, Half-yearly and Yearly maintenance.]
- 4.3 Advantages of Preventive maintenance:
- 4.4 Breakdown maintenance: List of tools / instruments and materials used for maintenance.
- 4.5 Making or Preparing Maintenance schedule of DC machines, Induction machines, Synchronous machines, Transformer, Transmission line, Distribution lines, Underground cables, Circuit breakers, Switch gear and protective relays and substations, SF-6 circuit breakers, Batteries in substation.

Syllabus coverage up to Internal assessment

Chapters: 1, and 2.

Learning Resources:			
Sl.No	Title of the Book	Name of Authors	Name of Publisher
1	Installation Commissioning & Maintenance of Electrical Equipments	Tarlok Singh	S. K. Kataria & Sons
2.	Installation Servicing and Maintenance	S N Bhattacharya	S Chand
3.	Testing Commissioning Operation and Maintenance of Electrical Equipments	S Rao	Khanna Publisher
4.	Hand book of Inspection, for all type of Electrical Instruments	Er. R. N. Sahoo	Orissa Power Generation consultants and services
5.	Installation, Maintenance and Repair of Electrical Machines and Equipments	Madhvi Gupta	Katson Books

Th4. RENEWABLE ENERGY SYSTEMS (Elective – B)

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	6 th
Total Period:	75	Examination	3 hrs
Theory periods:	4 P / week	Class Test:	20
Tutorial:	1 P / week	End Semester Examination:	80
Maximum marks:	100		

A. RATIONALE:

It is well known that a plenty of energy is needed to sustain industrial growth and agricultural production. The existing sources energy such as coal, oil, uranium etc may not be sufficient to meet the ever increasing energy demands. These conventional sources of energy are also depleting and may be exhausted at the end of the century or the beginning of the next century.

Consequently sincere efforts shall have to be made by the scientists and engineers in exploring the possibilities of harnessing energy from several energy sources.

B. OBJECTIVE:

After completion of this subject the student will be able:

1. Power production from pollution free forces and environment friendly resources.
2. Production of power form nature at free of cost.
3. Solar energy conversion is noiseless and cheap.

C. Topic wise distribution of periods:

Sl. No.	Topics	Periods
1.	Introduction to Renewable energy	5
2.	Solar Energy	15
3.	Wind Energy	12
4.	Biomass Power	12
5.	Other Energy Sources	16
	Total	60

D. COURSE CONTENTS

1. Introduction to Renewable energy:

- 1.1. Environmental consequences of fossil fuel use.
- 1.2. Importance of renewable sources of energy.
- 1.3. Sustainable Design and development.
- 1.4. Types of RE sources.
- 1.5. Limitations of RE sources.
- 1.6. Present Indian and international energy scenario of conventional and RE sources

2. Solar Energy:

- 2.1. Solar photovoltaic system-Operating principle.

- 2.2. Photovoltaic cell concepts
 - 2.2.1. Cell, module, array, Series and parallel connections. Maximum power point tracking (MPPT).
 - 2.3. Classification of energy Sources.
 - 2.4. Extra-terrestrial and terrestrial Radiation.
 - 2.5. Azimuth angle, Zenith angle, Hour angle, Irradiance, Solar constant.
 - 2.6. Solar collectors, Types and performance characteristics,
 - 2.7. Applications: Photovoltaic - battery charger, domestic lighting, street lighting, water pumping, solar cooker, Solar Pond.
- 3. Wind Energy:**
- 3.1. Introduction to Wind energy.
 - 3.2. Wind energy conversion.
 - 3.3. Types of wind turbines
 - 3.4. Aerodynamics of wind rotors.
 - 3.5. Wind turbine control systems; conversion to electrical power:
 - 3.6. Induction and synchronous generators.
 - 3.7. Grid connected and self excited induction generator operation.
 - 3.8. Constant voltage and constant frequency generation with power electronic control.
 - 3.9. Single and double output systems.
 - 3.10. Characteristics of wind power plant.
- 4. Biomass Power:**
- 4.1. Energy from Biomass.
 - 4.2. Biomass as Renewable Energy Source
 - 4.3. Types of Biomass Fuels - Solid, Liquid and Gas.
 - 4.4. Combustion and fermentation.
 - 4.5. Anaerobic digestion.
 - 4.6. Types of biogas digester.
 - 4.7. Wood gassifier.
 - 4.8. Pyrolysis,.
 - 4.9. Applications: Bio gas, Bio diesel
- 5. Other Energy Sources**
- 5.1. Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems.
 - 5.2. Ocean Thermal Energy Conversion (OTEC).
 - 5.3. Geothermal Energy – Classification.
 - 5.4. Hybrid Energy Systems.
 - 5.5. Need for Hybrid Systems.
 - 5.6. Diesel-PV, Wind-PV, Microhydel-PV.
 - 5.7. Electric and hybrid electric vehicles.

