Curriculum
for
Certificate Programme
In
ELECTRICIAN
for
Maharaja Ranjit Singh Punjab Technical University,
Bathinda (Punjab)

Prepared By:

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FOREWORD

Rapid industrialization and globalization has created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In order to cope with the challenges of handling new materials, machines and technologies, we have to develop human resources having appropriate competencies. There is an increasing demand of skilled workforce in India in particular and the world over in general. Under the new circumstances, India faces a challenging task of meeting the technical manpower requirement, especially in the area of skilled workforce to cater to industrial needs. Efforts have to be made so that passouts from our technical institutions are acceptable at global level.

Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Technical institutions play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by Maharaja Ranjit Singh Punjab Technical University (MRSPTU), Bathinda, Punjab to start the skill oriented integrated courses at certificate, diploma and degree level, as per the needs of the industry, are laudable.

In order to meet the future requirements of technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of technical programmes at various levels. The curricula for various programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of programme and various courses.

The success of any technical programme depends upon its effective implementation. However best the curriculum document is designed, if it is not implemented properly, the output will not be as per expectations. In addition to acquisition of appropriate physical resources, availability of motivated, competent and qualified faculty is equally essential for effective implementation of the curricula.

It is expected that MRSPTU will carry out curriculum evaluation on a continuous basis to identify the new skill requirements. At the same time, it is expected that innovative methods of course offering will be used to develop desired skills and infuse the much needed dynamism in the system.

Dr. M.P. Poonia
Director
National Institute of
Technical Teachers Training & Research
Chandigarh

PREFACE

Curriculum document is a comprehensive plan of an educational programme. It is through the curriculum that the educational objectives of a programme are achieved. It has to be ensured that the curriculum is dynamic, articulated, balanced, data based, feasible, and as per industrial needs. Curriculum Development Centre at NITTTR, Chandigarh has been extending services to technical education system of the states in northern region in developing and updating their curriculum on regular basis.

Maharaja Ranjit Singh Punjab Technical University (MRSPTU), Bathinda, Punjab assigned the project for developing the curriculum of some integrated programmes to this institute in the month of May 2016. A series of curriculum workshops were held during the months of June-July, 2016. This curriculum document is an outcome of the extensive discussions held with the representatives from various organizations, technical institutions and industry during the curriculum workshops. While developing the study and evaluation scheme and detailed contents, the following aspects have been kept in mind :

- Employment Opportunities of Certificate holders
- Job role of certificate holders
- Learning outcome of the Programme
- Mobility of students for their professional growth

We have taken cognizance of recommendation of experts both from industry and academic institutions and have adequately incorporated segments of Industrial Training in the curriculum. Time has specifically been allocated for undertaking extra-curricular activities. Emphasis has been laid on developing and improving communication skills in the students for which units on Communication Skills have been introduced in both the semesters of the certificate course.

We hope that this curriculum document will prove useful in producing skilled manpower at desired level in the state of Punjab. The success of this outcome-based curriculum depends upon its effective implementation and it is expected that MRSPTU will make all efforts to create better facilities, develop linkages with the world-of-work and foster conducive and requisite learning environment as prescribed in the curriculum document.

Professor and Head
Curriculum Development Centre
NITTTR, Chandigarh

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Coordinator

1. SALIENT FEATURES OF THE PROGRAMME

1.	Sector	:	Power & Energy
2.	Name of the Certificate Programme	:	Electrician
3.	Entry Qualification	:	Matriculation or equivalent NSQF Level as prescribed by MRSPTU, Bathinda
4.	Duration of the Programme	:	One Year
5.	Intake	:	30
6.	Pattern of the Programme	:	Semester Pattern
7.	NSQF Level	:	Level - III

2. JOB ROLE AND JOB OPPORTUNITIES

a) Job Role

A certificate holder in Electrician is responsible for wiring, servicing, testing, repair and maintenance of general electrical appliances and control instruments by identifying faulty parts.

b) Job Opportunities

On successful completion of this course, the students will be gainfully employed in the following areas:

i) Various electrical appliances manufacturing industry.

ii) Maintenance section of Govt. organizations/private/public sector.

iii) Work as certified electrician.

iv) Self employed.

3. LEARNING OUTCOMES OF THE PROGRAMME

After undergoing the programme, students will be able to:

1. Draw and interpret D.C. and A.C. circuits
2. Use different types of electrical tools and measuring instruments
3. Identify and rectify different types of faults in electrical equipments/appliances
4. Install and test different types of domestic and industrial wiring circuits
5. Maintain and troubleshoot electrical machines and starters
6. Perform and test winding for electrical machines
7. Apply basic principles of math and physics in solving trade problems
8. Communicate effectively in English with others
9. Describe the characteristics/properties and uses of material related to the trade

4. STUDY AND EVALUATION SCHEME FOR CERTIFICATE PROGRAMME IN ELECTRICIAN

FIRST SEMESTER

CODE	UNITS	STUDY SCHEME Total Hours		CREDITS	MARKS IN EVALUATION SCHEME								Total Marks
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
CELE11-101	*Communication Skills	8	-	1	25	-	25	25	1	-	-	25	50
CELE1-101P	*Communication Skills Lab.	-	24	1	-	50	50	-	-	75	3	75	125
CELE1-102	Engineering Drawing (Electrician)	-	-	1	-	-	-	75	3	-	-	75	75
CELE1-102P	Engineering Drawing (Electrician) Lab.	-	48	1	-	50	50	-	-	-	-	-	50
CELE1-103	Basic Electricity	32	-	2	25	-	25	50	2	-	-	50	75
CELE1-103P	Basic Electricity Lab.	-	128	4	-	75	75	-	-	100	4	100	175
CELE1-104	Electrical Measuring Instruments	16	-	1	25	-	25	25	1	-	-	25	50
CELE1-104P	Electrical Measuring Instruments Lab.	-	80	3	-	50	50	-	-	100	4	100	150
CELE1-105	Electrical Machines - I	48	-	3	25	-	25	50	2	-	-	50	75
CELE1-105P	Electrical Machines – I Lab.	-	128	4	-	75	75	-	-	100	4	100	175
CELE1-106P	#Student Centred Activities (SCA)	-	48	2	-	25	25	-	-	-	-	-	25
CELE1-107P	+4 Weeks Industrial Training (during vacation)	-	-	4	-	-	-	-	-	100	3	100	100
Total		**104**	**456**	**27**	**100**	**325**	**425**	**225**	**-**	**475**	**-**	**700**	**1125**

