Government of Karnataka
Department of Collegiate and Technical Education
Board of Technical Examinations, Bangalore

Course Code	**20EE21P**	**Semester**	**II**
Course Title	**Residential Electrical Wiring Practice**	**Course Group**	Core
No. of Credits	**4**	**Type of Course**	Lecture & Practical
Course Category	**PC**	**Total Contact Hours**	6 Hrs Per Week
			78 Hrs Per Semester
Prerequisites	Fundamental of Electrical and Electronics Engineering	**Teaching Scheme**	**(L:T:P)-1:0:2**
CIE Marks	**60**	**SEE Marks**	**40**

RATIONALE

Residential electrical wiring involves the design, estimation and physical wiring of a residential building for voltages less than 650V by an Electrician. A diploma student who is willing to take Electrician as a profession must have good knowledge of different types of wiring that is being carried out according to the budget of house owner. Studying this course enhances the skill of the student to utilize the resources-best design, latest technology and longevity of house wiring in best possible way that is also cost effective keeping the protection of wiring, house hold gadgets and property.

1. COURSESKILL SET

The aim of the course is to help the student to attain the following industry identified competency through various teaching –learning experiences

- Good Knowledge of different types of wiring that is being carried out according to the budget
- Skills to utilize the resources-best design, latest technology and longevity of house wiring in best possible way that is also cost effective keeping the protection of wiring, house hold gadgets and property.
- To carry out all sorts of troubleshooting in electrical circuits of domestic wiring, and fault repair

2. INSTRUCTIONAL STRATEGY

1. Instructor should expose students to different tools used in electrical wiring, Operational safety and Procedure to be followed in domestic wiring.
2. Focus should be on proper selection and sizing of wires, cables and use of protective devices as well as on testing and troubleshooting of electrical faults.

3.COURSE OUT COMES

On successful completion of the course, the students will be able to

CO1	Comply with the safety procedures and standards.
CO2	Select cables, wiring, optimize accessories and forecast.
CO3	Develop and test wiring installations as per standards and customer requirement.
CO4	Troubleshoot and repair the wiring installations for proper working.

4. COURSE TOPICS

Sl No.	Unit Name	Lecture Hours	Practical Hours	Total Hours
1	**Health & Safety practices at the work place**	01	02	03
2	**Planning & Design**	07	14	21
3	**Installation & Testing**	12	24	36
4	**Fault Location &Earthing**	06	12	18
	TOTAL	**26**	**52**	**78**

5. DETAILS OF COURSE CONTENT

Unit No.	Unit skill set (In cognitive domain)	Topics/Sub topics	Hours		
			L	T	P
UNIT-1 **Basic Health & Safety** **practices at the work place**	• To understand basic health and safety practices covering CEA safety regulations 2010 • To study use of PPE equipment's • Good housekeeping practices and disposal of waste.	1. Identify Various types of safety signs 2. Demonstrate and practice use of PPE 3. Demonstrate how to free a person from electrocution 4. Administer appropriate first aid 5. Fire safety, causes and precautionary activities. Use of appropriate fire extinguishers on different types of fires 6. Demonstrate rescue techniques during fire hazard, Inform relevant authority about any abnormal situation.	**1**	**0**	**2**
UNIT-II **Planning & Design**	**Read, interpret and revise drawings, Installation descriptions and manuals related to Internal Wiring.** • Layout and Circuit drawings • Follow written instructions • Plan installation • Work using drawing and documentation provided • Ensure correct requirement of wires, cables, fuse,	1. Identify, specify, dismantle and assemble different types of Lighting accessories (Switches, Socket Outlets, Plugs and Lamp holders)	**1**	**0**	**2**
		2. Identify different types of cables with specifications based on: • Materials • Voltage ratings • Sizes • Insulation Strands & Core	**1**	**0**	**2**
		3. Measure the wire sizes of different cables.			
		4. Current rating of Single core Copper and Aluminum conductors of different sizes.			
		5. Identify, specify, dismantle and	**1**	**0**	**2**