Syllabus coverage up to Internal assessment

Chapters: 1, 2 and 3.

Learning Resources:			
Sl.No	Title of the Book	Name of Authors	Name of Publisher
1.	<i>Renewable Energy Sources and Emerging Technologies</i>	<i>D.P.Kothari, K.C Singal, Rakesh Ranjan</i>	<i>PHI Learning Pvt.Ltd, New Delhi</i>
2.	<i>Non-Conventional Energy Resources</i>	<i>B.H.Khan</i>	<i>Tata McGrawHill</i>
3	<i>Non-Conventional Energy Resources</i>	<i>J.P Navani & Sonal Sapra</i>	<i>S chand</i>
4.	<i>Non Conventional Energy sources and Utilisation</i>	<i>R K Rajput</i>	<i>S Chand</i>
5	<i>Wind Electrical Systems</i>	<i>S. N. Bhadra, D. Kastha, S. Banerjee</i>	<i>Oxford Univ. Press, New Delhi</i>
6.	<i>Non Conventional Energy Resources</i>	<i>N K Bansal</i>	<i>S Chand</i>

Th4. ELECTRIC VEHICLES

(Elective- C)

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester:	6 th
Total Period:	75	Examination:	3 hrs
Theory periods:	4 P / week	Class Test:	20
Tutorial:	1 P / week	End Semester Examination:	80
Maximum marks:	100		

A. RATIONALE:

The sole objective of this subject to be familiar with advanced Electric drive vehicle technology, its economic analysis, comparative study and environmental aspects.

B. OBJECTIVE:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- a) Interpret the salient features of Hybrid electric vehicles.
- b) Interpret the Dynamics of hybrid and Electric vehicles
- c) Maintain the DC-DC converters in EV applications.
- d) Maintain the DC-AC converters in EV applications
- e) Select the batteries for EV applications, its charging.

C. Topic wise distribution of periods:

Sl. No.	Topics	Periods
1.	Introduction to Hybrid Electric Vehicles	10
2.	Dynamics of hybrid and Electric vehicles	10
3.	DC-DC Converters for EV and HEV Applications	15
4.	DC-AC Inverter & Motors for EV and HEVs	15
5.	Batteries	10
Total		60

D. COURSE CONTENTS

Unit – I Introduction to Hybrid Electric Vehicles

Evolution of Electric vehicles, Advanced Electric drive vehicle technology Vehicles- Electric vehicles (EV), Hybrid Electric drive (HEV), Plug in Electric vehicle (PIEV), Components used Hybrid Electric Vehicle ,Economic and environmental impacts of Electric hybrid vehicle Parameters affecting Environmental and economic analysis. Comparative study of vehicles for economic, environmental aspects.

Unit – II Dynamics of hybrid and Electric vehicles

General description of vehicle movement, Factors affecting vehicle motion- Vehicle resistance, tyre ground adhesion, rolling resistance, aerodynamic drag, equation of grading resistance, dynamic equation. Drive train configuration, Automobile power train, classification of vehicle power plant. Performance characteristics of IC engine, electric motor, need of gear box. Classification of motors used in Electric vehicles. Basic architecture of hybrid drive trains, types of HEVs Energy saving potential of hybrid drive trains ,HEV Configurations-Series, parallel, Series-parallel, complex.