* Common with other certificate programmes

\# SCA will comprise of co-curricular activities like extension lectures on entrepreneurship, environment and energy conservation, sports, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities etc.

\+ **Industrial Training**

After examination of 1st Semester, the students will go for training during vacation in a relevant industry/field organization for a minimum period of 4weeks and will prepare a diary. The students will prepare a report at the end of training and will present

it in a seminar. This evaluation will be done by concerned instructor in the presence of one industrial representative from the related programme/trade.

Total weeks per semester = 16 Total working days per week = 5 Total hours per day = 7

Total Hours in a semester = 16 x 5 x 7 = 560

One credit is defined as one hour of lecture per week or two hours of practicals per week for one semester. Fractions in credits have been rounded to nearest integer.

SECOND SEMESTER

CODE	UNITS	STUDY SCHEME Total Hours		CREDITS	MARKS IN EVALUATION SCHEME								Total Marks
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
CELE1-208	*Basic Sciences	48	-	3	25	-	25	50	2	-	-	50	75
CELE1-209	Repair and Maintenance of Electrical Installations	32	-	2	25	-	25	50	2	-	-	50	75
CELE1-209P	Repair and Maintenance of Electrical Installations Lab.	-	128	4	-	75	75	-	-	100	4	100	175
CELE1-210	Electrical Machines - II	48	-	3	25	-	25	50	2	-	-	50	75
CELE1-210P	Electrical Machines – II Lab.	-	128	4	-	75	75	-	-	100	4	100	175
CELE1-211	Electrical Controls and Switchgears	32	-	2	25	-	25	50	2	-	-	50	75
CELE1-211P	Electrical Controls and Switchgears Lab.	-	96	3	-	50	50	-	-	100	4	100	150
CELE1-212P	#Student Centred Activities (SCA)	-	48	2	-	25	25	-	-	-	-	-	25
CELE1-213P	+4 Weeks Industrial Training	-	-	4	-	-	-	-	-	100	3	100	100
Total		**160**	**400**	**27**	**100**	**225**	**325**	**200**	**-**	**400**	**-**	**600**	**925**

* Common with other certificate programmes

\# SCA will comprise of co-curricular activities like extension lectures on entrepreneurship, environment and energy conservation, sports, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities etc.

\+ **Industrial Training**

After examination of 2nd Semester, the students will go for training during vacation in a relevant industry/field organization for a minimum period of 4 weeks and will prepare a diary. The students will prepare a report at the end of training and will present it in a seminar. This evaluation will be done by concerned instructor in the presence of one industrial representative from the related programme/trade.

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

It was discussed and decided that the maximum marks for SCA should be 25 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

i. 5 Marks for general behavior and discipline
(by Principal in consultation with all the trainers)

ii. 5 Marks for attendance as per following:
(by the trainers of the department)

a)	75%	Nil
b)	75 - 80%	2 Marks
c)	80 - 85%	3 Marks
d)	Above 85%	5 Marks

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

a)	15	-	National Level participation or inter-University competition
b)	10	-	Participation in two of above activities
c)	5	-	Participation in internal sports of the University

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

UNIT – 1.1
SUBJECT CODE: CELE1-101
COMMUNICATION SKILLS

LEARNING OUTCOMES:

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

- Speak confidently.
- Overcome communication barriers.
- Write legibly and effectively.
- Listen in proper prospective.
- Read various genres adopting different reading techniques.
- Respond to telephone calls effectively.

Practical (24 Hours)	**Theory (08 Hours)**
	Basics of Communication • Process of communication • Types of communication - formal and informal, oral and written, verbal and non-verbal • Objectives of communication • Essentials of communication • Barriers to communication (1 hour)
• Looking up words in a dictionary (meaning and pronunciation) (2 hours)	Functional Grammar and Vocabulary • Parts of speech • Tenses • Correction of incorrect sentences (2 hours)
• Self and peer introduction • Greetings for different occasions (1 hour)	Listening • Meaning and process of listening • Importance of listening • Methods to improve listening skills Speaking • Importance • Methods to improve speaking • Manners and etiquettes (2 hours)
• Newspaper reading (1 hour)	Reading • Meaning • Techniques of reading: skimming, scanning, intensive and extensive reading (1 hour)
• Vocabulary enrichment and grammar exercises • Exercises on sentence framing accurately (6 hours)	Functional Vocabulary - One-word substitution - Commonly used words which are often misspelt - Punctuation - Idioms and phrases (2 hours)

• Reading aloud articles and essays on current and social issues • Comprehension of short paragraph (5 hours)	
• Write a short technical report • Letter writing (3 hours)	
• Participate in oral discussion • Respond to telephonic calls effectively • Mock interview (6 hours)	

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Laboratory and practical work
- Viva-voce

UNIT - 1.2
SUBJECT CODE: CELE1-102
ENGINEERING DRAWING (ELECTRICIAN)

LEARNING OUTCOME:

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

- Identify and use engineering drawing materials and instruments.
- Prepare free hand sketches of electrical tools and instruments.
- Identify and use symbols of various electrical devices.
- Read and interpret electrical installation plans.
- Read and draw wiring diagrams of electrical installations, bell circuits etc.
- Read diagrams of MDB, ELCB, MCB.

