

Programme Name/s : Electrical Engineering/ Electrical Power System
Programme Code : EE/ EP
Semester : Second
Course Title : ELEMENTS OF ELECTRONICS
Course Code : 312309

I. RATIONALE

Diploma in Electrical Engineering students need to maintain and operate electronics systems. This course deals with basic operating principles and handling of electronics devices to troubleshoot electronics circuits used in Electrical system.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use electronic components and circuits in electrical equipment and systems

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify various electronic components
- CO2 - Use semiconductor diodes in different applications.
- CO3 - Use semiconductor transistors in different applications.
- CO4 - Use different types of Oscillators as per requirement
- CO5 - Test operation of regulated power supply.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL		Based on SL								
				CL	TL	LL			FA-TH			SA-TH	Total	FA-PR	SA-PR	SLA						
				Max	Max	Max	Min	Max								Min	Max	Min	Max	Min		
312309	ELEMENTS OF ELECTRONICS	EOE	DSC	4	-	4	2	10	5	3	30	70	100	40	25	10	25@	10	25	10	175	

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 Differentiate between given active and passive electronic components. TLO 1.2 Calculate value of given resistor and capacitor using colour code and printed information. TLO 1.3 Interpret with sketches given signal. TLO 1.4 Compare characteristics of given voltage and current source	Unit - I Electronic components and Signals 1.1 Active and passive components 1.2 Resistor,Capacitor,inductor,symbols,applications,colour codes, specifications 1.3 Concept of Unipolar and Bipolar Devices. 1.4 Classification of signals-sinusoidal, triangular and square 1.5 Signal waveform ,Time and Frequency domain, Representation, Amplitude,Frequency,phase,wavelength 1.6 Voltage and current source Ideal and non ideal Sources Dependent voltage and current sources .	Chalk-Board Assignment Demonstrations Hands-on

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	<p>TLO 2.1 TLO 2.1 Check the operation of the given diode</p> <p>TLO 2.2 TLO 2.2 Plot V-I characteristic of the given diode</p> <p>TLO 2.3 TLO 2.3 Describe working Principle of given type of Rectifier without and with Filter.</p> <p>TLO 2.4 TLO 2.4 Explain given type of wave shaping circuits</p>	<p>Unit - II Semiconductor Diodes</p> <p>2.1 Construction, symbol, working principle, specification, applications ,types of biasing and V-I characteristic of Zener diode ,LED , Photo diode. Working principle and applications of OLED</p> <p>2.2 Rectifiers- Full wave center tapped and Bridge Rectifier, circuit diagram, wave forms ,working principle . Rectifier IC KBU 808 Pin diagram and applications</p> <p>2.3 Parameters of rectifier: Average DC value of current and voltage, ripple factor, PIV of diode, TUF and efficiency of rectifier.</p> <p>2.4 Need of filters ,Types- C,LC,CLC,L ,circuit diagram wave forms and working principle.</p> <p>2.5 Wave shaping circuits Linear and non linear wave shaping - RC integrator, RC Differentiator, Diode based Clipper circuits , Diode based Clamper. Circuits</p>	<p>Chalk-Board Assignment Presentations Hands-on</p>
3	<p>TLO 3.1 Describe the working of the given type of transistors</p> <p>TLO 3.2 Compare the performance of three type of transistor configurations.</p> <p>TLO 3.3 Solve simple numerical on Current gains.</p> <p>TLO 3.4 Use transistor for various applications (Amplifier and Switch) .</p> <p>TLO 3.5 Explain working of given type of JFET and MOSFET.</p>	<p>Unit - III Semiconductor Transistors</p> <p>3.1 Current operating Devices, Bipolar Junction Transistor- Types NPN , PNP, symbol, construction and working principle .</p> <p>3.2 Need of biasing ,Types- Fixed bias and Voltage divider bias</p> <p>3.3 Regions of operation and their significance - Cut off region , Active region and Saturation region</p> <p>3.4 Transistor configurations: CB, CE, CC, working , comparison and applications</p> <p>3.5 Transistor parameters- Alpha, Beta, Gama, Input, and output resistance, Relationship between alpha and beta, numerical on same.</p> <p>3.6 Applications- Transistor as an amplifier- Small signal and power amplifier , Class A, Class B, Class C, Class AB Amplifier , Transistor as a switch ,</p> <p>3.7 Voltage operating devices, Construction Of JFET(N-Channel and P channel),symbol ,working principle, different parameters of JFET and applications.</p> <p>3.8 MOSFET: Construction ,symbol ,working principle of Enhancement and Depletion MOSFET, and their applications.</p>	<p>Chalk-Board Assignment Demonstration Hands-on</p>

