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BASIC ELECTRICAL AND ELECTRONICS ENGINEERING **Course Code : 312302**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science/**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CST/ CW/ DS/ HA/ IF/ IH/ SE**
Semester	**: Second**
Course Title	**: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**
Course Code	**: 312302**

I. RATIONALE

Diploma engineers have to deal with electrical and electronic systems. Modern engineering systems, irrespective of the field, are increasingly incorporating smart technologies that rely on electrical and electronic components. A well-rounded education in electrical and electronics principles enables engineers to work seamlessly across disciplines. Electrical and Electronics Engineering forms the foundation for understanding the hardware components of computer systems. This knowledge is crucial for students in computer science as it helps them comprehend how computers process and store information at the hardware level. This course is designed with basic information to help students apply basic concepts, rules, and safety rules of electrical engineering and electronic engineering and perform practicals thereof.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

This course is to be taught and implemented with the aim to develop in the student, the course outcomes (COs) leading to the attainment of following industry identified outcomes expected from this course: Apply basic concept of electrical and electronics engineering in various applications in relevent technical fields.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Calculate and measure basic electrical quantities and parameters.
- CO2 - Use different electrical machines by making connections.
- CO3 - Use electrical safety devices in electrical circuit
- CO4 - Use relevant diode in different electronic circuits.
- CO5 - Use BJT and FET in various electronic circuits.
- CO6 - Use various types of sensors and transducers.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
312302	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	BEE	AEC	4	-	4	2	10	5	1.5	30	70*#	100	40	50	20	50@	20	50	20	250

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Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Apply Faraday's law of electomagnetic induction and Fleming's right hand rule, Lenz's law for induced emf to find its magnitude and direction. TLO 1.2 Differentiate alertnating current (AC) and direct current (DC) TLO 1.3 Explain parameters of single phase AC sinusoidal waveform. TLO 1.4 Describe the silent features of three phase AC supply system. TLO 1.5 Explain star and delta connection in three phase AC system. TLO 1.6 Calculate the phase and line current and voltage in star and delta connections.	**Unit - I Basic Electrical Fundamentals** 1.1 Electric and magnetic circuits. 1.2 Series and parallel magnetic circuits. 1.3 Faraday's laws of electromagnetic induction, Fleming's right hand rule,Lenz's law 1.4 Dynamically and statically induced emf, self and mutual inductance 1.5 AC and DC quantity, advantages of AC over DC supply. 1.6 Single phase AC, sinusoidal AC wave: instantaneous value, cycle, amplitude, time period, frequency, angular frequency, RMS value, Average value for sinusoidal waveform, form factor, peak factor. 1.7 Three phase supply system over single phase supply system, Phase sequence and balanced and unbalanced load 1.8 Star and delta connections, Phase and line current, phase and line voltage in star connected and delta connected balanced system.	Chalk-Board Presentations Demonstration

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Explain the working principle of the given type of transformer. TLO 2.2 Distinguish the construction of the given type of transformer. TLO 2.3 Describe the construction and working of the given type of DC motor. TLO 2.4 Select relevant type of DC motor for the given application with justification TLO 2.5 Explain working principle and operation of Universal motor. TLO 2.6 Describe the procedure to connect stepper motor for the given application with sketches.	**Unit - II Electrical Machines.** 2.1 Transformer: Working principle, emf equation, Voltage ratio, current ratio and transformation ratio, losses. 2.2 DC motor construction - parts its function and material used. 2.3 DC motor -Principle of operation. 2.4 Types of DC motors, schematic diagram, applications of dc shunt, series and compound motors. 2.5 Universal motor: principle of operation, reversal of rotation and applications. 2.6 Stepper motor: types, principle of working and applications.	Chalk-Board Presentations Demonstration
3	TLO 3.1 Describe the characteristics and features of the given type of protective device. TLO 3.2 Select the relevant protective device for the given application with justification TLO 3.3 Select suitable switchgear for the given situation with justification. TLO 3.4 state the I.E. rule related to be applied for the given type of earthing with justifications.	**Unit - III Electrical Safety and Protective Devices.** 3.1 Low rating Fuse: Operation, types 3.2 Switch Fuse Unit and Fuse Switch Unit: Differences, use of multimeter for electrical quantities/ parameters measurements. 3.3 MCB and ELCB/RCB: Operation and general specifications 3.4 Earthing: Types, Importance of earthing, factors affecting eatthing resistance. 3.5 Measures for reducing earth resistance, I.E rules relevant to earthing.	Chalk-Board Demonstration Presentations
4	TLO 4.1 Measure Zener voltage on given V-I characteristics of the Zener diode. TLO 4.2 Explain the working principle of LED. TLO 4.3 Describe the working principle of given type of filter. TLO 4.4 Explain the working principle of regulated power supply and UPS.	**Unit - IV Special purpose diodes and their applications.** 4.1 Zener diode: working, symbol, applications. 4.2 LED: working, symbol, applications. 4.3 Filters: Need for filters, circuit diagram and working of L, C and CLC filter. 4.4 Working principle and block diagram of regulated power supply. 4.5 UPS: Block diagram of Online and Offline UPS.	Chalk-Board Demonstration Assignment
5	TLO 5.1 Describe with sketches the construction and working of the given type of transistors. TLO 5.2 Compare the performance of the given transistor configurations TLO 5.3 Explain applications of transistor as a switch and amplifier. TLO 5.4 Explain with sketches the construction and working of the given type of FET.	**Unit - V Transistors** 5.1 BJT: Types, symbol, construction and working principle of NPN transistor. 5.2 Transistor configurations: CB, CE, CC 5.3 Characteristics of transistor in CE configuration. 5.4 Transistor parameters: alpha, beta and derive relation between them. 5.5 Applications-Transistor as a switch and as an amplifier. 5.6 FET: Types, symbol, construction and working principle of n channel JFET. 5.7 Characteristics of JFET: Drain and Transfer characteristics.	Chalk-Board Demonstration Assignments