Practical (48 hours)	**Theory**
• Introduction to engineering drawing instruments, materials, drawing board and drawing sheets (3 hours) • Different types of lines in engineering drawing as per BIS (3 hours) • Free hand sketching of electrical tools and instruments (6 hours) • Scales of drawings (2 hours) • Symbols used in electrical installations as per BIS (6 hours) • Drawing of fuse, MCB, ELCB, MDB, insulators (8 hours) • Wiring diagrams of electrical installations (10 hours) • Wiring diagram of bell circuits and staircase (10 hours)	

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Laboratory and practical work
- Viva-voce
- Sketching
- Drawing

UNIT – 1.3
SUBJECT CODE: CELE1-103
BASIC ELECTRICITY

LEARNING OUTCOME:

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

- Explain concepts of basic electricity terms
- Implement safety and preventive measures
- Identify and utilize various electrical accessories
- Identify and use symbols of electricity
- Draw and connect basic electrical circuits
- Calculate various electrical parameters

Practical (128 hours)	**Theory (32 hours)**
• Demonstration of safety signs, basic injury prevention, artificial respiration and use of fire extinguisher. (24 hours)	• Care and safety working habits. Types of fire extinguishers and usage. Introduction to Indian Electricity Rules (8 hours)
• Practice of using cutting pliers, screw drivers etc. Skinning cables and jointing practice of single strands/multi strand conductors. Practice of bare conductor joints like britannia, straight, T, western union joints. Practice of using micrometer, crimping tool, thimbles, lugs etc. Practice of soldering and brazing (56 hours)	• Define electricity terms (voltage, current, power) and symbols in electricity. Explanation and definition of conductors, insulators and semi-conductors. Types of wires/cables, joints and their uses. Solder, flux and brazing techniques (10 hours)
• Demonstration of electrical accessories e.g. switches, sockets, holders, plugs, MCB, ELCB, MCCB etc. (24 hours)	• Introduction to electrical accessories (6 hours)
• Verification of Ohm's Law. Calculate electrical energy. Verification of laws of series, parallel and combination circuits. (24 hours)	• Ohm's Law. Simple electrical circuit problems. Law of series, parallel and combination circuits. (8 hours)
	• Basic properties of material used for electrical conductors, insulators and electric devices like RLC, diode transistor

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Laboratory and practical work
- Viva-voce

UNIT- 1.4

SUBJECT CODE: CELE1-104

ELECTRICAL MEASURING INSTRUMENTS

LEARNING OUTCOME:

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

- Explain working principle of different measuring instruments
- Identify and use different measuring instruments
- Use various safety measures
- Connect the circuits as per given specifications
- Differentiate between AC and DC supply

Practical **(80 hours)**	**Theory** **(16 hours)**
• Measure voltage, current, resistance and power using ammeter and voltmeter (10 hours)	• Working principle of analog and digital ammeter and voltmeter, their connections and safety measures to be taken during use (2 hours)
• Identify different types of measuring instruments and their connectors (10 hours)	• Types of instruments (indicating, recording, integrating and effects based) (2 hours) • Deflecting torque, controlling torque, damping torque (2 hours)
• Measure insulation value of different cables using insulation tests (10 hours)	• Working of insulation tester and earth tester, safety measures to be taken during use of instruments (1 hour)
• Measure value of different resistors using multimeter and also note down their voltage and current variation in tabular form (10 hours)	• Multimeter – Principle of digital multimeter, study their different controls, frequently occurring problems in digital multimeter (2 hours)
• Measure power factor in polyphase circuit using voltmeter, ammeter and wattmeter (10 hours)	• Define power factor, working principle of power factor meter and their connections (2 hours)
• Perform the connections of 3 phase energy meter (10 hours)	• Working principle of 3 phase and single phase digital energy meter, their connection diagrams and errors during utilization (2 hours)

• Measure speed of motor using tachometer (7 hours)	• Working of tachometer, analog and digital tachometer (1 hour)
• Measure power of inductor using wattmeter (7 hours	• Working principle of wattmeter and connections (1 hour)
• Measuring intensity of various light sources using lux meter (6 hours)	• Working of lux meter (1 hour)

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Laboratory and practical work
- Viva-voce

UNIT - 1.5
SUBJECT CODE: CELE1-105
ELECTRICAL MACHINES - I

LEARNING OUTCOME:

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

- Identify various A.C. and D.C. electrical machines
- Identify and use various A.C. motors, D.C. motors and transformers
- Identify and utilize various instrument transformers like C.T./P.T.
- Assemble and dissemble small A.C. and D.C. motors, single phase transformers
- Identify and rectify general faults in electrical machines

Practical	**(128 hours)**	**Theory**	**(48 hours)**
• Identification of parts of D.C. machine	(12 hours)	• General concept of electrical machines	(5 hours)
• Connection of shunt generators. Voltage build-up in D.C. generator	(20 hours)	• Principle of D.C. generator, parts of D.C. generator	(5 hours)
• Identification of parts and terminals of D.C. motors.	(12 hours)	• Terms used in D.C. motors, types of D.C. motors	(5 hours)
• Practical application of D.C. motors and their uses	(28 hours)	• Starters used in D.C. motors	(15 hours)
• Identification of types of transformers	• (20 hours)	• Principles and working of transformers. 1ϕ and 3ϕ transformers	(8 hours)
• Demonstration of current and potential transformers, testing of transformer oil	(20 hours)	• Construction of transformers, dehydration and oil testing of transformer oil	(4 hours)
• Care and maintenance of transformers	(16 hours)	• Construction of instrument transformers like C.T./P.T.	(6 hours)

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Laboratory and practical work
- Viva-voce

SUBJECT CODE: CELE1-107
INDUSTRIAL TRAINING – I (4 Weeks)

The purpose of industrial training is to:

- Develop understanding regarding the size and scale of operations and nature of industrial/field work in which students are going to play their role after completing the courses of study.
- Develop confidence amongst the students through firsthand experience to enable them to use and apply institute based knowledge and skills to perform field activities
- Develop special skills and abilities like interpersonal skills, communication skills, attitudes and values.