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.
4	<p>TLO 4.1 Explain working principle of Oscillator with its need.</p> <p>TLO 4.2 Compare the performance of the given feedback.</p> <p>TLO 4.3 Explain Barkhausen's criterion.</p> <p>TLO 4.4 Describe working of the given type of oscillator with circuit diagram.</p>	<p>Unit - IV Oscillators</p> <p>4.1 Oscillator: Need, Definition</p> <p>4.2 Types of feedback: Positive feedback, Negative feedback. Barkhausen's criterion</p> <p>4.3 Oscillator: Circuit Diagram , working and comparison of RC ,LC, and Crystal oscillator.</p> <p>4.4 Types of RC oscillator- Wien bridge and RC Phase shift Oscillator Frequency calculation</p> <p>4.5 Types of LC oscillator-Colpitts oscillators ,Hartley oscillators.Frequency calculation</p>	<p>Chalk-Board</p> <p>Assignment</p> <p>Demonstration</p> <p>Hands-on</p>
5	<p>TLO 5.1 Explain parameters of voltage regulators.</p> <p>TLO 5.2 Calculate output voltage of the given regulator.</p> <p>TLO 5.3 Check the working of the given type of regulator ICs.</p> <p>TLO 5.4 Explain working of SMPS.</p>	<p>Unit - V Regulators and power supply.</p> <p>5.1 Voltage regulation Load and line regulation :Definition, formulae</p> <p>5.2 Block diagram, Construction, and operation of DC Regulated power supply</p> <p>5.3 Basic Zener diode as a voltage regulator.</p> <p>5.4 Regulator IC's: IC's 78XX,79XX ,IC 723 as fixed, variable and Dual Regulated DC power supply</p> <p>5.5 Switch mode power supply: Need, block diagram and working.</p>	<p>Chalk-Board</p> <p>Assignment</p> <p>Demonstration</p> <p>Hands-on</p>

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
<p>LLO 1.1 Identify active and passive components in given circuit</p> <p>LLO 1.2 Measure the value of given resistors on Digital Multimeter(DMM)</p> <p>LLO 1.3 Test Diode and LED on Digital Multimeter.</p>	1	Identification of Active and Passive components and DMM handling.	4	CO1
LLO 2.1 Measure amplitude, time period and frequency of given signal on CRO	2	Measurement of amplitude, time period and frequency of given signal on CRO	2	CO1
LLO 3.1 Check PN junction Diode in forward bias. and Plot the V-I characteristics of PN junction diode and determine cut in voltage.	3	Check the performance of PN Junction diode.	2	CO2
LLO 4.1 Check the performance of Zener diode in forward and reverse biasing	4	* Check performance of Zener diode.	2	CO2
LLO 5.1 Build the circuit for Photo Diode and Observe the change in current with change in light intensity of the source	5	Test the performance of photo diode by varying the light intensity as well as the distance of the light source.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Construct and test half wave rectifier on breadboard .	6	* Construct and Test the half wave rectifier.	2	CO2
LLO 7.1 Prepare the circuit for Half Wave Rectifier with LC filter/ pi filter using PN junction Diode . LLO 7.2 Observe and draw input & output waveforms for sinusoidal wave .	7	*Prepare and Test the half wave rectifier with LC filter/ π filter	2	CO2
LLO 8.1 Build the circuit for Full Wave Centre Tapped Rectifier using PN junction Diode. LLO 8.2 Observe and draw input & output waveform for sinusoidal wave	8	*Build and Test the full wave rectifier using two diodes	2	CO2
LLO 9.1 Construct the circuit for Full Wave Bridge Rectifier using PN junction Diodes LLO 9.2 Observe and draw input and output waveform for sinusoidal wave	9	* Construct and Test the full wave Bridge rectifier on bread board using four diodes	2	CO2
LLO 10.1 Build the circuit for Full Wave Rectifier using PN junction Diode with LC/Pi filter LLO 10.2 Calculate ripple factor for given setup.	10	*Use LC/ π filter with full wave rectifier to measure ripple factor.	2	CO2
LLO 11.1 Prepare the circuit for full wave rectifier using IC KBU 808 with filter LLO 11.2 Observe and draw input & output waveform for sinusoidal wave.	11	* Prepare and Test the full wave rectifier on bread board using IC KBU 808 with filter.	2	CO2
LLO 12.1 Build/Test positive Clipper circuit. LLO 12.2 Build/Test negative Clipper circuit.	12	*Build clipper circuit and observe the waveforms.	2	CO2
LLO 13.1 Construct and Test Positive Clamper Circuit LLO 13.2 Construct and Test negative Clamper Circuit	13	* Construct clamper circuit and observe waveforms.	2	CO2
LLO 14.1 Identify the terminals of the PNP and NPN transistor for TO-5, TO-220, TO-66 LLO 14.2 Selection of transistor for different parameters as max. voltage, current and switching speed	14	Identify and select transistors for given application using datasheets	2	CO3
LLO 15.1 Build the circuit for BJT in common base configuration LLO 15.2 Plot input and output characteristics of common base configuration	15	Build and Test the performance of BJT in CB mode	2	CO3
LLO 16.1 Construct the circuit for BJT in common emitter configuration. LLO 16.2 Plot input and output characteristics of common emitter configuration.	16	* Construct and test the circuit for BJT in common emitter configuration.	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 17.1 Test the performance parameters of BJT as Switch LLO 17.2 Identify Cutoff and saturation regions.	17	*Test the performance parameters of BJT as Switch	2	CO3
LLO 18.1 Build the circuit for FET in common source configuration. LLO 18.2 Plot characteristics for drain to source voltage VDS verses drain current ID for different Values of VGS	18	* Check the performance of FET drain Characteristics.	2	CO3
LLO 19.1 Build the circuit for FET in common source configuration LLO 19.2 Plot characteristics for Gate to source voltage VGS verses drain current ID and calculate transconductance.	19	Test the performance of FET transfer characteristics and calculate transconductance.	2	CO3
LLO 20.1 Build the circuit and measure the frequency of given LC Oscillator circuit LLO 20.2 Build the circuit and measure the frequency of given RC Oscillator circuit	20	Measure the frequency of given Oscillator circuit	2	CO4
LLO 21.1 Test the voltages & waveforms at various Test points of regulated dc power supply. LLO 21.2 Identify the various faults in the Regulated DC power supply	21	*Find out faults at different stages of regulated DC power supply	2	CO5
LLO 22.1 Rectify the various faults in the Regulated DC power supply.	22	*Trouble shoot given DC regulated power supply	2	CO5
LLO 23.1 Build Zener voltage regulator for given voltage. LLO 23.2 Calculate load and line regulation.	23	*Build and Test the performance of Zener voltage regulator for given voltage.	2	CO5
LLO 24.1 Construct the circuit for Positive voltage regulator using 78XX IC. LLO 24.2 Calculate load and line regulation.	24	* Construct and Test the performance of Positive voltage regulator using 78XX , three terminal IC for given voltage.	2	CO5
LLO 25.1 Prepare the circuit for Dual voltage regulator using 78XX and 79XX IC LLO 25.2 Calculate load and Line regulation.	25	* Prepare and Test the performance of Dual voltage regulator using 78XX and 79XX ,three terminal IC for given voltage	2	CO5
LLO 26.1 Build LOW/High voltage regulator circuit using IC LM723. Calculate load and line regulation	26	*Test the performance of IC 723 as Regulator.	2	CO5
Note : Out of above suggestive LLOs - <ul style="list-style-type: none"> * 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

