



BANGLADESH TECHNICAL EDUCATION BOARD
Agargaon, Dhaka-1207

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)

ELECTRICAL TECHNOLOGY

TECHNOLOGY CODE: **667**

6th SEMESTER

DIPLOMA IN ENGINEERING
PROBIDHAN-2016

ELECTRICAL TECHNOLOGY

6th SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total
						Theory		Practical		
						Cont. assess	Final exam	Cont. assess	Final exam	
1	66761	Alternating Current Machines-1	3	3	4	60	90	25	25	200
2	66762	Electrical & Electronic Measurement-2	2	3	3	40	60	25	25	150
3	66763	Transmission and Distribution of Electrical Power-1	3	3	4	60	90	25	25	200
4	66867	Communication Engineering	2	3	3	40	60	25	25	150
5	66868	Micro Controller & PLC	2	3	3	40	60	25	25	150
6	65852	Industrial Management	2	0	2	40	60	0	0	100
Total			14	15	19	280	420	125	125	950

AIMS

After completion of the course students will be able to acquire knowledge, skills and attitude in the area of Alternating Current Machines emphasizes on:

- Power transformer.
- Auto transformer.
- 3-phase induction motor.

SHORT DESCRIPTION

Transformer : principle of operation & construction, emf equation, transformation ratio, losses, equivalent resistance, leakage reactance, tests, regulation, efficiency, three phase connection, auto transformer, parallel operation, Three-phase induction motor: working principle, construction, magnetic field, torque, energy stage, tests, starting and speed control.

DETAIL DESCRIPTION**Theory:**

- 1 Understand working principle and construction of transformer.**
 - 1.1 Define transformer.
 - 1.2 Explain the working principle of a transformer.
 - 1.3 Describe the construction of a transformer.
 - 1.4 Identify the materials used for a transformer construction.
 - 1.5 List different types of transformers.
 - 1.6 Describe Core type, Shell type and Spiral core type transformer.
 - 1.7 Compare between the core type and shell type transformer.
- 2 Perceive the emf equation, transformation ratio and Losses of transformer.**
 - 2.1 Define emf equation, transformation ratio of transformer
 - 2.2 Derive the emf equation of transformer.
 - 2.3 Explain voltage ratio, current ratio and transformation ratio.
 - 2.4 List the losses of transformer.
 - 2.5 Interpret Hysteresis loss, Eddy current loss, Core loss and Copper loss.
 - 2.6 Solve problems on emf equation.
- 3 Interpret the principle of operation of transformer on no-load condition and load condition.**
 - 3.1 Explain no-load operation of transformer.
 - 3.2 Define no-load voltage, current, mutual flux, no load power factor.
 - 3.3 Draw the vector diagram of a transformer on no load condition.
 - 3.4 Solve problems related to no load test.
 - 3.5 Explain operation of a transformer on load condition.
 - 3.6 Draw the vector diagram of transformer on lagging, leading and unity power factor.
 - 3.7 Solve problems related to transformer on load.
- 4 Understand equivalent circuit of transformer, magnetic leakage and leakage reactance of transformer.**
 - 4.1 Draw the equivalent circuit and vector diagram of a transformer.
 - 4.2 Explain the equivalent circuit of a transformer.
 - 4.3 Derive the equivalent resistance of a transformer referred to primary.
 - 4.4 Calculate the equivalent resistance of a transformer referred to secondary.
 - 4.5 Explain magnetic leakage of transformer.
 - 4.6 List the disadvantages of magnetic leakage.
 - 4.7 Calculate leakage reactance of transformer in terms of primary and in terms of secondary.
 - 4.8 Solve problems on equivalent circuit of transformer, leakage reactance and impedance of transformer.