It is needless to emphasize further the importance of Industrial Training of students during their one-year certificate programme. It is industrial training, which provides an opportunity to students to experience the environment and culture of world of work. It prepares students for their future role as skilled person in the world of work and enables them to integrate theory with practice.

An external assessment of 100 marks have been provided in the study and evaluation scheme of 1st semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

The instructor along with one industrial representative from the concerned trade will conduct performance assessment of students. The components of evaluation will include the following:

a) Punctuality and regularity 20%
b) Industrial training report 50%
c) Presentation and viva-voce 30%

UNIT – 2.1
SUBJECT CODE: CELE1-208
BASIC SCIENCES

LEARNING OUTCOMES:
After undergoing this unit, the students will be able to:

- Apply the basic principles of maths in solving the basic problems of the trade.
- Apply the basic principles of physics in solving the basic problems of the trade.

Practical	Theory (48 Hours)
	Mathematics • Basic Algebra – algebraic formula. Simultaneous equation – quadratic equations (4 hours) • Simultaneous linear equation in two variables (3 hours) • Arithmetic and geometric progression, sum of n-terms, simple calculations. (3 hours) • Mensuration – Find the area of regular objects like triangle, rectangle, square and circle; volumes of cube, cuboid, sphere cylinder (6 hours) • Trigonometry - Concept of angle, measurement of angle in degrees, grades and radians and their conversions, T-Ratios of Allied angles (3 hrs) • Co-ordinate Geometry - Cartesian and polar coordinates, conversion from cartesian to polar coordinates (2 hrs) • Concept of Differentiation and Integration (3 hrs)

	Physics • FPS, CGS, SI units, dimensions and conversions (2 hours) • Force, speed, velocity and acCELE1ration – Definition, units and simple problems (3 hours) • Stress and strain, modulus of elasticity (2 hours) • Heat and temperature, its units and specific heat of solids, liquids and gases (4 hours) • Electricity and its uses, basic electricity terms and their units, D.C. and A.C., positive and negative terminals, use of switches and fuses, conductors and insulators (5 hours) • Work, Power and Energy-Definition, units and simple problems (4 hours) • Concept of force, Inertia, Newton's First law of motion; momentum and Newton's second law of motion; Impulse; Newton's third law of motion. (2 hrs) • Friction and Lubrication (1 hour) • Law of conservation of energy (1 hour)

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/prototype making

UNIT - 2.2

SUBJECT CODE: CELE1-209

REPAIR AND MAINTENANCE OF ELECTRICAL INSTALLATIONS

LEARNING OUTCOMES:

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

- Identify various types of electrical installations and appliances
- Carry out trouble shooting and repair common faults in the electrical installations
- Install wiring of any building
- Install wiring for single and three phase motor connections
- Measure the earth resistance
- Carry out earthing and maintain it
- Install batteries and carry out maintenance of batteries
- Perform general repair and maintenance of domestic appliances
- Identify and use various types of luminaries

Practical	**(128 hours)**	**Theory**	**(32 hours)**

Domestic and Industrial Wiring

- Lab. or live project based wiring exercise. Making students familiar with selection of various items required
- Live/lab. Project on UPS/inverter wiring
- Termination of wires/cables on bus bar and motors using thimbles and cable glands
- Electric load calculation

(20 hours)

Earthing

- Practice on measurement of earth resistance
- Practice on maintenance of earthing/ earthing pit
- Practice on carrying out earthing

(24 hours)

Cell/Battery

- Practical exercise of battery connection
- Practical exercise on battery charging and maintenance

(28 hours)

Domestic Appliances

Repair and maintenance of following:

- Washing machine
- Immersion rod
- Hot plate
- Geyser – gas/electric
- Electric oven

Domestic and Industrial Wiring

- Different types of domestic wiring
- Types of switches/sockets/MCB/ELCB
- Types of wires/cables/sizes
- Types of panels/distribution boards
- Testing of wiring like continuity, insulation resistance, polarity testing etc.

(8 hours)

Earthing

- Types of earthing
- Need of earthing
- Measurement of earth resistance, study of earth tester
- Maintenance of earthing

(4 hours)

Cell/Battery

- Types of batteries, battery charging, series/parallel connection
- Care and maintenance of lead acid battery

(4 hours)

Domestic Appliances

Introduction to concept and types of various domestic appliances:

- Washing machine – types
- Fan – types/working
- Electric iron – types and working
- Inverter - concept of wiring
- Desert cooler connection
- Water pump
- Mixer/grinder

• Hair drier • Fans • Electric iron • Microwave oven • Inverter • Air cooler/water cooler/AC/Refrigerator connection • Mixer grinder • Water pump • Sandwich toaster • RO installation/repair (32 hours) **Luminaries** Practical exercises on connections of various types of luminaries like: • Single tube • Double tube • Sodium vapour • Mercury vapour • Neon lamps • Halogen lamps • Metal halides • CFL, LED etc. (24 hours)	• Immersion rod • Hot plate • Electric oven • Microwave oven • Hair drier • Electric toaster • Induction heating (8 hours) **Luminaries** • Introduction of various types of luminaries being used such as sodium, mercury, LED, CFL etc. • Connections of commonly used luminaries such as sodium vapour, mercury vapour, tube light, metal halide lamps, LED, CFL etc. • Single and double tube fluorescent lamp fitting connections (8 hours)