- Transistor as switch- Build /Test transistor switch circuit on General purpose PCB for various input signals
- Diode: Build a circuit on general purpose PCB to clip a positive half cycle at 1.5 v of a waveform with input signal 5Vpp, and prepare the report
- Diode: Build a circuit on general purpose PCB to clamp a waveform at 3.0 V using diode and passive components.
- Photodiode: Build a circuit on breadboard to turn the relay on and off by using photo diode and prepare a report.
- Rectifier: Build a half wave rectifier for 6V, 500mA output current on general purpose PCB.
- Rectifier: Build a full wave bridge rectifier with capacitor filter for 6V, 500mA output current on general purpose PCB
- Using Data sheets compare various electronic parameters of different types of JFET and MOSFET.
- Transistor as switch- Build /Test transistor switch circuit on General purpose PCB for various input signals
- Transistor- Build a circuit to switch on and off the LED using BJT as a switching component
- Voltage Regulator: Build a circuit of DC regulated power supply on general purpose PCB for 9V and 500mA output
- Oscillator: Build circuit to generate audio frequency.
- Prepare display boards/models/charts to visualize the appearance of electronic active and passive components.

Assignment

- Study Different types of Rectifier ICs available.
- Study working of OLED Display.

Note :
This is a suggestive list of micro project and assignments , Similar activities can be set for relevant skill development For this course in L A scheme 2 hrs per week are allocated for self learning, Course teacher shall allocate micro project or / and assignments by considering 30 hrs SL work . Micro project may be assign for a team of 4 to 5 students .SL work shall be assessment is a formative (continuous)assessment . Depending on allocated task Course teacher shall set rubrics , This continuous assessment record will be helpful for SLA

