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ELEMENTS OF ELECTRICAL ENGINEERING **Course Code : 312315**

Programme Name/s	**: Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Medical Electronics/ Electronics & Computer Engg.**
Programme Code	**: AO/ DE/ EJ/ EK/ ET/ EX/ IC/ IE/ IS/ MU/ TE**
Semester	**: Second**
Course Title	**: ELEMENTS OF ELECTRICAL ENGINEERING**
Course Code	**: 312315**

I. RATIONALE

A technical person has to deal with the various electrical machines, equipment, and protective devices. In order to increase the technical proficiency, a technician should possess essential knowledge of electrical engineering parameters, basic concepts, and laws of electrical engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use electrical equipment efficiently for different electronic engineering application.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Interpret the magnetic field parameters for the particular magnetic circuits.
- CO2 - Analyze A.C. circuits for single phase and polyphase supply.
- CO3 - Select the transformer and DC motor for the given application.
- CO4 - Select the fractional horse power motor for the given application.
- CO5 - Choose the protective devices for the electrical protection.

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	
312315	ELEMENTS OF ELECTRICAL ENGINEERING	EEE	SEC	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175

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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 Describe the terms related to Magnetic circuit. TLO 1.2 Distinguish between electric and magnetic circuit. TLO 1.3 Interpret magneto motive force in series and parallel magnetic circuit. TLO 1.4 Describe laws related to magnetic circuit. TLO 1.5 Classify the types of induced electromotive force	**Unit - I Magnetic circuits** 1.1 Define and state units of Magnetic flux, Flux density, Magnetomotive force, Magnetic field strength, Permeability. 1.2 Electric circuit and magnetic circuit analogy and differences. 1.3 Series and parallel magnetic circuit. 1.4 Faraday's laws of electro-magnetic induction, Lenz's law, Fleming right hand and left hand rule. 1.5 Dynamically and statically induced emf, self and mutual induced Electromotive force and its inductances.	Presentations Chalk-Board Video Demonstrations Model 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 Compare AC quantities with DC quantities. TLO 2.2 Describe terminology related to A.C. fundamentals. TLO 2.3 Describe different forms of representation for electrical quantity. TLO 2.4 Analyze A.C. circuits for different types of load. TLO 2.5 Explain generation of three phase induced emf. TLO 2.6 Analyze three phase circuit for star and delta connection.	**Unit - II A.C fundamentals for single phase and polyphase circuits** 2.1 Define A.C. and D.C. quantities, advantages of A.C over DC. 2.2 Single phase sinusoidal A.C. wave: instantaneous value, cycle, amplitude, time period, frequency, angular frequency, R.M.S. value, average value for sinusoidal waveform. 2.3 Vector, polar and complex forms representation of an ac quantity, phase angle, phase difference concept of lagging and leading. 2.4 A.C through pure resistance, inductance and capacitance. Its equation, vector diagram and waveform. 2.5 Define polyphase system and advantages of three phase system over single phase system. 2.6 Generation of three phase induced emf and its waveform. 2.7 Phase and line currents, phase and line voltages in star connected and delta connected balanced load system.	Video Demonstrations Presentations Chalk-Board
3	TLO 3.1 Explain construction and working principle of given type of transformer. TLO 3.2 Select different types of transformer for the particular application. TLO 3.3 Describe construction and the working of DC motor. TLO 3.4 Select the type of DC motor for given application.	**Unit - III Transformers and DC motors** 3.1 Transformer construction and working principle, emf equation, voltage ratio, transformation ratio. 3.2 Auto-transformer, Pulse transformer and Isolation transformer construction, working principle and applications. 3.3 DC motor construction and working principle. 3.4 Different types of DC motors with its schematic diagram. 3.5 Applications of DC motors.	Chalk-Board Model Demonstration Video Demonstrations Presentations
4	TLO 4.1 Explain the construction and working principle of the given type of FHP motor. TLO 4.2 Select relevant FHP motor for the respective application TLO 4.3 Describe the procedure to connect given motor for the given application.	**Unit - IV Fractional horse power motors** 4.1 Construction, working principle and application of split phase single phase AC induction motors. 4.2 Construction, working principle and application of universal motor and reversal of direction of rotation. 4.3 Construction, working principle and application of stepper motor. Only concept of speed control, stepper motor's reversal of direction of rotation 4.4 Construction, working principle, specification and application of linear induction motor	Model Demonstration Presentations Chalk-Board Flipped Classroom