Unit No.	Unit skill set (In cognitive domain)	Topics/Sub topics	Hours		
			L	T	P
	switches and other electrical accessories for optimal expenditure •Ensure wiring and points selected in wiring are according to load growth in future	assemble different types of LT Switchgears and Protective devices. (Main Switch, Distribution Boards, Fuse, MCB, RCCB).			
		6. Identify, Specify and Select different types of Conduits and its accessories.			
		7. Interpret the various BIS symbols used in electrical wiring diagrams 8. Interpret Manufactures Catalogue for Cables and wiring accessories. 9. B.I.S Regulations, Recommendations and the National Electrical Code of practice pertaining to wiring installations.	**1**	**0**	**2**
		Concept of Phase wire, Neutral wire, Earth wire and Half wire and determining the size of conductors. 10. Concept of Layout plan (Wiring plan), Layout diagram (Wiring Layout), Installation plan, Circuit (schematic) diagram and Wiring diagram.	**1**	**0**	**2**

Unit No.	Unit skill set (In cognitive domain)	Topics/Sub topics	Hours L	Hours T	Hours P
		11. Wiring circuits – planning, permissible load in sub circuits, estimation of load, cable size. 12. Prepare a layout diagram, circuit / schematic diagram, installation plan and wiring diagram for the following: a) A bed room with 2 Lamps, 1 fan and one 5A socket. b) A living room with 4 Lamps, 2 fans and three 5A socket. c) A Kitchen with one 15A socket, one 5A socket, one light point and one Exhaust fan. d) A bathroom with one 15A socket, one 5A socket and one light point.	**1**	**0**	**2**
		13. Conduitwiring –Bending procedure of conduits, Drawing of cables through conduits.	**1**	**0**	**2**
UNIT-III **Installation& Testing**	**<u>Installation of wiring system</u>** **1.** Select and Install equipment's and wire ways as per drawings and documents provided. **(Surface Conduit)** **2.** Install conduits, accessories and attach securely onto surface. **3.** Install Electrical Switchboards onto surface. **4.** Draw and terminate the cables insidethe	**1)** Prepare the different wirings methods and joints. • Switch loop in • Junction box Loop in • Ceiling Rose Loop in • Simple Twist Joint • Married Joint in Stranded conductors	**1**	**0**	**2**
		2) Identify the phase and neutral terminals of the supply.	**1**	**0**	**2**
		1. Testing domestic wiring installation: • Continuity test (OC & SC Test) • Polarity test			

Unit No.	Unit skill set (In cognitive domain)	Topics/Sub topics	Hours		
			L	T	P
	switchboard and conduits according to circuit drawing. **<u>Test installations before energizing to ensure personal and electrical safety to include:</u>** 1. Check correct polarity of all Control and Protective Devices. 2. Short circuit test, Open circuit test, Insulation resistance and earth continuity test. 3. Checking complete function on all equipments installed to ensure correct operation of new installation as per instruction. 4. Set the installation to fully functioning and ensure customer can operate.	• Earth and ground test • Insulation and leakage test			
		4) Prepare layout diagram, installation plan and wiring diagram according to National electrical code for the following wiring installations on a board in PVC Surface conduit wiring system. Install, test and ensure the functioning of the wiring installation.			
		1. Two lamps controlled independently. 2. Two lamps in series controlled by one switch.	**1**	**0**	**2**
		3. One lamp, one fan and one three pin socket controlled from one switchboard.	**1**	**0**	**2**
		4. One lamp controlled from three different places. **(Intermediate wiring)** 5. Consumer main board with Energy meter, Double pole iron Clad Switch and Distribution Board.	**1**	**0**	**1**
		5) Anelectrical installation having one room having 2 light points, 1 fan point and one 5A socket. One light point and fan are controlled from two locations.**(One lighting sub circuit and multiple switchboards)**	**1**	**0**	**2**
		6) An electrical installation having • Two rooms with 1 light point, one fan point and one 5A socket. • One living room with two 5A sockets, 1 fan points and 2 light points. **(Two lighting sub-circuits and multiple switchboards)**	**2**	**0**	**4**
		7) An electrical installation having four 15A sockets and 4 light	**2**	**0**	**4**

Unit No.	Unit skill set (In cognitive domain)	Topics/Sub topics	Hours L	Hours T	Hours P
		points. **(TwoPower sub-circuits and one lighting sub-circuit)**			
		8) Design a 2BHK residential installation scheme and estimate the materials required. Draw the layout diagram; installation plan and wiring diagram according to National electrical code for the following wiring installations.Also prepare the bill of materials.	**2**	**0**	**4**
UNIT-IV **Fault Location & Earthing**	**Fault location** • Diagnose the electrical installation and identify the problems such as bad connection, polarity of control and protective devices, incorrect wiring and equipment failure. **Earthing** • Prepare the plate, pipe for earthing according to ISI standard(IS : 3043 – 1987) • Test the earthing and measure the earth resistance using earth tester / Megger.	• Various faults in residential wiring. • Procedure for fault locating. • Checking the function of each component for proper functioning.	**2**	**0**	**4**
		• Reasons for system and equipment earthing • Terminologies related to earthing • Characteristics of TN,TT and IT systems	1	0	**2**
		• Methods of preparing pipe earthing and plate earthing, according to B.I.S. recommendations.	3	0	**6**
		• Specifications of Pipe Earthing			
		• Specifications of Plate Earthing			
		TOTAL	**26**	**0**	**52**