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Variable DC power supply 0-30V, 2A, SC protection, display for voltage and current.	3,4,11,12,16,17,18,19
2	Cathode Ray Oscilloscope Dual Trace 20Mhz. 1 5Mega ohm Input impedance	5,6,7,8,9,10
3	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	2,5,6,7,8,9,10
4	Digital Multimeter: 3 1/2 digit display, 9999 counts digital multimeter measures: Vae Vee (1000V max), Ade- Aae (10 amp max), Resistance (0-100 MS2). Capacitance and Temperature measurement	All
5	Lux meter 3000 Lumen. Battery operated hand held type	4
6	Trainer Kits/Breadboard for Rectifiers, Regulators, Transistors, JFET	5,6,7,8,9,10,11,13,14,16,17,18,19

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	Electronic components and Signals	CO1	10	4	4	4	12

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
2	II	Semiconductor Diodes	CO2	14	4	6	6	16
3	III	Semiconductor Transistors	CO3	14	4	6	6	16
4	IV	Oscillators	CO4	12	4	4	6	14
5	V	Regulators and power supply.	CO5	10	4	4	4	12
Grand Total				60	20	24	26	70

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each practical will be assessed considering 60% weightage to process and 40% product based on the nature of practicals.
- Two formative assessment tests for 30 marks and average of two unit tests.

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning
- End semester assessment of 70 marks

XI. SUGGESTED COS - POS MATRIX FORM

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	2	-	1	1	1	-	2			
CO2	2	-	1	1	2	-	2			
CO3	2	1	1	1	2	1	2			
CO4	2	1	1	1	2	1	2			
CO5	2	1	1	1	2	1	2			

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	V .K. Mehta ,Rohit Mehta	Principles of Electronics	S.Chand and Company Ram Nagar, New Delhi-110 055,11th edition 2014, ISBN 9788121924504
2	B.L.Theraja	Basic Electronics	S. Chand Publishing, 2007,ISBN:9788121925556
3	R.S.Sedha	A textbook of Applied Electronics	S Chand, New Delhi 2008, ISBN:978-8121927833

Sr.No	Author	Title	Publisher with ISBN Number
4	Mottershead, Allen	Electronic Devices and Circuit: An introduction	Goodyear Publishing Co. New Delhi ISBN: 9780876202654
5	Horowitz, Paul Hill, Winfield	The Art of Electronics	Cambridge University Press, New Delhi 2015 ISBN: 9780521689175
6	Bell, David	Fundamentals of Electronic Devices and Circuits	Oxford University Press, International edition, USA, 2015, ISBN: 9780195425239
7	Vijay Baru, Rajendra Kaduskar, Sunil T. Gaikwad	Basic Electronic Engineering	Dreamtech press, New Delhi, 2015, ISBN: 9789350040126

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=Fwj_d3uO5g8	Diodes
2	http://www.eleccircuit.com	Electronic circuit
3	https://www.electroschematics.com/tools/	Electronic tools
4	www.futurlec.com	Electronic tools/components
5	www.alldatasheet.com	Datasheets
6	www.nptel.iitm.ac.in	Electronic circuits
7	www.electronics-tutorials.com	Electronic circuits
8	https://www.learningaboutelectronics.com/	Voltage Regulator
9	https://www.animations.physics.unsw.edu.au/	Electronic tools/components/Circuit

Programme Name/s : Electrical Engineering/ Electrical Power System
Programme Code : EE/ EP
Semester : Second
Course Title : FUNDAMENTAL OF ELECTRICAL ENGINEERING
Course Code : 312310

I. RATIONALE

Technologists in electrical engineering are expected to handle electrical machines, instruments, devices and equipment. The basic aim of this course is that, the student must understand the basic concepts, principles and laws of electric and magnetic circuits and practical thereof. The basic aim of this course is that the student must develop the basic concepts, fundamental laws of electric circuits, magnetic circuits,electromagnetic induction,Capacitors,Batteries and practical thereof. This course will enable the students to apply the fundamental concepts of electrical engineering to understanding of other higher level subjects in further study.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply basic principles of electrical engineering to solve the simple electrical engineering problems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Determine various parameters used in electric circuit.
- CO2 - Use basic laws of electrical engineering in D.C. Circuits.
- CO3 - Use capacitor and battery in electrical circuits.
- CO4 - Use principles of magnetism in Magnetic Circuits.
- CO5 - Apply Laws of electromagnetism in electrical circuit and systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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				CL	TL	LL						FA-TH	SA-TH			FA-PR	SA-PR	SLA				
				Max	Max	Max	Min	Max				Min	Max	Min		Max	Min					
312310	FUNDAMENTAL OF ELECTRICAL ENGINEERING	FEE	DSC	4	-	4	2	10	5	3	30	70	100	40	25	10	25#	10	25	10	175	

