MINOR COURSE-MN 2A	ELECTRICAL CIRCUITS NETWORK & BASIC INSTRUMENTATION SKILLS	(Theory Credit -03) (Total Marks=60+15)

Course Objective:

This course aims to provide students with a strong foundation in electrical circuits, network analysis, and basic instrumentation skills. It introduces fundamental electrical principles, circuit elements, power components, and protection mechanisms. The course also emphasizes practical aspects such as electrical schematics, wiring, measurement techniques, and the use of various electrical and electronic instruments, including multimeters, oscilloscopes, and signal generators.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. **Understand basic electrical principles** including voltage, current, resistance, power, and Ohm's law, and apply them to analyze AC and DC circuits.
2. **Analyze electrical circuits** by determining current and voltage drops across various elements, understanding real, imaginary, and complex power components, and calculating power factor.
3. **Interpret electrical drawings and schematics**, including symbols, power circuits, control circuits, and ladder diagrams, to track connections and identify current flow and voltage drops.
4. **Explain the working principles of generators and transformers**, including AC and DC generators, transformer construction, and operation.
5. **Understand the fundamentals of electric motors**, including single-phase and three-phase AC/DC motors, their design, speed, and power considerations.
6. **Identify and apply electrical protection mechanisms** such as relays, fuses, circuit breakers, overload devices, grounding, and phase reversal protection.
7. **Perform electrical wiring tasks**, including selecting and connecting conductors and cables, understanding star and delta connections, measuring voltage drop, and assembling extension boards.
8. **Develop basic measurement skills** by understanding accuracy, precision, sensitivity, resolution, and error analysis in electrical instruments.
9. **Operate measurement instruments** such as multimeters, voltmeters, and oscilloscopes to measure voltage, current, resistance, and signal characteristics.
10. **Use signal generators and analysis instruments**, including low-frequency signal generators, pulse/function generators, and wave analyzers, for testing and troubleshooting electrical circuits.
11. **Apply impedance measurement techniques** using RLC bridges, Q-meters, and digital LCR bridges for circuit analysis and component testing.
12. **Compare and utilize digital instruments**, including digital voltmeters and multimeters, and measure time intervals, frequency, and period using universal counters.

This outcome-based approach ensures that students acquire both theoretical knowledge and hands-on skills in electrical circuits and instrumentation, preparing them for advanced studies and practical applications in electrical engineering and physics.

Course Contents:

Basic Electricity Principles (02 HRS): Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC and DC current.

Electrical Circuits (03 HRS): Main electric circuit elements and their combination. Current and voltage drop across the DC circuit elements. Real, imaginary and complex power components of AC source. Power-factor.

Electrical Drawing and Symbols (02 HRS): Drawing symbols. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

Generators and Transformers (04 HRS): AC & DC generators. Principle, construction and working of transformers.

Electric Motors (03 HRS): Single-phase, three-phase connections, AC & DC motors. Basic design, Speed & power of AC/DC motor.

Electrical Protection (03 HRS): Relays. Fuses and disconnect switches. Circuit breakers, Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal.

Electrical Wiring (03 HRS): Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits, Cable trays. Splices and solder. Preparation of extension board.

Basic of Measurement (05 HRS): Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Electronic Voltmeter (05 HRS): Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance.

Cathode Ray Oscilloscope (05 HRS): Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), Specifications of a CRO and their significance. Uses of CRO **,** Digital storage Oscilloscope: Block diagram and principle of working.

Signal Generators and Analysis Instruments (03 HRS): Low frequency signal generators. Pulse generator, and function generator. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters (04 HRS): Working principles ofbasic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & workingprinciples of a Q- Meter. Digital LCR bridges.

Digital Instruments (03 HRS): Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter (03 HRS): Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time- base stability, accuracy and resolution.

Reference Books:

1. Text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan& N. S. Kumar, 3 rd Ed., 2012, Tata Mc-Graw Hill.
7. Electronic circuits: Handbook of design and applications, U. Tietze, Ch. Schenk, 2008, Springer
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson.
9. Essentials of Circuit Analysis, Robert L. Boylestad, Pearson Education (2004)
10. Introductory circuit analysis, R. Boylestead, 2016, Pearson

MINOR COURSE-MN 2A	ELECTRICAL CIRCUITS NETWORK & BASIC INSTRUMENTATION SKILLS	(Practical Credit -01) (Total Marks=25)

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges
10. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
11. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
12. To measure Q of a coil and its dependence on frequency, using a Q- meter.
13. Measurement of voltage, frequency, time period and phase angle using CRO.
14. Measurement of rise, fall and delay times using a CRO.
15. Measurement of distortion of a RF signal generator using distortion factor meter.
16. Measurement of R, L and C using a LCR bridge/ universal bridge.

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.
4. Electronic circuits: Handbook of design and applications, U. Tietze, Ch. Schenk, 2008, Springer
5. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson.
6. Introductory circuit analysis, R. Boylestead, 2016, Pearson