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
6	TLO 6.1 Select relevant transducer for given application. TLO 6.2 Differentiate the features of transducers and sensors for given quantity measurement. TLO 6.3 Explain with sketches the working principle of given type of thermal, optical sensors.	**Unit - VI Sensors and Transducers** 6.1 Sensors and Transducers: Basic definition, difference, classification. 6.2 Thermal, Optical, Electric sensors 6.3 Transducers: Need of transducer, types of transducers: Primary, Secondary, Active, Passive, Analog, Digital 6.4 Selection criteria of transducer	Chalk-Board Demonstration Assignments

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use electrical meters for measurement of electrical parameters. LLO 1.2 Identify presence of magnetic flux lines.	1	*Measure the parameters of simple electrical and identify presence of flux lines in magnetic circuit.(e.g. current, voltage, power, flux)	2	CO1
LLO 2.1 Interpret the AC waveform for resistive and inductive circuit displayed on CRO.	2	*Measure frequency, time period, rms value, peak value of sinusoidal AC waveform for resistive and inductive circuit using CRO.	2	CO1
LLO 3.1 Measure the phase difference between voltage and current in the AC circuit of the inductive circuit.	3	Phase difference of voltage and current in inductive circuit.	2	CO1
LLO 4.1 Measure the line voltage, phase voltage a, phase current, and line current in three phase star connected balanced load. LLO 4.2 Determine phase voltage and line current relation in star connected load.	4	*Measure the line voltage, phase voltage and phase current and line current in three phase star connected balanced load.	2	CO1
LLO 5.1 Find the phase voltage and line current relation in delta connected load.	5	Measure the line voltage, phase voltage and phase current and line current in three phase delta connected balanced load.	2	CO1
LLO 6.1 Determine the transformation ratio.	6	*Determination of the voltage and current ratio of single phase transformer.	2	CO2
LLO 7.1 DC shunt motor operation.	7	*Operate DC shunt motor by connecting three point starter.	2	CO2
LLO 8.1 DC series motor operation	8	Operate DC series motor by connecting three point starter	2	CO2
LLO 9.1 Speed reversal of universal motor.	9	*Reverse the direction of rotation of universal motor.	2	CO2
LLO 10.1 Demonstrate stepper motor operation.	10	Demonstrate the operation of stepper motor for various speed rotation.	2	CO2
LLO 11.1 Use of multimeter for measurement.	11	*Use multimeter for measurement of voltage, current (AC,DC), resistance and continuity of the given electrical circuit.	2	CO3
LLO 12.1 Connection of fuses in electrical circuit.	12	Connect fuse in electrical circuit and check its operation at normal and abnormal conditions.	2	CO3
LLO 13.1 Connection of MCB in electrical circuit	13	*Connect MCB in electrical circuit and check its operation at normal and abnormal conditions.	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Connection of ELCB in electrical circuit.	14	Connect ELCB in electrical circuit and check its operation at normal and abnormal conditions.	2	CO3
LLO 15.1 Measurement of earth resistance.	15	Use of earth tester for meaurement of earthing resistance of a installed earthing of laboratory.	2	CO3
LLO 16.1 Check the forward and reverse bias V-I characteristics of Zener diode.	16	*Connect the Zener diode in the circuit and test its operation in forward and reverse bias mode.	2	CO4
LLO 17.1 Find the voltage regulation of Zener diode.	17	*Determine the voltage regulation by using Zener diode under variable input and output conditions.	2	CO4
LLO 18.1 Filter the ripples by using L, C and pi filter.	18	Check the output waveform of L, C and π filters on CRO of rectifier circuit.	2	CO4
LLO 19.1 Check the operation of UPS under online and offline mode.	19	*Make the input and output connections of UPS and measure the output voltage under online and offline mode.	2	CO4
LLO 20.1 Check the abnormal and normal operation of UPS.	20	*Make the input, output connections and check the operation of UPS under normal and overload condition.	2	CO4
LLO 21.1 Check the operation of NPN transistor under CE configuration.	21	*Test input /output characteristics of NPN transistor in CE configuration.	2	CO5
LLO 22.1 Check the operation of NPN transistor under CB configuration.	22	Test input /output characteristics of NPN transistor in CB configuration.	2	CO5
LLO 23.1 Check operation of transistor for ON and OFF conditions.	23	*Check the switch ON and switch OFF condition of LED by using transistor.	2	CO5
LLO 24.1 Use FET (BFW10) to plot drain and transfer characteristics.	24	Determine the Drain and Transfer characteristics of FET.	2	CO5
LLO 25.1 Use of RTD (PT-100) for measurement of temperature.	25	*Measure temperature of liquid using RTD (PT-100) transducer.	2	CO6
LLO 26.1 Use active transducer (thermocouple) for measurement of temperature.	26	Measure temperature of liquid using thermocouple measurement.	2	CO6
LLO 27.1 Use of photoelectric sensor to sense motion.	27	Check the motion of given object using photoelectric sensor.	2	CO6
LLO 28.1 Use Passive transducer to measure resistance.	28	*Measure the resistance of LDR in varying light intensity.	2	CO6
LLO 29.1 Use Passive transducer to measure displacement.	29	Measure displacement using LVDT.	2	CO6
LLO 30.1 Use Passive transducer to measure displacement.	30	Measurement of displacement using potentiometer.	2	CO6