Total IKS Hrs for Sem. : 0 Hrs

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1	<p>TLO 1.1 Interpret the given electric parameters.</p> <p>TLO 1.2 Explain the given terms of electric circuit.</p> <p>TLO 1.3 Explain the given effect of the electric current</p> <p>TLO 1.4 Calculate work, power and energy for the given circuit.</p>	<p>Unit - I Basic Electrical Parameters</p> <p>1.1 Direct Current (DC), Alternating Current (AC), Voltage Source and Current Source: Ideal and Practical.</p> <p>1.2 Electric Current, Electric Potential, Potential Difference(PD), Electro-Motive Force(EMF)</p> <p>1.3 Electrical Work, Power and Energy.</p> <p>1.4 Resistance, Resistivity, Conductivity, Effect of Temperature on Resistance</p> <p>1.5 Types of Resistor and their application</p> <p>1.6 Heating Effect, Magnetic Effect, Chemical Effect of Electric current</p>	<p>Chalk-Board Presentations</p> <p>Demonstration Model</p> <p>Demonstration Video</p> <p>Demonstrations</p>
2	<p>TLO 2.1 Apply Ohm's law to calculate internal resistance of the given circuit.</p> <p>TLO 2.2 Calculate equivalent resistance for the given circuit.</p> <p>TLO 2.3 Categorize the given type of network</p> <p>TLO 2.4 Apply the Kirchhoff's current law and Kirchhoff's voltage law to calculate the electrical quantities in the given circuit.</p>	<p>Unit - II D.C. Circuits</p> <p>2.1 Ohm's Law, Internal resistance of source, internal voltage drop, Terminal Voltage.</p> <p>2.2 Resistance in Series, Resistance in Parallel. (theory and numerical)</p> <p>2.3 Active, Passive, Linear, Non-linear Circuit, Unilateral Circuit and Bi-lateral Circuit, Passive and Active Network, Node, Branch, Loop, Mesh.</p> <p>2.4 Comparison of Kirchhoff's Current Law, Kirchhoff's Voltage Law (Simple numericals).</p>	<p>Chalk-Board Demonstration Video</p> <p>Demonstrations Presentations</p>

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3	<p>TLO 3.1 Describe the construction of the given type of capacitor.</p> <p>TLO 3.2 Explain the working of the capacitor in the given circuit.</p> <p>TLO 3.3 Calculate equivalent capacitance in the given D.C. circuit.</p> <p>TLO 3.4 Define Battery and state its types and connections</p> <p>TLO 3.5 Plot charging and discharging curves for the given capacitor and battery.</p>	<p>Unit - III Capacitors and Battery</p> <p>3.1 Capacitor, its construction, Parallel Plate Capacitor</p> <p>3.2 Various connections of capacitor.</p> <p>3.3 Energy Stored in Capacitor.</p> <p>3.4 Charging and Discharging of Capacitor.</p> <p>3.5 Breakdown voltage and Di-electric strength.</p> <p>3.6 Applications of Capacitor</p> <p>3.7 Types of battery, Construction, series and parallel connection of Battery</p> <p>3.8 Charging and Discharging of Capacitor and battery</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Model</p> <p>Demonstration</p> <p>Hands-on</p>
4	<p>TLO 4.1 Interpret the terms related to a magnetic circuit.</p> <p>TLO 4.2 Calculate various parameters of the given magnetic circuit.</p> <p>TLO 4.3 Compare the series and parallel magnetic circuit based on the given criteria.</p> <p>TLO 4.4 Plot B-H curve and hysteresis loop of the given magnetic materials.</p>	<p>Unit - IV Magnetic Circuits</p> <p>4.1 Magnetic lines of force, Flux, Flux density, Magnetic flux intensity.</p> <p>4.2 Magneto-Motive-Forces (MMF), Ampere Turns (AT), Reluctance, Permeance, Reluctivity.</p> <p>4.3 Electric and Magnetic circuit: Series Magnetic and Parallel Magnetic Circuit.</p> <p>4.4 Magnetization Curve (B-H Curve)</p> <p>4.5 Magnetic Hysteresis, Hysteresis Loop, Applications.</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Demonstration</p> <p>Model</p> <p>Demonstration</p> <p>Presentations</p>
5	<p>TLO 5.1 Describe the use of Faraday's laws of electromagnetic induction in the given application.</p> <p>TLO 5.2 Distinguish between the given type of e.m.fs.</p> <p>TLO 5.3 Apply Faraday's laws to calculate induced e.m.f. in the given circuit.</p> <p>TLO 5.4 Calculate self-inductance and energy stored in the magnetic field of the given circuit.</p>	<p>Unit - V Electromagnetic Induction</p> <p>5.1 Development of Induced e.m.f. and Current, Faraday's Laws of Electromagnetic Induction.</p> <p>5.2 Static and dynamic emf, Lenz's Law, Fleming's Right hand rule</p> <p>5.3 Self Inductance, Coefficient of Self-inductance (L), Mutual inductance, Coefficient of Mutual inductance (M), self induced e.m.f. and mutually induced e.m.f, Coefficient of Coupling.</p> <p>5.4 Inductance in series</p> <p>5.5 Types of inductor, their application and Energy Stored in Magnetic Field</p>	<p>Chalk-Board</p> <p>Model</p> <p>Demonstration</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p>