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/prototype making
- Viva-voce
- Software installation and operation

UNIT - 2.3
SUBJECT CODE: CELE1-210
ELECTRICAL MACHINES - II

LEARNING OUTCOME:
After undergoing this unit, students will be able to:

- Identify various AC motors, alternators
- Identify and utilize tools and instruments required for winding.
- Use various AC motors and AC motor starters
- Use alternator for practical needs
- Identify various winding material
- Wind and rewind small AC/DC motors and transformers

Practical (128 hrs)	**Theory (48 hrs)**
• Identification of parts of various single phase and 3 phase AC motors (20 hrs)	• Theory of single phase and 3 phase AC motors, construction, working and details of these motors (8 hrs)
• Practice on running on various starters like DOL, star delta, (20 hrs)	• Study of various starters used in 3 phase motors like DOL, start delta (8 hrs)
• Speed control and practical application of AC motors like squirrel cage, slip ring, synchronous motor, single phase motors-capacitor motors, universal motors, split phase motors, over-hauling of AC motors etc. (30 hrs)	• Care and maintenance of single phase and 3 phase synchronous motors. Theory of working and diagram of various single phase motors like capacitor motor, universal motor and split phase motor (12 hrs)
• Identification of parts and terminals of alternator. Connection for starting, and running of alternator. (20 hrs)	• Various parts of alternator (8 hrs)
• Practice on winding of small AC motors like ceiling fan and single phase transformers. (38 hrs)	• Material used in electrical machine winding. Theory of winding material used in winding purposes. Single phase motor and transformer winding techniques. (12 hrs)

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/prototype making
- Viva-voce
- Assembly and disassembly

UNIT - 2.4
SUBJECT CODE: CELE1-211
ELECTRICAL CONTROL AND SWITCHGEARS

LEARNING OUTCOME:
After undergoing this unit, students will be able to:

- Select and use switching devices
- Identify and use various types of fuse
- Identify and draw control circuit
- Identify ELCB, MCB and their utilization and installation
- Identify and utilize various tools and control instruments

Practical (96 hrs)	**Theory (32 hrs)**
• Demonstration of switchgear (8 hrs) • Electrical connection diagram of switch, isolator and circuit breaker (10 hrs)	• Introduction to switchgear, difference between switch, isolator and circuit breaker (2 hrs) • Concept of fuse, switch unit (2 hrs)
• Demonstration and study of various type of fuses, testing of fuses (10 hrs)	• Fuse and its purpose, types of fuse and their application (4 hrs)
• Practice of making electrical connections of M.C.B.; E.L.C.B.; M.C.C.B. installations (12 hrs) • Testing of M.C.B. and E.L.C.B. and other circuit breakers (10 hrs)	• Introduction to M.C.B., E.L.C.B., M.C.C.B; relay - salient features and their uses. (6 hrs) • Study of different circuit breakers (ACB, VCB, OCB, MCCB) and lightening arresters (6 hrs)
• Demonstration and study of control circuit and power circuit of D.O.L. starter (10 hrs) • Demonstration and study of control circuit and power circuit of star delta starter (8 hrs) • Demonstration and study of reversing the direction of three phase induction motor using contactor control circuit (10 hrs) • Demonstration of remote control circuit of three phase induction motor (8 hrs) • Study and demonstration of overload relay (10 hrs)	• Introduction to magnetic contactor control circuits and power circuit (6 hrs) • Application of contactor control circuit (6 hrs)

Means of Assessment

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/prototype making
- Viva-voce
- Assembly and disassembly

SUBJECT CODE: CELE1-213
INDUSTRIAL TRAINING – II (4 Weeks)

The purpose of industrial training is to:

- Develop understanding regarding the size and scale of operations and nature of industrial/field work in which students are going to play their role after completing the courses of study.
- Develop confidence amongst the students through firsthand experience to enable them to use and apply institute based knowledge and skills to perform field activities
- Develop special skills and abilities like interpersonal skills, communication skills, attitudes and values.

It is needless to emphasize further the importance of Industrial Training of students during their one-year certificate programme. It is industrial training, which provides an opportunity to students to experience the environment and culture of world of work. It prepares students for their future role as skilled person in the world of work and enables them to integrate theory with practice.

An external assessment of 100 marks have been provided in the study and evaluation scheme of 2nd semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

The instructor along with one industrial representative from the concerned trade will conduct performance assessment of students. The components of evaluation will include the following:

a) Punctuality and regularity 20%
b) Industrial training report 50%
c) Presentation and viva-voce 30%

7. RESOURCE REQUIREMENT

7.1 LIST OF TOOLS/EQUIPMENT

a) TRAINEES TOOL KIT FOR 30 TRAINEES +1 INSTRUCTOR

Sr. No.	Names of the Items	Quantity
1.	Steel Tape, 15 m length	31 Nos.
2.	Plier Insulated, 150 mm	31 Nos.
3.	Plier Side Cutting, 150 mm	31 Nos.
4.	Screw Driver, 100 mm	31 Nos.
5.	Screw Driver, 150 mm	31 Nos.
6.	Electrician Connector, screw driver insulated handle thin stem, 100 mm	31 Nos.
7.	Heavy Duty Screw Driver , 200 mm	31 Nos.
8.	Electrician Screw Driver thin stem insulated handle, 250 mm	31 Nos.
9.	Punch Centre , 150 mm X 9 mm	31 Nos.
10.	Knife Double Bladed Electrician	31 Nos.
11.	Neon Tester	31 Nos.
12.	Steel Rule 300 mm	31 Nos.
13.	Hammer, cross peen with handle	31 Nos.
14.	Hammer, ball peen With handle	31 Nos.
15.	Gimlet 6 mm.	31 Nos.
16.	Bradawl	31 Nos.
17.	Scriber (Knurled centre position)	31 Nos.
18.	Pincer 150 mm	31 Nos.

