ELEMENTS OF ELECTRICAL ENGINEERING **Course Code : 313343**

Programme Name/s : **Mechatronics**
Programme Code : **MK**
Semester : **Third**
Course Title : **ELEMENTS OF ELECTRICAL ENGINEERING**
Course Code : **313343**

I. RATIONALE

Any technical person is expected to have basic knowledge of electrical engineering as they have to work in different engineering fields that deals with various types of electrical machines and equipment. This course will enable the students to apply the fundamental concepts of electrical engineering for understanding of other higher semester courses as well as later in the world of work.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply basic principles of electrical engineering to solve the 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 in a given electrical circuit.
- CO2 - Use principles of magnetic circuits in electrical devices.
- CO3 - Select DC motor and transformer for specific applications.
- CO4 - Select AC motor and special purpose motor for given application.
- CO5 - Select electrical measuring instruments and protective devices.

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	
313343	ELEMENTS OF ELECTRICAL ENGINEERING	EEE	AEC	3	-	2	1	6	3	3	30	70	100	40	25	10	-	-	25	10	150

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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 Explain the given terms of electric circuits. TLO 1.2 Compare AC and DC. TLO 1.3 Apply Ohms law, KCL, KVL to electrical circuits. TLO 1.4 Compare single phase and three phase circuits. TLO 1.5 Calculate equivalent resistance and other parameter of a given circuit.	**Unit - I Basic Fundamentals** 1.1 Introduction to voltage, current, EMF, potential difference, work, power, energy and its units 1.2 Direct current (DC), Alternating current (AC) 1.3 Resistor, Inductor, Capacitor 1.4 Ohms law, KCL, KVL 1.5 Definitions - Cycle, frequency, phase, period, maximum value, average value, R.M.S. value 1.6 Series and parallel circuit of resistance 1.7 Compare single phase and Three phase circuits 1.8 Numerical on KCL, KVL, series and parallel circuit	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Interpret the terms related to a magnetic circuit. TLO 2.2 Compare of electric and magnetic circuit. TLO 2.3 Plot B-H curve and hysteresis loop of the given magnetic materials. TLO 2.4 Describe Faraday’s laws of electromagnetic induction, Fleming’s right-hand rule, Lenz’s law.	**Unit - II Magnetic Circuit and Electromagnetism** 2.1 Definition of magnetic lines of force, magnetic flux, flux density, magneto-motive-forces (mmf), magnetic field strength, reluctance 2.2 Comparison of electric and magnetic circuit 2.3 Magnetization curve (B - H curve), hysteresis loop of the given magnetic materials 2.4 Faraday's laws of electromagnetic induction, Fleming’s right-hand rule, Lenz’s law 2.5 Statically and dynamically induced emf	Lecture Using Chalk-Board Presentations Video Demonstrations

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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.
3	TLO 3.1 Explain construction and working of DC motor. TLO 3.2 List different types of DC motor and its applications. TLO 3.3 Explain construction and working of transformer. TLO 3.4 Interpret the EMF equation and transformation ratio of two winding transformer. TLO 3.5 Calculate transformation ratio(K) of transformer. TLO 3.6 Compare auto transformer and two winding transformer.	**Unit - III DC Motors and Transformer** 3.1 DC motor construction and working principle of operation 3.2 Types of DC motor and its applications 3.3 Transformer construction and working principle of operation 3.4 EMF equations and transformation ratio of transformer 3.5 Numerical on EMF equations and transformation ratio of transformer 3.6 Losses in a transformer 3.7 Introduction of auto transformer and compare it with two winding transformers	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Explain construction and working of single-Phase induction motor. TLO 4.2 Classify single phase induction motors. TLO 4.3 Explain construction and working of three Phase induction motor. TLO 4.4 List the applications of single phase and three phase induction motors. TLO 4.5 Explain construction and working of different types of FHP motors and list its applications. TLO 4.6 Illustrate need of starters. TLO 4.7 Select the appropriate drives for the specified motor.	**Unit - IV AC Machine and Special purpose motor** 4.1 Single-phase induction motor – construction, working principle and application 4.2 Types of single-phase induction motor – split phase, capacitor start induction run, capacitor start capacitor run, permanent capacitor, shaded pole induction motor 4.3 Three phase induction motor – construction, operation and types and its application 4.4 Other Motors (FHP): Universal motor, servo motor, stepper motor – construction, working and applications 4.5 Need of starters 4.6 Classification of drives, factors for selection of drives for different motors	Lecture Using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 List of applications of different measuring instruments. TLO 5.2 List of applications of different measuring instruments. TLO 5.3 List the applications of MCB, MCCB and ELCB. TLO 5.4 Explain necessity of earthing.	**Unit - V Measuring Instruments and Protective Devices** 5.1 Use of AC and DC ammeter, voltmeter, wattmeter, digital multimeter, clip on meter, tachometer, megger, tachometer energy meter, (applications only) 5.2 Operation of fuses and its types 5.3 Operation and application of MCB, MCCB and ELCB 5.4 Necessity of earthing and types of earthing	Lecture Using Chalk-Board Presentations Video Demonstrations