- 4.9 Define percentage resistance, reactance and impedance.
- 4.10 Express the deduction of the equation for percentage resistance, reactance and impedance.
- 5 Realize the open circuit test, short circuit test and voltage regulation of transformer**
- 5.1 Describe open circuit test.
- 5.2 Describe short circuit test.
- 5.3 Draw the vector diagrams.
- 5.4 Solve problems related to open and short circuit test.
- 5.5 Define voltage regulation.
- 5.6 Express the deduction of the equation for voltage regulation at unity, lagging and leading power factor.
- 5.7 Solve problems related to voltage regulation.
- 6 Understand the efficiency and cooling system of transformer.**
- 6.1 Derive the formula for calculation of efficiency of transformer.
- 6.2 Explain the factors affecting core loss and copper loss of the transformer.
- 6.3 Deduce the equation for maximum efficiency.
- 6.4 Evaluate the variation of efficiency with power factor.
- 6.5 Define all day efficiency and mention the formula of all day efficiency.
- 6.6 Solve problems on efficiency, maximum efficiency and all day efficiency.
- 6.7 Explain the necessity of cooling system of transformer.
- 6.8 Describe the methods of cooling system the transformer.
- 6.9 Narrate the transformer oil and its properties.
- 7 Realize the construction and Principle of operation of three phase transformer.**
- 7.1 Describe the construction of three phase transformer.
- 7.2 List various methods of connection of 3-phase transformer and their applications.
- 7.3 Describe the methods of star–star, delta–delta, star–delta and delta–star connection.
- 7.4 Outline open delta connection or V-V connection.
- 7.5 Describe Scott or T-T connection.
- 7.6 Explain the application of V-V and T-T connection.
- 7.7 Draw the connection of 3-phase to 2-phase and vice-versa.
- 8 Comprehend the principle of auto-transformer.**
- 8.1 Describe auto-transformer.
- 8.2 Explain the terms transformed power and conducted power.
- 8.3 List the advantages and disadvantages of auto-transformer.
- 8.4 Convert a Two-winding transformer to auto-transformer.
- 8.5 Mention the uses of auto-transformer.
- 8.6 Solve problems related to auto-transformer.
- 9 Understand the principle of parallel operation of transformer.**
- 9.1 Describe the purpose of polarity test.
- 9.2 Describe the subtractive and additive polarity.
- 9.3 Illustrate the test to determine the polarity of a transformer
- 9.4 Explain the purpose of parallel operation.
- 9.5 List the conditions for parallel operation.
- 9.6 Describe the parallel operation of transformers with equal voltage ratio.
- 9.7 Explain the specification on the name plate of a transformer.
- 9.8 Solve problems related to parallel operation.
- 10 Realize the principle and construction of 3-phase induction motor.**
- 10.1 Explain the general principle of induction motor.
- 10.2 Distinguish between induction motor and conduction motor.
- 10.3 List various types of induction motor with their applications.
- 10.4 Mention different parts of a 3-phase induction motor.
- 10.5 Describe the construction of stator of an induction motor.

- 10.6 Narrate the construction of squirrel cage rotor, double squirrel cage rotor and phase wound rotor of induction motor.
- 10.7 Explain the purpose of skewing the rotor bars in a squirrel cage rotor.
- 10.8 Define slip and slip speed.
- 10.9 Express the derivation of the equation $f_r = s \times f$ and $N_r = \frac{120f}{P}(1-s)$
- 10.10 Outline rotor voltage, rotor current and rotor power.
- 10.11 Solve problems related to slip. .
- 11 Recognize the concept of development of rotating magnetic field and torque in rotor.**
- 11.1 Explain the development of rotating magnetic field for three phase induction motor.
- 11.2 Express the deduction of the formula $\Phi_R = 1.5\Phi_m$.
- 11.3 Demonstrate the principle of rotation of a 3-phase motor.
- 11.4 Clarify starting torque, running torque and maximum torque.
- 11.5 Explicit the deduction of the equation of starting torque, running torque and maximum torque.
- 11.6 Describe the condition for maximum torque at running and starting condition.
- 11.7 Mention the relation between torque and rotor power factor.
- 11.8 Explain the relation between torque and speed.
- 11.9 Draw the torque speed curve.
- 11.10 Explain the effect of changing the voltage on torque and speed.
- 12 Perceive the concept of Power stages of induction motor.**
- 12.1 List the losess in 3-phase induction motor.
- 12.2 Indicate different stages of power developed in an induction motor.
- 12.3 Solve Energy stages related problems.
- 13 Understand the equivalent circuit and maximum Power output of an induction motor.**
- 13.1 Explain the equivalent circuit of an induction motor.
- 13.2 Clarify maximum power output of an induction motor.
- 13.3 Express the deduction of the maximum power output $R_L = Z_o$.
- 14 Realize the principle of starting of a 3-phase induction motor.**
- 14.1 Explain the purpose of starter.
- 14.2 List the starters used for starting 3-phase induction motor.
- 14.3 Describe the direct Online starter method, Start-delta starter method (manual and automatic), Auto transformer starter method of starting squirrel cage induction motor.
- 14.4 Illustrate the rheostat method of starting slip ring induction motor. .
- 15 Understand the principle of speed control of induction motor.**
- 15.1 List the methods of speed control of 3-phase induction motor.
- 15.2 Describe speed control by changing applied voltage, changing applied frequency and changing stator poles.
- 15.3 Describe rheostat control method, concatenation method & injecting emf in rotor circuit method.