b) SHOP TOOLS, INSTRUMENTS AND MACHINERY

Sr. No.	Names of the Items	Quantity
1.	C- Clamp 200 mm, 150 mm and 100 mm	2 Nos each
2.	Spanner Adjustable 150 mm,300mm	2 Nos each
3.	Blow lamp 0.5 ltr	1
4.	Melting Pot	1
5.	Ladel	1No
6.	Chisel Cold firmer 25 mm X 200 mm	2
7.	Chisel 25 mm and 6 mm	2 Nos each
8.	Hand Drill Machine	1
9.	Portable Electric Drill Machine 6 mm capacity	1
10.	Pillar Electric Drill Machine 12 mm capacity	1
11.	Allen Key	1 set
12.	Oil Can 0.12 ltr	1
13.	Grease Gun	1 No
14.	Outside Micrometer	2
15.	Motorised Bench Grinder	1

16.	Rawl plug tool and bit	2 set
17.	Pulley Puller	2
18.	Bearing Puller	2
19.	Pipe vice	4
20.	Thermometer 0 to 100 deg Centigrade	1 No.
21.	Scissors blade 150 mm	4 Nos.
22.	Crimping Tool	2 sets
23.	Wire stripper 20 cm	2 Nos.
24.	Chisel Cold flat 12 mm	2 Nos.
25.	Mallet hard wood 0.50 kg	4 Nos.
26.	Hammer Extractor type 0.40 kg	4 Nos.
27.	Hacksaw frame 200 mm 300 mm adjustable	2 Nos.each
28.	Try Square 150 mm blade	4 Nos.
29.	Outside and Inside Divider Calliper	2 Nos.each
30.	Pliers flat nose 150 mm	4 Nos.
31.	Pliers round nose 100 mm	4 Nos.
32.	Tweezers 100 mm	4 Nos.
33.	Snip Straight and Bent 150 mm	2 Nos.each
34.	D.E. metric Spanner	2 Nos.
35.	Drill hand brace	4 Nos.
36.	Drill S.S. Twist block 2 mm, 5 mm 6 mm set of 3	4 Set
37.	Plane, smoothing cutters 50 mm	2 Nos.each
38.	Gauge, wire imperial	2 Nos.
39.	File flat 200 mm 2nd cut	8 Nos.
40.	File half round 200 mm 2nd cut	4 Nos.
41.	File round 200 mm 2nd cut	4 Nos.
42.	File flat 150 mm rough	4 Nos.
43.	File flat 250 mm bastard	4 Nos.
44.	File flat 250 mm smooth	4 Nos.
45.	File Rasp, half round 200 mm bastard	4 Nos.
46.	Soldering Iron 25 watt, 65 watt, 125 watt	2 Nos.each
47.	Copper bit soldering iron 0.25 kg.	2 Nos.
48.	Desoldering Gun	4 Nos.
49.	Hand Vice 50 mm jaw	4 Nos.
50.	Table Vice 100 mm jaw	8 Nos.
51.	Pipe Cutter to cut pipes upto 5 cm. dia	4 Nos.
52.	Pipe Cutter to cut pipes above 5 cm dia	2 Nos.
53.	Stock and Die set for 20 mm to 50 mm G.I. pipe	1 set
54.	Stock and Dies conduit	1 No.
55.	Ohm Meter; Series Type & Shunt Type	2 Nos. each
56.	Multi Meter (analog) 0 to 1000 M Ohms,2.5 to 500 V	2 Nos.
57.	Digital Multi Meter	6 Nos.
58.	A.C. Voltmeter M.I. 0 –500V A.C	1 No.
59.	Milli Voltmeter centre zero 100 – 0 – 100 m volt	1 No.
60.	D.C. Milli ammeter 0 -500m A	1 No.
61.	Ammeter MC 0-5 A, 0- 25 A	1 No. each
62.	A.C. Ammeter M.I. 0-5A, 0-25 A	1 No. each
63.	Kilo Wattmeter 0-1-3 kw	1 No.

64.	A.C. Energy Meter, Single phase 5 amp. Three Phase 15 amp	1 No. each
65.	Power Factor Meter	1 No.
66.	Frequency Meter	1 No.
67.	Flux meter	1 No.
68.	Wheatstone Bridge with galvanometer and battery	1 No.
69.	Laboratory Type Induction Coil	1 No.
70.	DC Power Supply 0-30V, 2 amp	1 No.
71.	Rheostat 0 -1 Ohm, 5 Amp 0 -10 Ohm, 5 Amp 0- 25 Ohm, 1 Amp 0- 300 Ohm, 1 Amp	1 No. each
72.	1 Phase Variable Auto Transformer	1 No.
73.	Battery Charger	1 No.
74.	Hydrometer	1 No.
75.	Miniature Breaker 16 amp (Raw Material)	1 No.
76.	Working Bench 2.5 m x 1.20 m x 0.75 m	4 Nos.
77.	Fire Extinguisher CO2, 2 KG	2 Nos.
78.	Fire Buckets	2 Nos.
79.	Tachometer	1 No.
80.	Current Transformer 415 Volt,50 Hz, CT Ratio 150 / 5 Amp, 5VA	1 No.
81.	Potential Transformer 415 Volt,50Hz, PT Ratio 11KV/ 110V, 10VA	1 No.
82.	Growler	1 No.
83.	Tong Tester / Clamp Meter 0 – 100 amp. AC	1 No.
84.	Megger 500 volts	1 No.
85.	Contactor & auxiliary contacts 3 phase, 440volt, 16amp (Raw Material)	1 No. each
86.	Contactor & auxiliary contacts 3 phase, 440 volt, 32 amp. (Raw Material)	1 No. each
87.	Limit Switch (Raw Material)	1 No.
88.	Rotary Switch 16 A (Raw Material)	1 No.
89.	Load Bank 5 KW(Lamp / heater Type)	1 No.
90.	Brake Test arrangement with two spring balance 0 to 25 kg rating	1 No.
91.	Knife Switch DPDT fitted with fuse terminals 16 amp (Raw Material)	4 Nos.
92.	Knife Switch TPDT fitted with fuse terminals 16 amp (Raw Material)	4 Nos.
93.	Voltage Stabiliser Input: 150 – 230 volt AC Output: 220 volt AC	1 No.
94.	Motor-Generator (AC to DC) consisting of : Squirrel Cage Induction Motor with star delta starter and directly coupled to DC shunt generator and switch board mounted with regulator, air breaker, ammeter, voltmeter, knife blade switches and fuses, set complete with case iron and plate, fixing bolts, foundation bolts and flexible coupling. Induction Motor rating: 7 HP, 400V, 50 cycles, 3 phase DC Shunt Generator rating: 5 KW, 440V	1 No.

