GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

APPLIED ELECTRICAL AND ELECTRONICS.
(Code: 3331905)

Diploma Programmes in which this course is offered	Semester in which offered
Mechanical, Metallurgy, and Mining Engineering	3rd Semester

1. RATIONALE

Electrical and electronics engineering equipment is widely used in mechanical/ metallurgy/mining engineering applications and a diploma engineer from any of these disciplines have to identify the related equipment being used in the industry with respect to their working and major faults that could occur**.** Majority of mechanical/metallurgy/mining industries are of small and medium scale where electrical engineers are not recruited. For normal electrical and electronics tasks, shop floor mechanical /metallurgy/mining diploma engineer needs to attend the situation. If electrical personnel are to be called to electrical/electronic related issues, some basic reasons are primarily required to be known by them. Therefore, this course will help the student to acquire the requisite knowledge and skills.

2. COMPETENCIES (Programme Outcomes as per NBA Terminology)

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competencies

- **Identify the major parts of electrical and electronic equipment being used in mechanical/metallurgy/mining engineering applications with respect to their working and major faults that could occur.**
- **Use electrical and electronic elements/systems to actuate simple mechanical mechanism.**
- **Attend normal electrical faults and use electrical tools and instruments for normal applications effectively.**

3. TEACHING AND EXAMINATION SCHEME.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	ExaminationScheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	**150**

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

4. COURSE DETAILS.

Unit	MajorLearning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Fundamentals of electrical engineering and magnetic circuit	1a. Define the terms associated with magnetic circuits. 1b. Compare between right hand rule and cork screw rule.	1.1 Electricity generation-principle, working setup, elements and their functions. 1.2 Concept of AC (Alternating Current) and DC (Direct current). 1.3 Magnetic circuit: M.M.F, magnetic force, magnetic field strength, permeability, reluctance, magnetic flux, hysteresis loop. 1.4 Magnetic field of permanent magnet and current carrying conductor, Right hand rule and Cork Screw rule.
	1c. Define the terms: Electromotive force, current, voltage, resistance, and conductance. 1d. Define the parameters associated with AC supply.	1.5 Terminologyassociated with electrical circuit: Electromotive force, current, voltage, resistance, and conductance. 1.6 Ohm's law. 1.7 AC wave cycle, instantaneous value, amplitude, frequency, time period, R.M.S. value, mean value, phase, phase difference, power factor, electric field, work, power and energy.
	1e. Establish the relationship between line and phase quantities. 1f. Describe the concept of single phase and three phase supply with sketches.	1.8 Concept of line value and phase value,line voltage, line current, phase voltage andphase current. 1.9 Concept of single phase and three phase supply.
Unit – II **Electrical components, tools and instruments**	2a. State the specifications of electrical materials and select the components for simple applications.	2.1. Types, specifications, materials and applications of wires, cables and fuses. 2.2. Types, construction, symbols,materials and applicationsof switches/plugs/sockets.
	2b. Use electrical tools and instruments for simple applications. 2c. Describe with sketches the connection of the various types of meters and CRO to measure the various parameters.	2.3. Types, specifications, materials of construction and applications of various tools. 2.4. Meters: multimeter,clip-on, meter, tester, voltmeter, ammeter, energy meter, CRO- Types, specifications, materials of construction, connection method and applications.
Unit – III Electrical Machines	3a. Explain the working of single phase transformer with	3.1 Transformer Types: Core and shell type, auto transformers.