Practical:

- 1 Observe and determine the transformation ratio of a single phase transformer.**
- 1.1 Inspect a single phase transformer.
- 1.2 Sketch the circuit diagram.
- 1.3 List the tools, equipments & materials for the experiment.
- 1.4 Connect the equipment according to the circuit diagram.
- 1.5 Apply the voltage to the high side and connect the load to the low side.
- 1.6 Tabulate the readings from the instruments and calculate the transformation ratio from
- the formula: $a = \frac{V_p}{V_s} = \frac{I_s}{I_p}$
- 2 Perform the open circuit test of single phase transformer.**
- 2.1 Draw the circuit diagram.

- 2.2 List the tools, equipment & materials required.
- 2.3 Connect the equipment according to the diagram.
- 2.4 Connect the low side of its rated supply voltage keeping high side open.
- 2.5 Record the readings of the instruments.
- 2.6 Calculate I_o , I_{μ} , I_w , R_o and X_o .
- 2.7 Draw no load vector diagram using the data obtained.
- 3 Perform the short circuit test of a single phase transformer.**
 - 3.1 Sketch the required circuit diagram.
 - 3.2 List tools, equipment & materials required.
 - 3.3 Connect the equipment according to the circuit diagram keeping high side to the source.
 - 3.4 Short circuit the low side by a low resistance wire.
 - 3.5 Energize the circuit by applying reduced voltage and increase the voltage until it takes full load of current.
 - 3.6 Record the instrument readings.
 - 3.7 Observe copper loss and calculate and find R_e' , X_e' & Z_e' .
- 4 Determine the voltage regulation of single phase transformer by direct loading.**
 - 4.1 Sketch the necessary circuit diagram.
 - 4.2 List the tools, equipment & materials required.
 - 4.3 Connect the meters according to the diagram.
 - 4.4 Connect the source to the primary keeping the secondary open and record no load voltage (V_o).
 - 4.5 Connect full load on the secondary & record the load voltage.
 - 4.6 Calculate the voltage regulation from the formula:

$$\% \text{ Voltage Reg.} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$$
- 5 Perform the polarity test of a single phase transformer.**
 - 5.1 Draw the required circuit diagram.
 - 5.2 Collect tools, equipment & materials required.
 - 5.3 Connect the equipment according to the diagram.
 - 5.4 Connect the circuit to the source.
 - 5.5 Record the voltmeter readings.
 - 5.6 Determine whether it is additive or subtractive polarity.
- 6 Perform parallel operation of two single phase transformers.**
 - 6.1 Draw the circuit diagram.
 - 6.2 Collect tools, equipment & materials required.
 - 6.3 Connect the equipment according to the circuit diagram with proper polarity.
 - 6.4 Energize the circuit and connect the load to the secondary.
 - 6.5 Record the energy shared by each transformer.
- 7 Perform transformer banking.**
 - 7.1 Collect the tools, equipment and materials required.
 - 7.2 Draw the circuit diagram of Y-Y, Y- Δ , Δ - Δ and Δ -Y banking respectively.
 - 7.3 Connect the equipment according to the diagram separately.
 - 7.4 Record the meter readings for each case separately.
 - 7.5 Calculate the voltage ratio in each case.
- 8 Perform V-V and T-T connection of transformer banking.**
 - 8.1 Collect the tools, equipment and materials required.
 - 8.2 Draw the circuit diagram of V-V connection respectively.
 - 8.3 Draw the circuit diagram of T-connection respectively.
 - 8.4 Connect the equipment according to the diagram separately.
 - 8.5 Record the meter readings for each case separately.
 - 8.6 Calculate the voltage ratio in each case.