Unit– III DC-DC Converters for EV and HEV Applications

EV and HEV configuration based on power converters, Classification of converters – unidirectional and bidirectional, Principle of step down operation, Boost and Buck- Boost converters, Principle of Step-Up operation, Two quadrant converters; multi quadrant converters, Electrical Engineering Curriculum Structure 210.

Unit– IV DC-AC Inverter & Motors for EV and HEVs

DC-AC Converters, Principle of operation of half bridge DC-AC inverter (R load, R-L load), Single phase Bridge DC-AC inverter with R load, R-L load, Electric Machines used in EVs and HEVs, principle of operation, working & control , Permanent magnet motors, their drives, switched reluctance motor, Characteristics and applications of above motors.

Unit– V Batteries

Overview of batteries, Battery Parameters, types of batteries, Battery Charging, alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, flywheels , Control system for EVs and HEVs, overview, Electronic control unit ECU, Schematics of hybrid drive train, control architecture Regenerative braking in EVs.

Syllabus coverage up to Internal assessment

Unit: 1,2

Learning Resources:			
Sl.No	Title of the Book	Name of Authors	Name of Publisher
1	Electric & Hybrid Vehicles	A.K. Babu	Khanna Publishing House
2.	A. E. Hybrid Vehicles and the Future of Personal Transportation	Fuhs	CRC Press
3.	I. <i>Electric and Hybrid Electric Vehicles</i>	Husain	CRC Press
4.	<i>Modern Electric Vehicle Technology</i>	Chan C. C. and K. T. Chau	Oxford Science Publication,
5.	M. H. <i>Power Electronics: Circuits, Devices and Applications,</i>	Rashid	3rd edition, Pearson,

Pr1.ELECTRICAL WORKSHOP PRACTICE

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	6 th
Total Period:	90	Examination	3 hrs
Lab. periods:	6 P / week	Sessional:	50
Maximum marks:	150	End Semester Examination:	100

A. **RATIONALE:** The sole objective of the subject is skill development among the students after performing practice of the experiments and become fit to meet the challenges in practical installation.

In the beginning all the tools and instruments required/ used in conducting this subject are to be illustrated. The students are required to make a thorough hand on approach in practicing the experiments.

B. **OBJECTIVE:**

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

1. To be familiar with different cable and overhead line joints.
2. To be familiar with Electrical installation of residential building and to identify and maintenances of different electrical gadgets.
3. Fault finding, repairing of DC and AC machines with their accessories.

C. **LIST OF EXPERIMENT:**

1. Identification of single core (SC), twin core (TC), three cores (3c), four cores (4c); copper and aluminum PVC, VIR & Weather proof (WP) wire and prepare Britannia T-joint and Married joint.
2. Cutting copper and aluminum cable and crimping lug to them from 2.5mm² to 6 mm² cross section.
3. Connection and testing of fluorescent tube light, high pressure M.V. lamp, sodium vapor lamp, M.H lamp, CFL and latest model lamps – measure inductance, Lux/ lumens (intensity of illumination) in each case-prepare lux table .
4. Study battery charger and make charging of lead acid battery (record charging voltage, current and specific gravity).
5. Erection of residential building wiring by CTS and conduit wiring system using main two points and test installation by test lamp method and a meggar.
6. Fault finding & repairing of Ceiling Fan – prepare an inventory list of parts.
7. Find out fault of D.C. generator, repair and test it to run.
8. Find out fault of D.C. motor starters and A.C motor starter – prepare an inventory list of parts used in different starters.
9. Dismantle, over haul and assemble a single phase induction motor. Test and run it. – prepare an inventory list.
10. Dismantle over haul and assemble a three phase squirrel cage and phase wound motor. Test and run them.
11. Overhaul a single phase and 3-phase variac.

