Program Name : **Mechanical and Chemical Engineering Program Group**

Program Code : **CH/AE/FG/ME/PG/PT**

Semester : **Second**

Course Title : **Electrical & Electronics Technology**

Course Code : **22232**

1. RATIONALE

Electrical and electronics equipment are the most essential inputs of any chemical engineering based industry. Further, the various chemical processes and other services in the chemical industries are performed using different electrical and electronics equipment. Chemical engineering diploma passouts must have knowledge of basic electrical and electronics principles, working of equipment, protective devices and the safety measures while working in chemical industry. This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts and principles of electrical and electronic engineering in various engineering applications to solve broad based problems.

2. COMPETENCY

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

- **Use the electrical and electronics equipment in the chemical industry.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Use principles of electric and magnetic circuits to solve engineering problems.
b. Determine the voltage and current in A.C. circuits.
c. Connect transformers and electrical machines for specific requirement.
d. Identify electronic components in electronic circuits.
e. Identify the types of diodes used in electronic circuits.
f. Identify the types of transistor used in electronic circuits.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs;.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics with the various levels of outcomes (details are in the subsequent sections) to be attained by the student by the end of the course, in all domains of learning terms of the industry/employer identified competency depicted at the centre of this map.

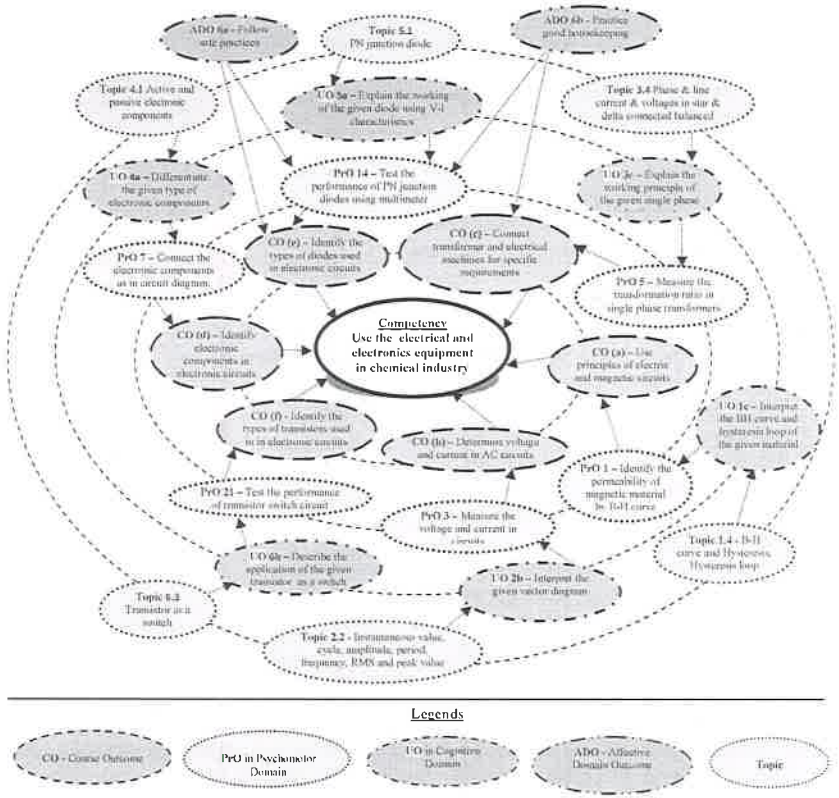

Figure 1 - Course Map

6. SUGGESTED PRACTICAL LEARNING OUTCOMES/TUTORIALS

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Exercises Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Determine the permeability of magnetic material by plotting its B-H curve.	I	02*
2	Measure voltage, current and power in 1-phase circuit (with	II	02*