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 *Draw layout of Electrical Engineering laboratory.	1	Preparation of Layout of Electrical Engineering Laboratory.	2	CO1
LLO 2.1 *Operate the fire extinguishers and prepare charts of the safety rules to be followed in the electrical lab	2	Operation of fire extinguisher and preparation of safety rules charts	2	CO1
LLO 3.1 *Use relevant electric tools for various applications	3	Check lab supply system and make use of relevant electric tools for various applications.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 *Verify Ohm's Law	4	Verification of Ohm's Law	2	CO1 CO2
LLO 5.1 *Able to connect and read multi range analog meters (Ammeter, Voltmeter)	5	Read analog meters for measurement of various electrical quantities in AC/DC circuits.	2	CO1
LLO 6.1 *Operate Multimeter and Clip-On meter for the measurement of AC/DC Current, Voltage and Resistance in the given circuit.	6	Use of Multimeter and Clip-On meter for the measurement of AC/DC Current, Voltage and Resistance in the given circuit	2	CO1 CO2
LLO 7.1 *Check frequency, Time period, Peak Value and Average Value of the given A.C. wave on CRO	7	Measurement of frequency, Time period, Peak Value and Average Value of the given A.C. wave on CRO.	2	CO1 CO2
LLO 8.1 *Verify Kirchoff's Voltage Law	8	Verification of Kirchoff's Voltage Law	2	CO1
LLO 9.1 *Verification of Kirchoff's Current Law.	9	Verification of Kirchoff's Current Voltage Law	2	CO1 CO2
LLO 10.1 **Use rheostat as current regulator and potential divider.	10	Use of rheostat as current regulator and potential divider	2	CO1 CO2
LLO 11.1 *Determine PD,EMF and internal resistance of DC source .	11	Determination of PD,EMF and internal resistance of DC source .	2	CO1 CO2
LLO 12.1 *Verify the properties of circuit of series connected resistance.	12	Verification of parameters of two/three resistances connected in series connection.	2	CO1 CO2
LLO 13.1 *Verify the properties of circuit of parallel connected resistance.	13	Verification of parameters of two/three resistances connected in parallel connection.	2	CO1 CO2
LLO 14.1 Determine the time constant (RC) by plotting the charging curves of a capacitor(C) through resistor (R)	14	Plot the charging characteristics of capacitor and find the time constant (RC).	2	CO1 CO3
LLO 15.1 Determine the time constant (RC) by plotting the discharging curves of a capacitor(C) through resistor (R)	15	Plot the discharging characteristics of capacitor and find the time constant (RC).	2	CO1 CO3
LLO 16.1 * Find the equivalent capacitance in the series connected circuits	16	Verification of the equivalent capacitance in series connected circuits	2	CO1 CO3
LLO 17.1 *Find equivalent capacitance of the parallel connected circuits	17	Verification of equivalent capacitance of the parallel connected circuits	2	CO1 CO3
LLO 18.1 Determine the Rise characteristics of Electric current in a circuit consisting of resistance and inductance in the circuit.	18	Plot the Rise characteristics of Electric current in a circuit consisting of resistance and inductance in the circuit.	2	CO1 CO4
LLO 19.1 Determine the Decay characteristics of Electric current in a circuit consisting of resistance and inductance in the circuit.	19	Plot the decay characteristics of Electric current in a circuit consisting of resistance and inductance in the circuit.	2	CO1 CO4
LLO 20.1 *Find B-H curve for the given magnetic material	20	Plot B-H curve for the given magnetic material.	2	CO4
LLO 21.1 *Obtain magnetization curve for magnetic material	21	Plot magnetization curve for magnetic core	2	CO4
LLO 22.1 *Plot Hysteresis Loop for the given transformer coil	22	Study of Hysteresis loop for the given transformer coil	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 23.1 *Verify Faraday's Law of Electromagnetic Induction (Statically Induced EMF)	23	Verification of Faraday's Law of Electromagnetic Induction (Statically Induced EMF)	2	CO4 CO5
LLO 24.1 *Verify Faraday's Law of Electromagnetic Induction (Dynamically Induced EMF)	24	Verification of Faraday's Law of Electromagnetic Induction (Dynamically Induced EMF)	2	CO4 CO5
LLO 25.1 Verify Fleming's Right Hand Rule	25	Verification of Fleming's Right Hand Rule	2	CO4 CO5
LLO 26.1 Verify Fleming's Left Hand Rule	26	Verification of Fleming's Left Hand Rule	2	CO4 CO5
LLO 27.1 *Determine Charging and discharging Curves of Battery.	27	Plot the Charging and discharging Curves of Battery	2	CO1 CO3
<p>Note : Out of above suggestive LLOs -</p> <ul style="list-style-type: none"> *1 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