6. SUGGESTED PRACTICAL SKILL EXERCISES

Unit No.	Practical Outcomes / practical exercises)	Unit No.	PO	CO	Hours		
					L	T	P
1	1) Demonstrate and practice use of PPE 2) Demonstrate how to free a person from electrocution 3) Demonstrate rescue techniques applied during fire hazard, correct method to move injured people during emergency 4) Use of appropriate fire extinguishers on different types of fires	1	1,4	1	0	0	2
2	Identify, specify, dismantle and assemble different types of Lighting accessories (Switches, Socket Outlets, Plugs and Lamp holders)	2	1,4	2	0	0	2
3	Identify, Measure the wire sizes and find the Current rating of different types of Single core Copper and Aluminum cables.	2	1,4	2	0	0	2
4	Identify, specify, dismantle and assemble different types of Conduits and its accessories, LT Switchgears and Protective devices. (Main Switch, Distribution Boards, Fuse, MCB, RCCB).	2	1,4	2	0	0	2
5	• Interpret the various BIS symbols used in electrical wiring diagrams. • Interpret Manufactures Catalogue for Cables and wiring accessories. • B.I.S Regulations, Recommendations and the National Electrical Code of practice pertaining to wiring installations.	2	1,4	2	0	0	2
6	• Identify the Phase wire, Neutral wire, Earth wire and Half wire in a switchboard. • Estimatethe permissible load in sub circuits and calculation of cable sizes.	2	1,4	2	0	0	2
7	Prepare a layout diagram, circuit / schematic diagram, installation plan and wiring diagram for the following: a) A bed room with 2 Lamps, 1 fan and one 5A socket. b) A living room with 4 Lamps, 2 fans and three 5A socket. c) A Kitchen with one 15A socket, one 5A socket, one light point and one Exhaust fan. d) A bathroom with one 15A socket, one 5A socket and one	2	1,4	2	0	0	2

Unit No.	Practical Outcomes / practical exercises)	Unit No.	PO	CO	Hours		
					L	T	P
	light point.						
8	Practice conduits bending, drawing of cables through conduits. (**on a board** in **PVC Surface conduit wiring system**)	**2**	**1,4**	**2**	**0**	**0**	**2**
9	Practice the different wirings methods and joints. • Switch loop in • Junction box Loop in • Ceiling Rose Loop in • Simple Twist Joint • Married Joint in Stranded conductors	**3**	**1,4**	**3**	**0**	**0**	**2**
10	Identify the phase and neutral terminals of the supply and perform the following test on domestic wiring installation: • Continuity test (OC & SC Test) • Polarity test • Earth and ground test • Insulation and leakage test	**3**	**1,4**	**3**	**0**	**0**	**2**
Install, test and ensure the functioning of the wiring installation by preparing layout diagram, installation plan and wiring diagram according to National electrical code for the following wiring installations on a board in PVC Surface conduit wiring system.							
11	• Two lamps controlled independently. • Two lamps in series controlled by one switch.	**3**	**1,4**	**3**	**0**	**0**	**2**
12	One lamp, one fan and one three pin socket controlled from one switchboard.	**3**	**1,4**	**3**	**0**	**0**	**2**
13	One lamp controlled from three different places. **(Intermediate wiring)**	**3**	**1,4**	**3**	**0**	**0**	**2**
14	Consumer main board with Energy meter, Double pole iron Clad Switch and Distribution Board.	**3**	**1,4**	**3**	**0**	**0**	**2**
15	An electrical installation having one room having 2 light points, 1 fan point and one 5A socket. One light point and fan are controlled from two locations.**(One lighting sub circuit and multiple switchboards)**	**3**	**1,4**	**3**	**0**	**0**	**2**
16	An electrical installation having • Two rooms with 1 light point, one fan point and one 5A socket.	**3**	**1,4**	**3**	**0**	**0**	**4**