Pr2. PROJECT Phase - II

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	6 th
Total Period:	120	Examination	3 hrs
Lab. periods:	8 P / week	Sessional	50
Maximum marks:	150	End Sem Examination	100

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 prime emphasis of the project work is to understand and apply the basic knowledge of the principles of Electrical engineering and practices in real life situations, so as to participate and manage a large Electrical engineering projects, in future. Entire Project spreads over 5th and 6th Semester. Part of the Project covered in 5th Semester was named as *Project Phase-I* and balance portion to be covered in 6th Semester shall be named as *Project Phase-II*.

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.
- To achieve real life experience in Project design.
- To develop the skill of writing Project Report

Project Phase-I and Phase-II

The Project work duration covers 2 semesters(5th and 6th sem). The Grouping of students, selection of Project, assignment of Project Guide to the Group was done in the beginning of 5th semester under Project Phase-I. The students were allowed to study literature, any existing system and then define the Problem/objective of the Project. Preliminary work and Design of the system also have to be complete in Phase-I. Development may also begin in this phase. Project Milestones are to be set so that progress can be tracked .

In Phase-II Development, Testing, Documentation and Implementation have to be complete. Project Report have to be prepared and 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 components of Task and schedule.

At the end of Project Phase-II in 6th semester there shall be one presentation by each group on whole Project work undertaken by them.

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 organisations to such an exhibition.

The Project Report need to be prepared as per standard format and following is the indicative format. The Teacher Guide may make minor alteration keeping the sense in tact.

Organization of Project Report

1. Cover page:

It should contain the following (in order)

- (i) Title of the Project
- (ii) "Submitted in partial fulfillment of the requirements for the Diploma in <Branch Name>"
- (iii) By Name of the Student(s)
- (iv) Logo of the Institution
- (v) Branch Name/Depart Name and Institution Name with Address
- (vi) Academic Year

2. 1st Inner page

Certificate:

It should contain the following

“This is to certify that the work in this Project Report entitled <Project Title> by <Name of student(s)> has been carried out under my supervision in partial fulfillment of the requirements for the Diploma in <Branch Name>” during session <session > in <Branch /Department Name> of <Institute name> and this work is the original work of the above student(s).

Seal and signature of the Supervisor/Guide with date

3. 2nd Inner Page
Acknowledgement by the Student(s)
4. Contents.
5. Chapter wise arrangement of Reports
6. Last Chapter: Conclusion
It should contain
 - (i) Conclusion
 - (ii) Limitations
 - (iii) Scope for further Improvement
7. References

Pr-3 LIFE SKILL

(Common to All Branches)

Practical	2 Periods/ week	Sessional	50 Marks
Total Periods	30 Periods	Total Marks	50 Marks

Objective: After completion of this course the student will be able to:

- Develop team spirit i.e. concept of working in team
- Apply problem solving skills for a given situation
- Use effective presentation techniques
- Apply task management techniques for given projects
- Enhance leadership traits
- Resolve conflict by appropriate method
- Survive self in today's competitive world
- Face interview without fear

DETAIL CONTENTS:

1. SOCIAL SKILL

Society, Social Structure, Develop Sympathy and Empathy
 Swot Analysis – Concept, How to make use of SWOT
 Inter personal Relation: Sources of conflict, Resolution of conflict ,
 Ways to enhance interpersonal relation

2. PROBLEM SOLVING

Steps of Problem solving:

- Identify and clarify the problem,
- Information gathering related to problem,
- Evaluate the evidence,
- Consider alternative solutions and their implications,
- Choose and implement the best alternative,
- Review
- Problem solving techniques:

1) Trial and error, 2) Brain storming, 3) Lateral (Out of Box) thinking

3. PRESENTATION SKILL

Body language , Dress like the audience
 Posture, Gestures, Eye contact and facial expression. STAGE FRIGHT,
 Voice and language – Volume, Pitch, Inflection, Speed, Pause
 Pronunciation, Articulation, Language, Practice of speech.
 Use of AV aids such as Laptop with LCD projector, white board etc.