95.	Used DC Generators-series, shunt and compound type for overhauling practice	1 No. each
96.	D.C. Shunt Generator with control panel,2.5 KW, 220V	1 No.
97.	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker, 2.5 KW, 220 V	1 No.
98.	Diesel Generator Set with change over switch, over current breaker and water-cooled with armature, star-delta connections AC 3 phase, 5 KVA, 240 volt	1 No.
99.	DC Series Motor coupled with mechanical load 0.5 to 2 KW, 220 Volts	1 No.
100.	DC Shunt Motor 2 to 2.5 KW, 220 volts	1 No.
101.	DC compound Motor with starter and switch 2 to 2.5 KW, 220 volts	1 No.
102.	Single phase Transformer, core type, air cooled 1 KVA , 240/415 V, 50 Hz	1 No.
103.	Three phase transformer, shell type oil cooled with all mounting 3 KVA , 415/240 V, 50 Hz , (Delta/Star)	1 No.
104.	Oil Testing Kit	1 No.
105.	Hygrometer	1 set
106.	a. Cut out relays b. Reverse current c. Over current d. Under voltage	1 No. each
107.	Starters for 2 to 5 H.P. A.C Motors a. Resistance type starter b. Direct on line Starter c. Star Delta Starter- manual, semi-automatic and automatic d. Auto Transformer type	1 No. each
108.	Motor Generator(DC to AC) set consisting of - Shunt Motor with starting compensator and switch directly coupled to AC generator with exciter and switch board mounted with regulator, breaker, ammeter, voltmeter frequency meter, knife blade switch and fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts and flexible coupling. Shunt Motor rating : 5 HP, 440V AC Generator rating : 3-Phase, 4 wire, 3.5 KVA, 400/230 Volts, 0.8 pf, 50 cycles	1 No.
109.	AC Squirrel Cage Motor with star delta starter and triple pole iron clad switch fuse. 2 to 3 HP, 3-phase ,400 volts, 50 cycles	1 No.
110.	AC phase-wound slip ring Motor with starter and switch 5 HP, 400 volts, 3-phase, 50 cycles	1 No.
111.	A.C. Series type Motor with mechanical load ¼ HP, 230V, 50 Hz	1 No.
112.	Single Phase Capacitor Motor with starter switch 1 HP 230 volt 50 cycles	1 No.
113.	Universal Motor with starter/switch 230 volt, 50 cycles ¼ HP	1 No.
114.	Bath Impregnating	1 No.
115.	Oven Stove	1 No.
116.	Synchronous motor 3 Phase, 3 HP, 415V, 50Hz, 4 Pole, with accessories.	1 no.

117.	Lux meter	1 no.
118.	Inverter- 1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	1 No.
119.	Domestic Appliances – a. Electric Hot Plate 1500 watt b. Electric Kettle, 1500 watts c. Electric Iron 1500 watts d. Immersion Heater 1500 watt e. A.C. Fan f. Geyser (Storage type) 15 ltr minimum g. Mixture & Grinder	 1 No. 1 No. 1 No. 1 No. 1 No. 1 No. 1 No.
120.	Washing Machine	1 No.
121.	Motor Pump set 1 HP, 1 Phase, 240 V	1 No.
122.	Pin Type, shackle type & suspension type insulators (Raw Material)	2 Nos. each

7.2 LIST OF CONSUMABLES

1.	Different types of electrical wires and cables	As required
2.	Different types of MCBs and ELCBs	As required
3.	Different types of resistors	As required
4.	Different types of capacitors	As required
5.	Different types of inductors	As required
6.	Different types of transformers	As required
7.	Different types of connectors	As required
8.	Different types of plugs and sockets	As required
9.	Solder wire	As required
10.	Conduit pipes of various sizes	As required
11.	Junction box	As required
12.	Distribution box	As required
13.	Wooden boards/PVC boards	As required