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Basic Electrical Engineering:

1) Prepare an electrical circuit comprising of one lamp and switch and measure current of the circuit.

2) Prepare a model of two resistances connected in series and parallel and measure the resistance of both circuits.
3) Prepare a magnetic circuit model to demonstrate magnetic force of line (flux) and check its properties.
4) Prepare a model to demonstrate Faraday's laws of electromagnetic induction.
5) Prepare a model to demonstrate dynamically and statically induced EMF.
6) Prepare a test lamp and check the supply continuity using it.
7) Connect two small battery cells (AA size) make series and parallel connections and measure the voltage of both connections.
8) Visit to supply panel of 3-phase and 1-phase AC supply and identify the supply connection.
9) Prepare star /delta connection model using three filament lamps.
10) Collect a small transformer and make model showing the input and output winding connection.
11) Collect the parts of a small transformer and make a demonstration model.
12) Prepare a demonstration model of DC motor. Collect different types of small rating fuses and make a demonstration chart.
13) Prepare a switchboard containing one switch, one fuse, and one socket and test it.
14) Collect MCB dismantle it and prepare a demonstration model showing actual parts of MCB.

- Basic Electronics Engineering:

1) Transistor: Build a circuit to switch ON and OFF LED using BJT as a switching component.
2) Voltage Regulator: Build a DC regulated power supply circuit on a general purpose PCB for +9V output voltage.
3) Transistor: Build a circuit using transistor to amplify the AC input signal of 200mV.
4) FET: Build a circuit using FET to amplify the AC input signal of 300mV.
5) LDR: Build a circuit of an Automatic street light controller using LDR on general purpose PCB.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Multimeter: 3 1/2 digit	1,16,17,21,22,23
2	Lamp Bank load -230 V 0-10 A	13,14
3	Earth tester analog/digital type	15
4	Electronic Work Bench: Bread Board: 840 tie points, Withstanding Voltage: 1,000V AC, Positive and Negative power rails on opposite side of the board, connecting wires.	16,17,18,21,22,23,24
5	Variable DC power supply 0-30V, 2A, SC protection, display for voltage and current.	16,17,21,22,23,24
6	CRO - 20 MHz. Dual channel	2,3,18
7	Three phase Auto Transformer -10/5 kVA, Input 415 V 3 phase. 50 Hz. Output 0-415 V, 10/20 A	4,5
8	AC Voltmeter Range (150/300/600V), Portable analog MI type as per relevant BIS standard	5,6
9	AC Ammeter range (0-2.5-5-10A), Portable analog MI type as per relevant BIS standard	5,6,13,14
10	Single Phase Transformer: 1kVA, single-phase, 230/150 V, air cooled	6
11	Single phase auto transformer (Dimmer stat) – 0-230 volt 2/5Amp	6,13