Unit No.	Practical Outcomes / practical exercises)	Unit No.	PO	CO	Hours		
					L	T	P
	• One living room with two 5A sockets, 1 fan points and 2 light points. **(Two lighting sub-circuits and multiple switchboards)**						
17	An electrical installation having four 15A sockets and 4 light points. **(Two Power sub-circuits and one lighting sub-circuit)**	**3**	**1,4**	**3**	**0**	**0**	**4**
18	Design a 2BHK residential installation scheme and estimate the materials required. Draw the layout diagram; installation plan and wiring diagram according to National electrical code for the following wiring installations. Also prepare the bill of materials.	**3**	**1,4**	**3**	**0**	**0**	**2**
19	• Perform the basic electrical tests on the given wiring system and identify the problems such as bad connection, incorrect wiring and equipment failure if any. • Locate various faults in residential wiring and rectify them. • Check the function of each component for proper functioning.	**4**	**1,4**	**4**	**0**	**0**	**4**
20	Prepare pipe earthing and **measure the earth resistance using earth tester / Megger.**	**4**	**1,4**	**4**	**0**	**0**	**4**
21	Prepare plate earthing and **measure the earth resistance using earth tester / Megger.**	**4**	**1,4**	**4**	**0**	**0**	**4**
				TOTAL			**52**

7. MAPPING OF CO WITH PO

CO	Course Outcome	PO Mapped	Experiment Linked	Cognitive Level R/U/A	Tutorial & Practical Sessions in Hrs
CO1	Comply with the safety procedures and standards	**PO1,PO4**	**1**	**A**	**3**
CO2	Select cables, wiring, optimize accessories and forecast.	**PO1,PO4**	**2,3,4,5,6,7,8**	**A**	**21**
CO3	Develop and test wiring installations as per standards and customer requirement.	**PO1,PO4**	**7,8,9,10,11, 12,13,14,15, 16**	**A**	**36**
CO4	Troubleshoot and repair the wiring installations for proper working.	**PO1,PO4**	**17,18,19**	**A**	**18**
Total					**78**

8. LEVEL OF MAPPING PO's with CO's

Course	CO's	Programme Outcomes (PO's)						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Residential Electrical Wiring Practice	**CO1**	**3**	0	0	**3**	0	0	0
	CO2	**3**	0	0	**3**	0	0	0
	CO3	**3**	0	0	**3**	0	0	0
	CO4	**3**	0	0	**3**	0	0	0
Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0-Not Mapped								

9.SUGGESTED LEARNING RESOURCES:

1) A Course in Electrical Installation Estimating &Costing: J.B GUPTA, Katson Books.
2) Electrical Design Estimating & Costing: K.B.Raina & S.K.Bhattacharya, New Age International Publishers.
3) Electrician - Trade Practical &Trade Theory, Semester-2 (NSQF LEVEL 5), National Instructional Media Institute (NIMI),Chennai
4) IS 732 (1989): Code of Practice for Electrical Wiring Installations

10.List of Software/Learning Websites

1. Electrical switch board wiring diagram !Diy house wiring
   https://www.youtube.com/watch?v=JmwL-3rhgwY
2. How to fit a flush double metal back box and double socket into a solid brick wall
   https://www.youtube.com/watch?v=1zMGbqJ7M64
3. single phase meter wiring diagram
   https://www.youtube.com/watch?v=5YNSiE7HWsY
4. Two Way Switching Explained - How to wire 2 way light switch
   https://www.youtube.com/watch?v=opoEswRp_jg
5. Three way light switching | Intermediate switch
   https://www.youtube.com/watch?v=SUlt4ouCYPU
6. Rcc Slab || Electrical Conduit Pipe || Working Process || House Wiringhttps://www.youtube.com/watch?v=5PtXIWjLpnc
7. what is Ground ? Earth / Ground earthing
   https://www.youtube.com/watch?v=zLW_7TPf310
8. Pipe Earthing
   https://www.youtube.com/watch?v=8PTNjw-hQIM

11. Suggested list of student Activities

1) Troubleshoot a given wiring system and make a report on procedures followed to locate faults.
2) Estimate the materials required for wiring a domestic house, lab etc. and prepare a cost estimate.
3) Interact with an electrical contractor and involve in a physical wiring work and make a report of all activities.