Unit	MajorLearning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	schematic line diagrams. 3b. Describe the construction of core and shell type transformer with sketches. 3c. Explain the working of autotransformer with sketches. 3d. State the line and phase values for star and delta connections of transformers.	3.2 Construction and working of transformer, transformation ratio. 3.3 Comparison between conventional and auto transformer. 3.4 Three phase supply connections - Star and Delta connection-diagrams/circuit, applications.
	3e. Explain the working of a DC machine. 3f. Justify the need for starter in DC machines.	3.5 DC machines:construction, working and applications, necessity of starter. 3.6 DC and AC generators-construction, working and applications.
	3g. Explain the working of synchronous machines. 3h. Describe the working of a three phase induction motors. 3i. Describe the working of a single phase induction motors. 3j. List the common faults occurring in AC motors.	3.1 Synchronous machines:construction andworking 3.2 Types of AC motors: Three phase and single phase- specification, construction, working, starting method, connection diagrams and applications. 3.3 Commonly occurring faults in single phase motor, three phase motor.
	3k. Describe the working of stepper motor with line diagrams 3l. Describe the working of servo motor with line diagram.	3.4 Fractional Horse power motors - construction, working,number of inputs, number of outputs and how to connect, common troubles and remedies: i. Stepper motor ii. Servo motors.
Unit – IV Electrical Safety and Protection	4a. Check the effectiveness of earth connections of any electrical installation. 4b. Check the insulation resistance of electrical installations.	4.1 Earthing. 4.2 Insulation.
	4c. List the different types of protective devices along with their symbols used in equipment and installations. 4d. Describe the working of optical fibres from opto-isolation point of view.	4.3 Safety and Protection-specification, working and applications of protective devices such as fuses, MCBs and ELCBs. 4.4 Concept of optical fibre communication. 4.5 Opto-isolation for circuit safety.
Unit – V Electronic Components and Circuits	5a. Specify values of different discrete electronic devices along with their symbols.	5.1 Discrete electronic components: Symbols, general construction and working: Resistor, Inductor, Capacitor, Diode, Transistor, photo diodes.

Unit	MajorLearning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	5b. State the need for microcontrollers and PLCs used with various equipments.	5.2 Microcontrollers and PLCs (Programmable Logic Controller) - Concept, general constructional features, working and applications.
	5c. Interpret the circuit diagrams consisting of regulated power supply and different types of rectifiers	5.3 Regulated power supply, Rectifier (Half and Full wave), Uninterruptible power supply (UPS) -
	5d. Interpret the circuit diagrams consisting of different types of power electronic devices such as DIAC, TRIAC, SCR, IGBT, GTOs	5.4 Power electronic components: Symbols, general construction and working: DIAC, TRIAC, SCR, IGBT and GTO.
	5e. Use PCBs for simple applications.	5.5 PCB-concept and general applications. 5.6 PCBs for following applications: i. Movement of stepper motor according to input value of x, y and z coordinates. ii. Generate different time delay by 555 timers IC. iii. A circuit which latch the given input (Switch 1) and reset by another input (Switch 2). iv. Circuit to detect a given object. (Use photo diode and photo transistor).

5. SUGGESTED SPECIFICATIONTABLE WITH HOURS & MARKS(THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of electrical engineering and magnetic circuit.	08	06	06	02	14
II	Electrical components, tools and instruments	10	04	04	08	16
III	Electrical machines, drives and transformers	12	08	06	06	20
IV	Electrical safety and protection	04	00	02	04	06
V	Electronic components and circuits	08	06	04	04	14
		42	**24**	**24**	**22**	**70**

Legends:R = Remember; U= Understand; A= Apply and above levels (Bloom's revised taxonomy)

Note:

a: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

b: If midsem test is part of continuous evaluation, unit numbers I, II (Up to 2.2), IV and V(only 5.1) are to be considered. It is also compulsory for student to complete experiment.no.1 to 5 to eligible for midsem test.

c: Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises shouldbeproperly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only course outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those programme outcomes/course outcomes related to affective domain.