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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.
5	TLO 5.1 Explain general safety rule of electrical system. TLO 5.2 Explain and select the different types of protective devices. TLO 5.3 Draw circuit connection diagram of protective devices. TLO 5.4 Describe earthing system and related terms.	**Unit - V Electrical protective devices** 5.1 Electrical general safety rules, Personal Protective Equipment (PPE), Selection of wires and cable as per application. 5.2 Type of fuses, operation, connection diagram and application of fuses, Miniature Circuit Breaker(MCB), Moulded Case Circuit Breaker (MCCB), Earth Leakage Circuit Breaker(ELCB)operation, connection diagram and general specification 5.3 Draw circuit connection diagram of Protective devices. 5.4 Need of Earthing, methods of earthing, types of earthing and factors affecting earthing as per Indian Electricity rule.	Model Demonstration Video Demonstrations Presentations Chalk-Board

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 Faraday's law of electro-magnetic induction. LLO 1.2 Classify types of induced emf.	1	*Demonstration of Faraday's law of electro-magnetic induction for statically and dynamically induced emf.	2	CO1
LLO 2.1 Use Faraday's law of electro-magnetic induction. LLO 2.2 Observe mutual induced emf in transformer.	2	*Demonstration of Mutually induced EMF by using single-phase transformers.	2	CO1
LLO 3.1 Use cathode ray oscilloscope. LLO 3.2 Identify different parameters on CRO.	3	*Measure frequency, Time period, Peak value, RMS value of sinusoidal AC waveform using CRO.	2	CO2
LLO 4.1 Identify phase angle and phase difference of given quantities. LLO 4.2 Identify the nature of power factor for the respective circuit.	4	Observe the phase difference between voltage and current on CRO for resistive, inductive, and capacitive load and comment on the nature of the power factor (Lagging, Leading, Unity).	2	CO2
LLO 5.1 Connect star connected three phase load. LLO 5.2 verify relationship between line and phase quantities.	5	*Connect three phase star connected balanced load and verify the relationship between line voltage and phase voltage, line current and phase current.	2	CO2
LLO 6.1 Connect delta connected three phase load. LLO 6.2 verify relationship between line and phase quantities.	6	Connect three phase delta connected balanced load and verify the relationship between line voltage and phase voltage, line current and phase current.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Calculate transformation ratio of transformer. LLO 7.2 Connect transformer to given load.	7	*Determine the transformation ratio current ratio of single phase transformer.	2	CO3
LLO 8.1 Identify pin configuration of pulse transformer. LLO 8.2 Check electrical isolation between input and output of pulse transformer.	8	Demonstration of working of pulse transformer by observing input pulse and output pulse of pulse transformer on CRO.	2	CO3
LLO 9.1 Identify different parts DC motor. LLO 9.2 Identify different types of DC motor.	9	Identify different types of DC motor by observing terminal connections and also identify different parts of DC motor.	2	CO3
LLO 10.1 Connect DC motor to DC supply. LLO 10.2 Select particular starter for particular motor starting.	10	*Start any DC motor using corresponding starter and observe speed on tachometer.	2	CO3
LLO 11.1 Connect single phase induction motor to the supply. LLO 11.2 Change the direction of rotation of single phase induction.	11	*Start single phase induction motor and reverse the direction of rotation of it.	2	CO4
LLO 12.1 Connect the universal motor to the supply. LLO 12.2 Change the direction of rotation of universal motor.	12	Start universal motor and reverse the direction of rotation of it.	2	CO4
LLO 13.1 Connect the linear induction motor to the supply. LLO 13.2 Observe linear motion of induction motor.	13	Identify different parts of linear induction motor and start it.	2	CO4
LLO 14.1 Select fuse for particular application. LLO 14.2 Select circuit breaker for particular application.	14	*Identify different types of fuses and circuit breakers. State their specification for suitable application.	2	CO5
LLO 15.1 Explain connection of earthing for domestics application. LLO 15.2 Test available of earthing for given switch board.	15	Testing of earthing using a test lamp and comment on it.	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

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)

Assignment

- 1) Search the different types of applications in which a transformer is required and prepare a report on it.

2) Prepare a report on different types of applications of single-phase motors. State the types of motors with their particular applications.
3) Prepare a PowerPoint presentation or animation to show the working of the DC motor.
4) Observe the different types of switchgear used at home and write a report on their types, ratings and applications.