- a.Types of Electrical equipment: Prepare chart showing real-life examples indicating various types of electrical equipment.
- b. Resistance: Collect samples of resistors and prepare models of simple series circuit and parallel circuit.
- c. Capacitance: Collect samples of capacitors and prepare models of simple series circuit and parallel circuit.
- d. Inductance: Collect samples of inductors and prepare models of simple series circuit and parallel circuit.
- e. Batteries : Collect samples and specifications of various batteries of different make and prepare chart of the same.
- f. EV-Batteries : Collect samples and specifications of various EV-batteries of different make and prepare chart of the same.
- g. Connect battery in series connection and measure voltage across each battery and total voltage .
- h. Connect battery in parallel connection and measure voltage across each battery and total voltage

Assignment

- a. Numerical based on Voltage and Current Source.
- b. Numerical based on Resistance, Resistivity, Effect of temperature on Resistance.
- c. Numerical based on Equivalent Resistance of Series and Parallel connection of Resistances in given D.C. Circuits.
- d. Numerical based on Equivalent Capacitance in given D.C. Circuits.
- e. Numerical based on calculation of various parameters of given magnetic circuit.
- f. Numerical based on calculation of self Inductance.
- g. Numerical based on Energy Stored in Magnetic Field.

Suggested Student Activity

- a. Illustrate situations wherein electrical energy is required.
- b. Prepare models in the form of mini-projects.
- c. Prepare power point presentation related to basics of electrical engineering.

d. Prepare a chart of electric circuit elements and relevant industrial application.

e. Prepare question bank referring old MSBTE question papers.

Note :

“These are the just suggestive topics. Faculty must design Microproject/Activities/ Assignments based on Course Outcome requirements”.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Rheostat (0-90 Ohm,5A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact, DC Source, Milliammeter	4
2	Lugs, Wire crimping tool, Soldering Gun, Banana clips	5
3	1.CRO with probe,10Hz-30MHz,01No 2.Rheostat of suitable rating 3. Autotransformer of suitable rating	7
4	1.EMF source: Ampere=0-1A ,Voltage=0-20V ,1 No. 2 Voltmeter: Suitable Voltage range,2 No. 3 Ammeter: Suitable current range,1 No 4 Series resistance: Suitable resistance in ohm,2 No.	12
5	1.EMF source: Ampere:0-1A ,Voltage:0-20V ,1 No. 2 Voltmeter: Suitable Voltage range,2 No. 3 Ammeter: Suitable current range,1 No. 4 Parallel resistance: Suitable resistance in ohm,2 No.	13
6	1.EMF source: Ampere=0-1uA,Voltage=0-20V,1 No. 2.Voltmeter: Suitable voltage,1 No. 3. Ammeter: Suitable current,1 No. 4.Capacitors: Suitable capacitor,1 No. 5.Resistance: Suitable resistance ,1 No. 6.Stop watch: Suitable stop watch 1 No.	14
7	1.EMF source: Ampere=0-1uA,Voltage=0-20V,1 No. 2.Voltmeter: Suitable voltage,1 No. 3. Ammeter: Suitable current,1 No. 4.Capacitors: Suitable capacitor,1 No. 5.Resistance: Suitable resistance ,1 No. 6.Stop watch: Suitable stop watch 1 No.	15
8	1.EMF source: Ampere=0-1A, Voltage=0-20V :1 No. 2.Voltmeter : Suitable Voltage,1 No. 3.Ammeter :Suitable Current,1 No. 4.Capacitor:Suitable Capacitor in Farad ,3 No.	16
9	1.EMF source: Ampere=0-1A, Voltage=0-20V :1 No. 2.Voltmeter : Suitable Voltage,1 No. 3.Ammeter :Suitable Current,1 No. 4.Capacitor:Suitable Capacitor in Farad ,3 No.	17
10	1.EMF source : Ampere:0-1A,Voltage:0-300V ,1 No. 2.Voltmeter : Suitable voltage,1 No. 3.Ammeter: Suitable current,1 No. 4.Inductive coil :Suitable Inductor 1 No.	23