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

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Connect the meter in the given circuit. LLO 1.2 Measure electrical parameters. LLO 1.3 Compare the readings of digital multimeter with that of analog meter.	1	* Measurement of various electrical quantities by using analog meters and digital multimeters	2	CO1
LLO 2.1 Connect the resistors in series and parallel. LLO 2.2 Find the equivalent resistance of series and parallel connection.	2	Measurement of equivalent resistance of series and parallel connection	2	CO1
LLO 3.1 Connect the DC / AC source with resistive load. LLO 3.2 Verify Ohm's Law equipment.	3	Verification of Ohm's law	2	CO1
LLO 4.1 Verify Kirchhoff’s laws.	4	*Verification of Kirchhoff’s current and voltage law	2	CO1
LLO 5.1 Verify of Faraday's law of electromagnetic induction (statically induced emf).	5	*Verification of Faraday's law of electromagnetic induction (statically induced emf)	2	CO2
LLO 6.1 Verify of Faraday's law of electromagnetic induction (dynamically induced emf).	6	Verification of Faradays law of electromagnetic induction (dynamically induced emf)	2	CO2
LLO 7.1 Draw B-H curve for the given magnetic material.	7	Determination of B-H curve for the given magnetic material	2	CO2
LLO 8.1 Identify the various parts of DC motor.	8	Identification of various parts of DC motor	2	CO3
LLO 9.1 Measure speed control of DC motor.	9	* Speed control of DC series motor by armature resistance control method	2	CO3
LLO 10.1 Determine the transformation ratio.	10	*Determination voltage and current ratio of single-phase transformer	2	CO3
LLO 11.1 Identify the various parts of three- phase induction motor.	11	Identification of various parts of three phase induction motor and its function	2	CO4
LLO 12.1 Identify various parts of stepper motor.	12	*Dismantling/assembling /testing a stepper motor and its types	2	CO4
LLO 13.1 Experiment with speed reversal of three phase induction motors.	13	*Using phase sequence change the direction of rotation of three-phase induction motor	2	CO4
LLO 14.1 Determine the fusing current by operate fuse in an electrical circuit.	14	* Performance of fuse in electrical circuit	2	CO5
LLO 15.1 Investigate the operation of MCB at normal and abnormal condition.	15	Performance of MCB in electrical circuit	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)

Micro project

- Collect the different types of small rating fuses and make demonstration charts. (Collect different types of small rating fuse, distribute fuse according to types, mention the rating and application of fuse)
- Connect two small battery cells (AA size) make series and parallel connection. Measure the voltage of both connections. (Collect small battery cells, connect battery cells in series and parallel, connect the voltmeter to measure voltage)