S. No.	Practical Exercises Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	resistive load).		
3	Measure voltage, current and power in R-L series circuit.	II	02
4	Measure transformation ratio (K) of 1-phase transformer.	III	02
5	Connect single phase transformer and measure input and output quantities.	III	02*
6	Make Star and Delta connection in induction motor starters and measure the line and phase values	III	02
7	Connect the passive electronic components as in circuit diagram	IV	02
8	Connect resistors in series and parallel combination on bread board to measure its value using digital multimeter.	IV	02*
9	Connect capacitors in series and parallel combination on bread board to measure its value using multimeter.	IV	02
10	Identify various active electronic components in the given circuit	IV	02
11	Measure the value of given resistor using multimeter	IV	02
12	Measure value of given capacitor ad inductor using LCR-Q tester	IV	02
13	Determine the value of given resistor using digital multimeter to confirm with colour code.	IV	02
14	Test the PN-junction diodes using digital multimeter.	V	02*
15	Test the performance of PN-junction diode.	V	02
16	Test the performance of Zener diode.	V	02
17	Test the performance of LED.	V	02
18	Identify three terminals of a transistor using digital multimeter.	VI	02
19	Test the performance of NPN transistor.	VI	02*
20	Determine the current gain of CE transistor configuration.	VI	02
21	Test the performance of transistor switch circuit.	VI	02
22	Test the performance of transistor amplifier circuit.	VI	02
	Total		**44**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
1	Selection of suitable component, apparatus/instrument	20
2	Preparation of experimental set up	10
3	Setting and operation	10
4	Safety measures	10
5	Observations and Recording	10
6	Interpretation of result and Conclusion	20
7	Answer to sample questions	10
8	Submission of report in time	10
	Total	100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Expt. S.No.
1	Single Phase Transformer: 1kVA, single-phase, 230/115 V, air cooled, enclosed type.	1,5
2	Single phase auto transformer (Dimmerstat) - Single-Phase, Air cooled, enclosed model, Input: 0 ~ 230, 10A, Output: 0 ~ 270Volts	2,3,4
3	Lamp Bank - 230 V 0-20 A	common
4	Single phase Induction motor – ½ HP,230 V,50 Hz, AC supply	5
5	Different types of starters	6
6	Digital multimeter , 3and ½ digit, seprate range for resistancs and capacitance,component tester, AC and DC measurement.	7,8,11,13, 14,15, 16
7	Dual trace CRO/DSO, 50MHz.	4,5,17,18,19,20,21,22
8	Function generator, 0-2MHz.,Sin ,square, pulse, triangular wave shape generation	17,21,22
9	LCR-Q Meter/Tester	12

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Electric and	1a. Explain the given terms related to electric and magnetic circuits.	1.1 Concepts of EMF, Current, Potential Difference, Power and Energy. 1.2 Concepts of M.M.F. magnetic force,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Magnetic Circuits	1b. Interpret the B-H curve and hysteresis loop of the given material. 1c. Apply Fleming's left hand rule and Lenz's law in the given situation. 1d. Derive the equations of self and mutual inductance for the given circuit.	permeability, hysteresis loop, reluctance, leakage factor. 1.3 magnetic and electric circuits, Faraday's laws of electromagnetic induction. 1.4 Dynamically induced emf. 1.5 Statically induced emf.-(a) Self induced emf (b) Mutually induced emf. 1.6 Equations of self and mutual inductance.
Unit– II A.C. Circuits	2a. Explain the given AC parameters. 2b. Interpret the given vector diagram. 2c. Derive the current and voltage relationship of the given star and delta connections. 2d. Find currents and voltages in the given series and parallel AC circuits.	2.1 A.C. circuit parameter: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, current, RMS value, Average value, Form Factor and Peak Factor, impedance, phase angle, and power factor. 2.2 Vector representation of emf and current; mathematical representation of an alternating emf and current. 2.3 A.C. through: resistors, inductors and capacitors; A.C. through: R-L series, R-C series, R-L-C series and parallel circuit; Power in A. C. Circuits. Concept of power triangle. 2.4 Voltage and Current relationship in Star and Delta connections.
Unit– III Transformer and single phase induction motors	3a Explain the working principle of the given single phase transformer. 3b Explain working principle of the given Autotransformer. 3c Explain working principle of the given single phase induction motors. 3d Explain the construction of the given FHP motors	3.1 General construction and working principle of transformers; Emf equation and transformation ratio of transformers; losses in transformers and efficiency equation. 3.2 Auto transformers. 3.3 Construction and Working principle of single phase A.C. motor. 3.4 Starting methods for induction motors. 3.5 Various types of FHP motors.
Unit – IV Electronic Components and Signals	4a. Differentiate the given type of electronic components. 4b. Calculate value of the given resistor and capacitor using colour code. 4c. Compare features of the voltage and current source on the basis of the given criteria. 4d. Describe the given signal	4.1 Active and passive electronic components 4.2 Resistor, capacitor, inductor symbols, working principals and applications, colour codes, specifications 4.3 Voltage and Current Source 4.4 Signal, waveform, Time and frequency domain representation, Amplitude, frequency, phase, wavelength

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	parameters with sketches. 4e. Distinguish the given analog and digital ICs on the basis of the given criteria.	4.5 Types of Signals: sinusoidal, triangular and square 4.6 Integrated Circuits – analog and digital
Unit– V Diodes and Applications	5a. Explain the working principle of the given diode using V-I characteristics. 5b. Describe the working principle of the given Zener diode. 5c. Interpret the zener voltage on the given Zener diode V-I characteristics. 5d. Explain the working principle of the given type of rectifiers. 5e. Describe the working of the given LED with sketches.	5.1 Symbol, construction and working principle of P-N junction diode 5.2 Rectifiers: Half wave, Full wave and Bridge Rectifier, working principle, circuit diagram, performance parameters PIV, ripple factor, efficiency, Need for filters: circuit diagram and working of 'L', 'C' and 'π'' filter 5.3 Zener diode working principle, symbol, Zener diode as voltage regulator 5.4 Regulated power supply 5.5 Construction and working principle of light emitting diode(LED)
Unit– VI Bipolar Junction Transistor	6a. Differentiate the salient features of the given unipolar and bipolar devices. 6b. Describe the application of the given transistor as switch with sketches 6c. Determine the current gain of the given transistor configuration. 6d. Describe the effect of cascading on bandwidth and voltage gain of the given amplifiers.	6.1 Unipolar and Bipolar devices 6.2 Symbol, construction and working principle of NPN transistor. 6.3 Transistor as switch and amplifier. 6.4 Input and Output characteristics of CE, CB and CC configurations. 6.5 Regions – Cut-off, saturation and Active region. 6.6 Transistor parameters- alpha, beta, input and output resistance and relation between alpha and beta