S. No.	UnitNo.	Practical/Exercise(Course Outcomes in Psychomotor Domain according to NBA terminology)	Apprx. Hrs. Required
1	**I**	a: Demonstrate generation of electricity and explain various terminologies associated with it. b: Demonstrate difference between AC and DC. c: Verify Ohm's law.	04
2	**I**	Perform any one from following. a: Obtain the required voltages across the branches in the given network. b: Obtain the required incoming current at different nodes of the given network.	02
3	**II**	Do electrical wiring for given case/parameters using electrical wires/cables, components and tools. Test the same and measure applicable parameters/variables like resistance, current, power, voltage, power factor, etc. Also do following. a: Identify the cables and fuses along with their specifications. b: Identify and state specifications of various meterstaken in use.	04
4	**III**	Perform following.(Any two, but preferably all). a: Connect the single phase electric motor to start them (using the circuit diagram). b: Connect the three phase electric motor to start them (using the circuit diagram).. c: Connect the DC motors to start them. (using the circuit diagram).	02
5	**III**	Perform any one from following.(Do both if possible). a: Connect the synchronous machine to run as a generator. (using the circuit diagram). b: Connect the synchronous machine to run as a motor.	02
6	**III**	Identify the faults in the given electric motor.	02
7	**III**	a: Operate the given stepper motors for the given speeds. (using the circuit diagram). b: Operate the given servo motors for the given speeds. (using the circuit diagram).	02
8	**IV**	a: Use the earth tester and megger for the given installation. b: Select the most appropriate protective device for the given application. c: Use fuse, MCBs and ELCBs for attending repair tasks.	04
9	**V**	Use PCB for simple applications.	04
10	**V**	Use PLC Or Microcontroller for specific applications.	02
		Total	**28**

NOTES:

a. It is compulsory to prepare log book of exercises. It is also required to get eachexercise recorded in the logbook, checked and duly signed by teacher with date.
b. Term work report must not include any photocopy/ies, printed manual/pages, litho,etc. It must be hand written / hand drawn by student only.
c. For 20 marks ESE, students are to be assessed for practical skills achieved.

7. SUGGESTED LIST OF STUDENT ACTIVITIES:

i. Write the specifications of lamp, CFL bulb, pump motor, fan and blender motor available at your room/house.
ii. Identify few mechanical engineering situations which require automation.
iii. Identify the type of electrical drives used in lathe, milling, grinding, shaper, power hack saw machines of your workshop. Also write their specifications.
iv. Visit nearby workshop, industry, testing lab and prepare a list of machines, instruments which are controlled using PLC and microcontroller.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any).

Sr. No.	Unit	Unit Title	Strategies
1	**I**	Fundamentals of electrical and magnetic circuits.	Demonstration. Movies.
2	**II**	Electrical components, tools and instruments	Demonstration.
3	**III**	Electrical machines, drives and transformers	Demonstration.Power point presentations, Movies.
4	**IV**	Electrical safety and protection	Real life situations, demonstrations, Movies.
5	**V**	Electronic components, tools and circuits	Real life situations, demonstrations, Movies.

9. SUGGESTED LEARNING RESOURCES

A) List of Books:

Sr.No.	Title of Books	Author	Publication
1.	Basic Electronics &Linear Circuits	Theraja, B.L.	McGraw Hill Education, New Delhi,
2.	A text book of ElectricalTechnology vol.2	Theraja, B.L.	S.Chand Publication, New Delhi 2011 or latest
3.	A Course In ElectricalAnd ElectronicMeasurements AndInstrumentation	Sawhney, A K	S.Chand Publication, New Delhi 2011 or latest
4.	Basic electronics	Mehta ,V.K.	S.Chand Publication, New Delhi 2011 or latest

B) List of Major Equipment/Materials with Broad Specifications

i. DC shunt,series and compound motor – 3 HP 230 V DC , 19 A, 1000 RPM
ii. DC shunt motor-generator set – 3 HP, 230 V DC, 16 A, 1000 RPM,
iii. Three Phase Induction motor-3 HP, 400 V, 50 Hz, 1500 RPM,
iv. Three Phase Synchronous Machine-3 HP 400 V, 50 Hz, 1500 RPM,
v. Single phase transformer – 230 V / 115 V, 1 kVA 1-phase transformer
vi. Auto transformer : 0 – 230 V, 10 Amp
vii. Welding transformer: 50 V, 50 /100 Amp

C) List of Software/Learning Websites

i. www.nptel.com/iitm/

ii. www.howstuffworks.com/

iii. www.vlab.com

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE.

Faculty Members from Polytechnics

- **Prof. Pratik Solanki**, Lecturer in Mechatronics, B.S.Patel Polytechnic, Kherva.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. N P Patidar,** Associate Professor, Dept. of Electrical and Electronics Engineering
- **Dr. Joshua Earnest,** Professor, Dept. of Electrical and Electronics Engineering