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.
- 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 auto-transformer- Input: 0 to 230 V, 10 A, Output: 0 to 270 V (2 Qty)	1,2,3,4,5,6,7,10,14,15
2	Stripper, Hammer, Plier, Tester, Standard wire gauge etc.	1,2,3,4,5,6,7,9,10,12,13
3	DC and AC Ammeter, 0-10/20 A (5 Qty)	1,2,3,4,5,6,7,9,10,13,14,15
4	DC and AC Voltmeter, 0-150/300 V (5 Qty)	1,2,3,4,5,6,7,9,10,13,14,15
5	Digital Multimeter (2 Qty)	1,2,3,4,5,6,7,9,10,13,14,15
6	Connecting wires	1,2,3,4,5,6,7,9,10,13,14,15
7	Loading rheostat – 7.5 KW, 230 V (5 Qty), 3 Phase, 4 wire balanced load, (Each branch having equal load) (1 Qty), Load – wire wound fixed resisters	1,2,3,4,7,9
8	Lamp bank: 230 V, 0 to 20 A. (1 Qty)	1,2,3,9,10,14,15
9	Tachometer – Non contact type, (0-10000rpm) (1 Qty)	1,9
10	Single phase transformer: 1 KVA, 1 Phase, 230/115 V, Air closed, enclosed type. (2 Qty)	10
11	Stepper motor kit (1 Qty)	12
12	Three phase auto transformer – 15 KVA, Input: 0 to 415V, 3 Phase, 50Hz, output: 0 to 415 V, 30A per line, Air cooled (1 Qty)	13
13	3 Phase Induction motor, 3HP/5HP, 415 V, 50 H Z, 1140 RPM (1 Qty)	13

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
14	Fuse (5A/10A, 230V, 50Hz)	14
15	Fuse Wire	14
16	MCB(1A/2A/3A/4A/5A/6A)	15
17	DC Source (24 V)	3,9
18	DC series and shunt motor (up to 230V, 5 HP) (1 Qty)	8,9

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 Fundamentals	CO1	10	4	6	6	16
2	II	Magnetic Circuit and Electromagnetism	CO2	6	2	4	4	10
3	III	DC Motors and Transformer	CO3	10	4	4	6	14
4	IV	AC Machine and Special purpose motor	CO4	12	4	8	6	18
5	V	Measuring Instruments and Protective Devices	CO5	7	4	4	4	12
Grand Total				**45**	**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 considere
- For formative assessment of laboratory learning 25 marks
- Each practical will be assessed considering appropriate percentage weightage to process and product and other instructions of assessment

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks through offline mode of examination
- For self learning assessment (SLA) of 25 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	3	2	-	3	2	-	2			
CO2	3	1	-	2	2	-	2			

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CO3	3	2	-	2	2	-	2			
CO4	3	2	-	2	2	-	2			
CO5	3	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	V. K. Mehta, Rohit Mahta	Basic Electrical Engineering	S. Chand Publication, ISBN:978-81-219-0871-9
2	P. V. Prasad, S. Sivanagaraju	Electrical Engineering Concepts and Application	Cengage Publication, ISBN:978-81-315-1787-1
3	V. K. Mehta, Rohit Mahta	Principles of Electrical Engineering and Electronics	S. Chand Publication, ISBN:978-81-219-4298-0
4	B. L. Theraja	Electrical Technology - Volume I	S. Chand and Co. New Delhi, ISBN:978-81-219-2440-5
5	B. L. Theraja	Electrical Technology - Volume II	S. Chand and Co. New Delhi, ISBN:978-81-219-2437-5

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.slideshare.net/ChetanPatil396/basic-electrical-p	Basic electrical parameters
2	https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/	Basic electrical parameters
3	https://www.corsi.univr.it/documenti/OccorrenzaIns/matdid/ma	D.C. circuits
4	https://www.britannica.com/science	Magnetic circuits
5	https://en.wikipedia.org/wiki/Magnetic_circuit	Magnetic circuits
6	https://en.wikipedia.org/wiki/Electromagnetic_induction	Electromagnetic induction
7	https://youtu.be/XT-UmPviH64?si=MLIZBB5BgOA2SWBk	Electromagnetic induction
8	https://youtu.be/M-QfX2fvpp4?si=xpZDAiX3-_7xrnnr	Basic magnetic circuits
9	https://archive.nptel.ac.in/courses/117/106/117106108/	Basic electrical circuits
10	https://archive.nptel.ac.in/courses/108/105/108105155/	Electrical machines-1
11	https://youtu.be/ivP_8w4FegE?si=5BLH_hvyhros570A	1 phase and 3 phase electrical system
12	https://youtu.be/9Xgn40eGcqY?si=YQy0vmxQ_yGR8-tz	Miniature circuit breaker
13	https://youtu.be/ikLhqUCQKkc?si=8VqRbV1zZlQUSYLd	Earth leakage circuit breaker
14	https://youtu.be/wgxcxOUjfro	Fuse

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. **Semester - 3, K Scheme**