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
11	1.EMF source: Ampere=0-1A,Voltage:0-300V ,1 No. 2.Voltmeter:Suitable Voltage,1 No. 3.Ammeter :Suitable current,1 No. 4.Inductive coil: Suitable inductor,1 No.	24
12	1.DC motor: Suitable motor:1No	26
13	1.EMF source: Ampere: 0-1A,Voltage:0-300V ,1 No. 2. Voltmeter: Suitable voltage:1 No. 3.Ammeter: Suitable current: 1 No. 4.Inductive coil: Suitable inductor,1 No.	21
14	1.EMF source: Ampere: 0-1A,Voltage:0-300V ,1 No. 2. Voltmeter: Suitable voltage:1 No. 3.Ammeter: Suitable current: 1 No. 4.Inductive coil: Suitable inductor,1 No.	20
15	1:EMF source: Ampere: 0-1A,Voltage:0-300V ,1 No. 2:Voltmeter:Suitable Voltage,1 No. 3:Ammeter: Suitable current,1 No. 4.Transformer :(0.5/1kVA)Suitable transformer,1 No.	22
16	Fire Extinguisher Kit	2
17	Electrical Drawing of the Laboratory	1
18	1.EMF source: Ampere:0-1A,Voltage:0-20V ,1 No. 2.Voltmeter Suitable voltage1 No. 3.Ammeter: Suitable current1 No. 4.Rheostat : Suitable load in ohm,1 No. 5. Resistive Load,1No	10
19	1.DC Generator: Suitable rating,1No	25
20	Stripper, Hammer, Plier, Nose Plier, Multi-meter, tester ,Tachometer, Megger,Standard Wire Gauge crimping tool, wire gauge etc	3
21	Multi-meter, Clip -On Meter, Ammeter ,Voltmeter, Rheostat,etc	6
22	1.Battery or D.C. Supply: Suitable Range 2. Single Pole Two Way Switch 3. Multi-meter 4. Stopwatch 5.A Choke Coil or a resistor in series with inductor	18
23	1.Battery or D.C. Supply: Suitable Range 2. Single Pole Two Way Switch 3. Multi-meter 4. Stopwatch 5.A Choke Coil or a resistor in series with inductor	19
24	1. D.C. Dual Power Supply, 1No 2.D.C. Voltmeter of Suitable Range,3No 3. Rheostat of Suitable Range,3No	8
25	1.Rheostat of suitable range, 3 No 2.D.C. Dual Power Supply ,suitable range,1 No 3.D.C. milli-Ammeter, suitable range,3 No	9

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
26	1.EMF source: Ampere=0-1uA,Voltage=0-20V,1 No. 2.Voltmeter: Suitable voltage,1 No. 3. Ammeter: Suitable current,1 No. 4.Capacitors: Suitable capacitor,1 No. 5.Resistance: Suitable resistance ,1 No. 6.Stop watch: Suitable stop watch 1 No. 7. Suitable EV-Battery Data	27

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 Parameters	CO1	10	2	6	4	12
2	II	D.C. Circuits	CO2	12	4	6	4	14
3	III	Capacitors and Battery	CO3	12	4	6	4	14
4	IV	Magnetic Circuits	CO4	12	4	4	6	14
5	V	Electromagnetic Induction	CO5	14	4	4	8	16
Grand Total				60	18	26	26	70

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of two unit tests considered.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester summative assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks through offline mode of examination.

XI. SUGGESTED COS - POS MATRIX FORM

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	1	-	1	-	-	2			
CO2	3	1	1	1	1	-	2			
CO3	3	1	1	2	2	-	2			

CO4	3	1	1	2	2	-	2			
CO5	3	1	1	2	2	-	2			

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	S. B. Lal Seksena and Kaustuv Dasgupta	Fundamentals of Electrical Engineering Part-1	Cambridge University Press, New Delhi ISBN : 9781107464353
5	Jegathesan V., Vinoth Kumar K., Saravanakumar R.	Basic Electrical and Electronics Engineering	Wiley India, New Delhi 2014 ISBN : 97881236529513
6	Husain Ashfaq	Fundamentals of Electrical Engineering	Dhanpat Rai & Co. (p) Ltd-delhi, ISBN: 978-8177000436

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/	Basic Electrical Parameters
2	https://en.wikipedia.org/wiki/Capacitor	Capacitor
3	https://www.corsi.univr.it/documenti/OccorrenzaIns/matdid/matdid441904.pdf	D.C. Circuits
4	https://www.slideshare.net/ChetanPatil396/basic-electrical-parameters-basic-electrical-engineering	Basic Electrical Parameters
5	https://www.britannica.com/science	Magnetic Circuits
6	https://en.wikipedia.org/wiki/Magnetic_circuit	Magnetic Circuits
7	https://en.wikipedia.org/wiki/Electromagnetic_induction	Electromagnetic Induction
8	https://youtu.be/XT-UmPviH64?si=MLIZBB5BgOA2SWBk	Electromagnetic Induction
9	https://youtu.be/M-QfX2fvpp4?si=xpZDAiX3-_7xrnr	Basics Magnetic Circuits
10	https://archive.nptel.ac.in/courses/117/106/117106108/	Basic Electrical Circuits
11	https://en.wikipedia.org/wiki/Electric_battery	Battery