4) Preparing extension box, switch box and wiring models, simple panel board, and distribution board, building wiring of a lab/ room, etc

12.ASSESSMENT FOR THEORY –PRACTICAL (P) COURSES

Sl.No	Assessment	Duration	Max marks	Conversion	
1.	CIE Assessment 1 (Written Test -1-theory) - At the end of **3rd week**	60 minutes	20	Average of two written tests 20	
2.	CIE Assessment 2 (Written Test -2-theory) - At the end of **13th week**	60 minutes	20		
3.	CIE Assessment 3 (Skill test) - At the end of **5th week**	3 Hours	100	20	Average of three skill tests 20
4	CIE Assessment 4 (Skill test) - At the end of **7th week**	3 Hours	100		
5	CIE Assessment 5 (Skill test) - At the end of **9th week**	3 Hours	100		
6	CIE Assessment 6 (Student activity) - At the end of **11th week**	-	20	20	
7.	Total Continuous Internal Evaluation (CIE) Assessment			60	
8.	Semester End Examination (SEE) Assessment (Practical Test)	3 Hours	100	40	
Total Marks				**100**	

Note:

1. CIE written test is conducted for 20 marks (Two sections). Each section shall have two full questions of same CL, CO. Student shall answer one full question (10 marks) from each section.

2. CIE Skill test is conducted for 100 marks (3 Hrs duration) as per scheme of evaluation and the obtained marks are scaled down to 20 marks.

12. SCHEME OF VALUATION FOR SKILL TEST CIE &SEE

(CONTINOUS INTERNAL &SEMESTER END EXAMINATION)

Sl. No.	Particulars	Marks
1	**Schematic diagram/installation plan**	15
2	**Selection of related wiring accessories**	15
3	**Installation of the wiring system**	30
4	**Testing & Troubleshooting**	20
5	**Safety procedures followed**	10
6	**Viva-voice**	10
Total		**100**

13. RUBRICS FOR ACTIVITY

RUBRICS FOR ACTIVITY (20marks) **Appropriate rubrics to be developed by the faculty as per the activity**						
Dimension	**Beginning**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	
Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	
					Average / Total Marks:	

14.EQUIPMENT LIST

(For a batch of 20students)

Sl.no	Name of equipment	Qty
1	Woodenboard2'x3'	20 Nos.
2	Electrician Tools	
	Screwdriver8",10",12"	10 Nos
	Combinationplier6",8"	10 Nos
	Neon tester	10 Nos
	Roundnoseplier15cm	10 Nos
	Electricianknife10cm	10 Nos
	Heavydutyscrewdriver10",12"Nosefliers6"	10 Nos
	B.P	10 Nos
	Hammer1/2kg.1/4kgCold	10 Nos
	chisel15cm	10 Nos
	Trisquare15cm	10 Nos
	Formerchisel14cm,20cm,25cm	10 Nos
	Poker15cm	10 Nos
	Hacksaw30cm	10 Nos
	Handdrillingmachine6mmWirestripper10cm	02 Nos.
	Measuringtapes5meter,Standardwiregauge.	.
3	Wiring accessories	
	a) PVCconduit1/2",3/4",1"	10lengthseach
	b) Saddles of as sorted sizes	20dozens
	c) DifferentSwitches5A,230v	50 Nos.
	d) DifferentSockets5A,230v	50 Nos.
	e) DifferentHolders5A,230v	50 Nos.
	f) Ceiling Roses	50 Nos.
	g) Wooden/PVC round blocks	50 Nos.
	h) Wiresofdifferentsq.mm1.5sq.mm,2.5sq.mm,4.0sq.mm	50 Nos
	i) Different Gang boxes	50 Nos.
	j) Kit–Katfuses5A,230v	50 Nos.
	k) Screws of as sorted sizes	200 Nos
	l) 7/18,7/16SWGAluconductorPVCcable(for joints)	02coils
	m) Fluorescent lamp fitting	10 Nos.
	n) Rotary switch	10 Nos.
	o) 1.5sqmm copper wire	4 coils
	p) Electronic regulator	5 Nos.
	q) Buzzer	05 Nos
4	Megger500V	05 Nos.
5	Earth tester	02 Nos.
6	Tong tester	02 Nos.
6	AVO meters/multimeter	05 Nos.
7	Singlephaseenergymeter10A230volts-analogtype	05 Nos.
8	ELCB, RCCB, MCB, MCCB,16Asinglephaseandthreephase	02Nos.each
9	16A,32A,230vdifferentDPswitches	05Nos.each