4. GROUP DISCUSSION AND INTERVIEW TECHNIQUES

Group Discussion:

Introduction to group discussion, Ways to carry out group discussion,

Parameters— Contact, body language, analytical and logical thinking, decision making

Interview Technique :

Dress, Posture, Gestures, facial expression, Approach

Tips for handling common questions.

5. WORKING IN TEAM

Understand and work within the dynamics of a groups.

Tips to work effectively in teams,

Establish good rapport, interest with others and work effectively with them to meet common objectives,

Tips to provide and accept feedback in a constructive and considerate way ,

Leadership in teams, Handling frustrations in group.

6. TASK MANAGEMENT

Introduction, Task identification, Task planning , organizing and execution, Closing the task

PRACTICAL

List of Assignment: *(Any Five to be performed including Mock Interview)*

1. SWOT analysis:-

Analyse yourself with respect to your strength and weaknesses, opportunities and threats.

Following points will be useful for doing SWOT.

- a) Your past experiences,
- b) Achievements,
- c) Failures,
- d) Feedback from others etc.

2. Solve the True life problem assigned by the Teacher.

3. Working in a Team

Form a group of 5-10 students and do a work for social cause e.g. tree plantation, blood donation, environment protection, camps on awareness like importance of cleanliness in slum area, social activities like giving cloths to poor etc.(One activity per group where Team work shall be exhibited)

4. Mock Interview

5. Discuss a topic in a group and prepare minutes of discussion.

6. Deliver a seminar for 5 minutes using presentation aids on the topic given by your teacher.

7. Task Management

Decide any task to be completed in a stipulated time with the help of teacher. Write a report considering various steps in task management (with Break up into sub tasks and their interdependencies and Time)

Note: -1. Please note that these are the suggested assignments on given contents/topic. These assignments are the guide lines to the subject teachers. However the subject teachers are free to design any assignment relevant to the topic.

Note: -2. The following Topics may be considered for Seminar/GD in addition to other Topics

at the discretion of the Teacher.

(Comparison with developed countries, Occupational Safety, Health Hazard, Accident & Safety, First-Aid, Traffic Rules, Global Warming, Pollution, Environment, Labour Welfare Legislation, Labour Welfare Acts, Child Labour Issues, Gender Sensitisation ,Harassment of Women at Workplace)

METHODOLOGY:

The Teacher is to explain the concepts prescribed in the contents of the syllabus and then assign different Exercises under Practical to the students to perform.

Books Recommended:-

Sl.No	Name of Authors	Title of the Book	Name of the Publisher
01	E.H. Mc Grath , S.J	Basic Managerial Skills for All	PHI
02	Lowe and Phil	Creativity and problem solving	Kogan Page (I) P Ltd
03	Adair, J	Decision making & Problem Solving	Orient Longman
04	Bishop , Sue	Develop Your Assertiveness	Kogan Page India
05	Allen Pease	Body Language	Sudha Publications Pvt. Ltd.

EQUIPMENT LIST OF ELECTRICAL WORKS PRACTICE

SI NO	EQUIPMENT LIST
1.	Single Core,Twin Core,Three Core,Four Core Copper and Aluminium PVC,VIR,and Weatherproof Wire
2.	Copper and Aluminium Cable ,Crimping Lug
3.	Flourescent Tube Light
4.	High Pressure M.V Lamp
5.	Sodium Vapour Lamp
6.	M.H Lamp
7.	CFL
8.	Battery Charger and Lead Acid Battery
9.	Single Phase Motor(Fan)
10.	DC Generator
11.	DC Motor with Starter
12.	AC Motor with Starter
13.	L.T And H.T Aluminium Cable
14.	Crimping Tools and Lug
15.	Single Phase Induction Motor
16.	Three Phase Squirrel Cage Induction Motor
17.	Phase Wound Motor
18.	Single Phase/ Three phase Variac
19.	Megger