7.3 LIST OF RECOMMENDED BOOKS

1. Electrician Trade Practical, Sem-I (2 Years), Published by NIMI, Guindy, Chennai.
2. Electrician Trade Practical, Sem-II (2 Years), Published by NIMI, Guindy, Chennai.
3. Electrician Trade Theory, Sem-I (2 Years), Published by NIMI, Guindy, Chennai.
4. Electrician Trade Theory, Sem-II (2 Years), Published by NIMI, Guindy, Chennai.
5. Electrician Trade Theory, 2nd Year, Available in Hindi, Published by NIMI, Guindy, Chennai.
6. Electrician Trade Theory, 1st Year, Available in Hindi, Published by NIMI, Guindy, Chennai.
7. Electrician Trade Practicals, 1st Year, Published by NIMI, Guindy, Chennai.
8. Electrician Trade Practicals, 2nd Year, Published by NIMI, Guindy, Chennai.
9. Basic Shop Practicals in Electrical Engineering (1st and 2nd Year) by M.L. Anwani, Published by Dhanpat Rai & Co. Pvt. Ltd., Delhi.
10. Basic Shop Practical by Mehta and Gupta, Published by Dhanpat Rai Publishing Company, Noida.
11. Basic Electrical Engineering (as per NIMI pattern) by M.L. Anwani, Published by Dhanpat Rai & Co. Pvt. Ltd., Delhi.
12. Basic Electrical Engineering by Mehta and Gupta, Published by Dhanpat Rai Publishing Company, Noida.
13. Elementary Electrical Engineering (as per NIMI pattern) by G.L. Marwaha, Published by Royal Book Depot (Regd.), Jalandhar City.

8. RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION AND EVALUATION

Since this skill development course is tailor made i.e. designed to meet the requirement of selected group of students for developing desired competencies in the given trade, it is pertinent for trainers to understand the design philosophy and arrange teaching-learning process using appropriate strategies. The following points may be considered by the trainer at the time of planning the training programme and subsequently during the implementation and evaluation stages:

1. There are multiple competencies in each unit. The course curriculum also includes a core unit on developing effective communication and entrepreneurial qualities. Each unit has specific competencies which trainees are expected to acquire at the end of the each unit. In order to achieve these competencies, the curriculum describes the practice tasks/exercises and related theoretical knowledge. Time has been allocated for both of these components.

2. The curriculum is designed for contact period of 35 hours per week but can be increased/changed as per convenience of the trainees and the trainer.

3. The trainer will assess the attainment of each specific learning outcome of the individual learner and will maintain record whether the trainee has achieved desired level i.e. Yes/No. In case of 'No' the trainee will work further to learn and attain the desired skills till s/he earns 'Yes'.

4. Each learning outcome will be assessed/tested by the trainee as per acceptable norms and record will be maintained for final certification. The final assessment of skills attained through practice jobs and acquisition of relevant knowledge should preferably be carried out appropriately.

5. The examiner will set an objective type question paper for theory examinations of each unit under final assessment. Preferably the question paper should aim at testing the understanding of basic principles and concepts by students and their applications.

6. The final assessment of practical skills development should not be limited to testing a few units, but should spread over to all the acquired skills in an integrated manner. It should ultimately assess the ability of the student to accomplish the desired learning outcomes of the programme.

9. LIST OF CONTRIBUTORS/EXPERTS

a) Following experts participated in the workshop to design curriculum of certificate programme in 'Electrician' with NSQF alignment for MRSPTU, Bathinda on 29-30 August, 2016 at NITTTR, Chandigarh.

1.	Dr. Ashok Kumar Goel, Professor & Head, Electronics and Communication Engineering Department and Director, College Development Council, MRSPTU Campus, Dabwali Road, Bathinda, Punjab
2.	Kanwar H.S. Dhindsa, Vice President, Mohali Industries Association, Mohali
3.	Shri Parmod Kumar Verma, Prop. M/S Pee Kay Trading Co., Manimajra
4.	Shri Anil Rana, M/S Rana & Rana Electrical Works, Sector 28, Chandigarh
5.	Shri Sukhvir Singh, Electrician Instructor, Govt. Industrial Training Institute, Patiala, Punjab
6.	Shri Sarabjeet Singh, Electrician Instructor, Govt. Industrial Training Institute, Patiala, Punjab
7.	Shri Ravinder Kaushal, Electrician Instructor, Govt. Industrial Training Institute, Sector-28, Chandigarh
8.	Shri ML Rana, HOD, Electrical Engineering Department, CCET (Diploma Wing), Sector-26, Chandigarh
9.	Shri Mukesh Kumar, Electrical Instructor, CCET (Diploma Wing), Sector-26, Chandigarh
10.	Mrs. Poonam Syal, Associate Professor, Electrical Engineering Department, NITTTR, Chandigarh
11.	Shri Hans Raj Sharma, Electrical Engineering Department, NITTTR, Chandigarh
12.	Shri Vinod Kumar Sharma, Electrical Engineering Department, NITTTR, Chandigarh
13.	Dr. AB Gupta, Professor & Head, Curriculum Development Centre, NITTTR, Chandigarh
14.	Prof. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh **Coordinator**

b) Following experts participated in the workshop to review the curriculum of certificate programme in 'Electrician' for MRSPTU, Bathinda on 20 January, 2017 at NITTTR, Chandigarh:

1.	Dr. MM Malhotra, Ex-Principal, TTTI, Chandigarh
2.	Shri Arvind Dixit, Advance Technology, Sector 24, Chandigarh
3.	Dr. Ashok Kumar Goel, Director, College Development Council, MRSPTU, Bathinda, Punjab
4.	Shri Kulmohan Singh, Ex-HOD, Electrical Engg., CCET (Diploma Wing), Sector 26, Chandigarh
5.	Shri HS Kalra, Ex-Principal, Govt. Industrial Training Institute, Sector-28, Chandigarh
6.	Shri Rakesh Goel, Estate Officer, NITTTR, Chandigarh
7.	Shri Pritpal Singh Aulakh, GZSCCET, Bathinda
8.	Shri Naib Singh, Sr. Technician, GZSCCET, Bathinda
9.	Shri Jagdip Singh, , Sr. Technician, GZSCCET, Bathinda
10.	Prof. PK Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh
11.	Dr. AB Gupta, Professor & Head, Curriculum Development Centre, NITTTR, Chandigarh **Coordinator**