To build a simple electrical circuit

- 1) Construct a closed circuit using,

one dry cell battery, one small light bulb holder, one small light bulb, small wire
stripper tape (scotch, masking, or electrical)
Answer the following questions:
a) What is the difference between an open and a closed circuit?
b) What is voltage?
c) How many connections to the battery are necessary for the light bulb to light up?
2) Prepare a switchboard to control one lamp, one socket with protection and indication.

Micro project

- **1) Magnetic circuits**: Collect the information for different types of magnetic materials and draw a B-H curve for the respective material.

2) A.C. Fundamentals: Visit a nearby industry and observe the different parameters such as frequency, voltage, current, power and prepare a report based on it.
3) Polyphase circuits: Observe the three-phase power distribution panel in their institute and prepare a report on it.
4) Transformer: Collect information regarding different types of transformers available in the laboratory and prepare a report on it.
5) Fractional horsepower motor: Visit the local market or use the internet and prepare a report based on i) Manufacturers ii) Technical specifications iii) Earthing arrangement iv)Price range.
6) Visit your institute workshop and prepare a report on the different types of machines used, their specifications and manufacturers, different types of motors used.

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	Single phase 230V, 50Hz, 1Hp Induction motor	11
2	Single phase 230V, 50Hz, 1/4Hp Universal motor	12
3	Single or three phase linear induction motor	13
4	Single Phase 230/115 V, 50Hz, 1 or 5 kVA Transformer	2,7
5	Single Phase 0-270V, 50Hz, 10A Auto-transformer	2,7,11
6	Cathode Ray Oscilloscope (CRO) 20MHz, Dual channel	3,4,8
7	Single phase 230V, 50Hz, 2A Inductive Load bank	4
8	Single phase 230V, 50Hz, 2A Capacitive Load bank	4
9	Single phase 230V, 10A Resistive Load bank	4,5,6
10	Pulse transformer 1:1:1 4503 or 1:1 4502	8
11	Different types of DC motor	9,10

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	Magnetic circuits	CO1	8	4	4	4	12
2	II	A.C fundamentals for single phase and polyphase circuits	CO2	11	4	6	8	18
3	III	Transformers and DC motors	CO3	8	6	4	4	14
4	IV	Fractional horse power motors	CO4	10	4	4	6	14
5	V	Electrical protective devices	CO5	8	4	4	4	12
Grand Total				**45**	**22**	**22**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each practical will be assessed considering - - 60% weightage to process and - 40% weightage to product Continuous assessment based on process and product related performance indicators, laboratory experience.

Summative Assessment (Assessment of Learning)

- End of semester exam based on observations and recording of the particular experiments

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	3	3	1	2	-	2			
CO2	2	3	2	-	2	3	2			
CO3	3	2	3	2	2	-	2			
CO4	2	2	3	3	2	2	2			
CO5	3	3	2	2	3	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.	Electrical Technology Vol-I	S.Chand and Co., new Delhi, ISBN:9788121924405
2	Theraja B.L.	Electrical Technology Vol-II	S.Chand and Co., new Delhi, ISBN:9788121924375
3	V. N. Mittle and Arvind Mittal	Basic Electrical Engineering	McGraw Hill, New Delhi, ISBN:978-0070593572
4	U.A.Bakshi	Basic Electrical Engineering	Technical Publications, ISBN:9789333220392
5	DP Kothari and I J Nagrath	Basic Electrical Engineering	Mc Graw Hill, New Delhi, ISBN: 978-9353165727
6	J.B. Gupta	A Course in Electrical Installation Estimating & Costing	S.K. Kataria & Sons, ISBN: 978-93-5014-279-0
7	K. B. Raina and S. K. Bhattacharya	Electrical design, estimation and costing, Second edition	New age international limited publisher, New Delhi, ISBN:978-8122443585

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://nptel.ac.in/courses/108105112	NPTEL study materials
2	https://www.electrical4U.com	All about electrical circuits
3	https://instrumentationtools.com/category/electrical-animation/	Animation of basic electrical engineering quantities
4	https://www.udemy.com/course/crash-course-electric-circuits-for-electrical-engineering/	Flip classroom learning material

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Sr.No	Link / Portal	Description
5	http://www.ece.umn.edu/users/riaz/animations/listanimations.html	Animation of electrical machines
6	https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/get_is_list_by_category_id/5	IS standard

Note :

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

MSBTE Approval Dt. 01/10/2024 **Semester - 2, K Scheme**