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
12	Rheostat (0-500 Ohm, 1.2A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	7
13	DC Ammeter range (0-5-10A), Portable analog PMMC type as per relevant BIS standard	7
14	DC series and shunt machines at least one each (up to 230 V, 3/5 HP).	7,8
15	D. C. Supply, A 230 V d.c. supply (with inbuilt rectifier to convert a.c.to d.c)	7,8
16	DC Voltmeter Range (0-150/300V), Portable analog PMMC type as per relevant BIS standard.	7,8
17	Tachometer, noncontact type 0-10000rpm	7,8,9,10
18	Rheostat (0-100 Ohm, 5A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	8
19	Single phase Universal motor -1/4 or 1/2 HP ,230 V	9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basic Electrical Fundamentals	CO1	11	4	6	4	14
2	II	Electrical Machines.	CO2	10	2	6	4	12
3	III	Electrical Safety and Protective Devices.	CO3	9	2	4	4	10
4	IV	Special purpose diodes and their applications.	CO4	10	4	4	4	12
5	V	Transistors	CO5	12	4	6	2	12
6	VI	Sensors and Transducers	CO6	8	2	4	4	10
Grand Total				**60**	**18**	**30**	**22**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks (Basic Electrical of 15 marks, Basic Electronics of 15 marks) and average of two unit test marks will be consider for out of 30 marks.
- For formative assessment of laboratory learning 50 marks (Basic Electrical -25 marks, Basic Electronics- 25 marks).
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- Note: Unit test will be conducted on written pattern (Not MCQ based)

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks through online MCQ examination.
- End semester summative assessment of 50 marks for laboratory learning (Basic Electrical- 25 marks, Basic Electronics- 25 marks)

XI. SUGGESTED COS - POS MATRIX FORM

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Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	--	--	2	--		2			
CO2	2	--	--	2	--		2			
CO3	2	--	--	3	2		3			
CO4	3	--	--	1	--		2			
CO5	3	--	--	1	--		2			
CO6	2	--	--	2	2		3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Theraja, B. L. Theraja, A. K.	A Text Book of Electrical Technology Vol-I	S.Chand and Co. New Delhi 2014 ISBN: 9788121924405
2	Mittle, V. N.	Basic Electrical Engg.	Tata McGraw-Hill, New Delhi ISBN : 978-0-07-0088572-5
3	Hughes, Edward	Electrical Technology	Pearson Education, New Delhi ISBN-13: 978-0582405196
4	Saxena, S. B. Lal	Fundamentals of Electrical Engineering	Cambridge University Press, New Delhi ISBN : 9781107464353
5	Jegathesan, V.	Basic Electrical and Electronics Engineering	Wiley India, New Delhi 2014 ISBN : 97881236529513
6	Sedha R.S.	Applied Electronics	S. Chand, New Delhi,2015 ISBN:9788121927833
7	V.K. Mehta	Principles of Electronics	S.Chand and Co Ram Nagar, New Delhi-110055,11th edition 2014 ISBN 9788121924504
8	Boylestad, Robert Nashelsky Louis	Electronic Devices and Circuit Theory	Pearson Education. New Delhi 2014 ISBN:9780132622264
9	Sawhney A.K.	Electrical and Electronic Measurements and Instrumentation	Dhanpat Rai and Sons, New Delhi,2005, ISBN:13-9788177000160
10	Kalsi H.S.	Electronic Instrumentation	McGraw Hill, New Delhi,2010 ISBN:13-9780070702066

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=anCnrtjNLQM	LVDT
2	https://qr.page/g/4PABoASTZYW	Transistor as an Amplifier
3	https://youtu.be/XT-UmPviH64?si=MLIZBB5BgOA2SWBk	Electromagnetic Induction
4	https://youtu.be/M-QfX2fvpp4?si=xpZDAiX3-_7xrnnr	Basics of magnetic circuits
5	https://archive.nptel.ac.in/courses/117/106/117106108/	Basic electrical circuits
6	https://archive.nptel.ac.in/courses/108/105/108105155/	Electrical Machines-1

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Sr.No	Link / Portal	Description
7	https://youtu.be/ivP_8w4FegE?si=5BLH_hvyhros570A	Single phase and Three phase electrical system
8	https://byjus.com/physics/working-principle-of-an-electrical-fuse/	Electrical fuse
9	https://youtu.be/9Xgn40eGcqY?si=YQy0vmxQ_yGR8-tz	Miniature circuit breaker
10	https://youtu.be/ikLhqUCQKkc?si=8VqRbV1zZlQUSYLd	Earth leakage circuit breaker
11	https://www.tutorialspoint.com/difference-between-bjt-and-fet	BJT's and FET's
12	https://www.tutorialspoint.com/difference-between-sensor-and-transducer	Sensors and Transducers
13	https://www.electrical4u.com/jfet-or-junction-field-effect-transistor/	Junction Field Effect Transistor
14	https://fossee.in/	Open Source Electronics Simulation software
15	https://cloud.scilab.in/	Open Source Scilab Cloud for Electronics Simulation

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students