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Electric and magnetic circuits	06	-	04	06	10
II	A.C. circuits	12	02	04	06	12
III	Transformer and single phase Induction motors	12	04	04	06	14
IV	Electronic components and Signals	10	02	04	06	12
V	Diodes and applications	12	02	04	06	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
VI	Bipolar Junction Transistor	12	02	04	04	10
Total		64	12	24	34	70

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Massive Open Online courses (MOOCs) may be used to teach various topics and sub topics.
a. Market survey and interpret the name plate ratings and identify the parts of an induction motor.
b. Make star delta connections of transformer.
c. Connect the various types of meters to measure the current and voltage of induction motor.
d. Visit the site and interpret the name plate ratings and identify the parts of a transformer.
e. Seminar on any relevant topic.

11. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Electric and magnetic circuit**: Each batch will prepare a coil without core. Students will note the deflection of galvanometer connected across the coil for: movement of the North Pole of permanent magnet towards and away from the coil (slow and fast movement), movement of the South Pole of permanent magnet towards and away from the coil (slow and fast movement). Students will demonstrate and prepare a report based on their observations.
b. **Transformer**: Each batch will visit nearby pole mounted sub-station and prepare a report based on the following points:
   - Rating: kVA rating, primary and secondary voltage, connections
   - Different parts and their functions
   - Earthing arrangement.
c. **Single phase induction motor:** Each batch will select a three phase squirrel cage type induction motor for a particular application (assume suitable rating). They will visit local electrical market (if the market is not nearby you may use the Internet) and prepare a report based on the following points:
   i. Manufactures
   ii. Technical specifications
   iii. Features offered by different manufacturers
   iv. Price range.
d. **Transistor as a switch:** Each batch (3-4 students) will search and study datasheet of transistor and relevant component and will build / test transistor switch circuit on breadboard/General purpose PCB for various input signal.
e. **Prepare display boards consisting of electronic components**: Each batch (3-4 students) will prepare display boards/ models/ charts/ Posters to visualize the appearance of electronic active and passive components.
f. **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.
g. **Diode:** Build a circuit on general purpose PCB to clamp a waveform at 3.0V using diode and passive components.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Fundamentals of Electrical Engineering	Saxena, S. B. Lal	Cambridge University Press, New Delhi, 2014, ISBN: 9781107464353
2	Basic Electrical Engineering	Mittle and Mittal	McGraw Hill Education, New Delhi, 2014, ISBN: 978-0-07-0088572-5
3	Electrical Machines	Bhattacharya, S.K.	McGraw Hill Education, New Delhi, 2014, ISBN: 978-9332902855
4	Electrical Technology Vol – I & II	Theraja, B. L.	S. Chand and Co., New Delhi, 2014, ISBN: 9788121924405
5	Basic Electrical and Electronics Engineering	Jagathesan, V.	Wiley India, New Delhi, 2014, ISBN: 97881236529513
6	A text book of Applied	Sedha, R.S.	S.Chand and Co., New Delhi,

S. No.	Title of Book	Author	Publication
	Electronics		2008,**ISBN:** 978-8121927833
7	Electronics Principles	Malvino, Albert Paul, David	McGraw Hill Education, New Delhi, 2014 , **ISBN:** 978-0070634244
8	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S. Chand and Co., New Delhi-110 055, 2014 , ISBN-:13-9788121924504
9	Fundamental of Electronic Devices and Circuits	Bell, David	Oxford University Press , New Delhi, 2015, ISBN: 9780195425239

14. SOFTWARE/LEARNING WEBSITES

a. Electronics Workbench
b. Scilab
c. www.nptel.iitm.ac.in
d. en.wikipedia.org/wiki/Transformer
e. www.animations.physics.unsw.edu.au//jw/AC.html
f. www.alpharubicon.com/altenergy/understandingAC.htm
g. www.electronics-tutorials
h. learn.sparkfun.com/tutorials/transistors
i. www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
j. faculty.cord.edu/luther/physics225/Handouts/transistors_handout.pdf
k. www.technologystudent.com/elec1/transis1.htm
l. www.learningaboutelectronics.com/
m. www.electrical4u.com