- 9 Perform the operation of auto-transformer and determining its transformation ratio.**
 - 9.1 Sketch the circuit diagram.
 - 9.2 Collect tools, equipment & materials required.
 - 9.3 Connect the equipment according to the circuit diagram.
 - 9.4 Energize the circuit and tabulate the meter readings.
 - 9.5 Calculate transformation ratio, conducted power & transformed power.
- 10 Perform the identification of the parts of a three phase induction motor.**
 - 10.1 Select a 3-phase induction motor.
 - 10.2 Collect different tools required for the experiment.
 - 10.3 List different parts of a 3-phase induction motor.
 - 10.4 Dismantle the parts of the motor.
 - 10.5 Identify different parts and make sketch of each part. .
 - 10.6 Assemble the dismantled parts.
- 11 Start a 3-phase induction motor by manual Star-delta starter.**
 - 11.1 Take a 3-phase squirrel cage induction motor.
 - 11.2 Collect the equipment & tools required.
 - 11.3 Draw the working diagram to perform the experiment.
 - 11.4 Connect the starter with the motor as per diagram.
 - 11.5 Start the motor with the starter: first in star and then in delta position.
 - 11.6 Measure the speed of the motor with tachometer.
 - 11.7 Calculate slip of the motor.
- 12 Start a 3-phase induction motor by Star-delta starter using PLC.**
 - 12.1 Take a 3-phase squirrel cage induction motor.
 - 12.2 Collect the equipment & tools required.
 - 12.3 Draw the working diagram to perform the experiment.
 - 12.4 Connect the starter with the motor as per diagram.
 - 12.5 Push the start button to start the motor automatically first in star and then in delta position.
 - 12.6 Measure the speed of the motor with tachometer.
 - 12.7 Calculate slip of the motor.

REFERENCE BOOKS

1. Electrical Machines by
– Charles. S. Siskind
2. A text book of Electrical Technology
– B. L Theraja and A.K Theraja.
3. Electrical Machine
– J B Gupta
4. Electrical Machines
– M.V. Deshpande

AIMS

To provide the student with opportunities to acquire knowledge, skills and attitude in the area of Electrical Measurement and Measuring Instruments with special emphasizes on:

- Extension of instrument range
- Operation of instrument transformer.
- Measurement of the resistance of various ranges.
- The concept of operation of meters for measurement of frequency and Power factor,

SHORT DESCRIPTION

Extension of instrument ranges: instrument range; Ammeter shunt, Voltmeter multiplier; Instrument transformer: construction and use of CT & PT; Measurement of resistance: Low resistance, Medium resistance and High resistance; Multimeter; Digital instrument; Frequency Meter: Principle of measurement, construction and operation; Energy factor meter: Construction and principles of operation; Digital energy factor meter;

DETAIL DESCRIPTION**Theory:**

- 1 Understand extension of instrument range.**
 - 1.1 List different types of instrument for which extension is required.
 - 1.2 Explain the principles and necessity for extension of instrument range.
 - 1.3 Describe the ammeter shunt for DC circuit.
 - 1.4 Express the deduction of the relation: $R_{sh} = \frac{R_m}{N-1}$
 - 1.5 Explain ammeter shunt for AC circuit.
 - 1.6 Solve problems relating to ammeter shunt.
 - 1.7 Describe voltmeter multiplier and the swamping resistance
 - 1.8 Explain voltmeter multiplier for AC instrument.
 - 1.9 Solve problems relating to voltmeter multiplier.
- 2 Perceive the concept of Instrument transformer.**
 - 2.1 Describe current transformer (CT) and potential transformer (PT).
 - 2.2 List the applications of current transformer and potential transformer.
 - 2.3 Explain the advantages and disadvantages of CT and PT.
 - 2.4 Describe the burdens of instrument transformer.
 - 2.5 Define Knee point, excitation curve and class of CT.
 - 2.6 Compare instrument transformer with Power transformer.
- 3 Realize the concept of current transformer (CT) and potential transformer (PT).**
 - 3.1 Describe the construction of current transformer.
 - 3.2 Draw and explain the connection and vector diagram of current transformer.
 - 3.3 Determine actual current ratio, ratio error and phase angle error.
 - 3.4 Explain the characteristics of current transformer.
 - 3.5 Narrate the classes of accuracy in instrument transformer.
 - 3.6 Outline the effect of open circuited secondary of current transformer.
 - 3.7 Describe the construction and use of clip on ammeters.
 - 3.8 Explain the construction of potential transformer.
 - 3.9 Sketch and explain the connection diagram with line and vector diagram of PT.
 - 3.10 Draw the circuit showing CT, PT and Watt meter with 1-phase and 3-phase load.

- 4 Recognize the measurement of resistance.**
 - 4.1 Classify resistance.
 - 4.2 Explain low, medium and high range of resistance.
 - 4.3 List the methods of measurement of low resistance.
 - 4.4 Describe the measurement of low resistance by ammeter- voltmeter method.
 - 4.5 Determine the low resistance by Kelvin's double bridge method.
 - 4.6 Solve problems on Kelvin's double bridge method.
- 5 Interpret the measurement of medium resistance.**
 - 5.1 List the methods for measurement of medium resistance.
 - 5.2 Describe Wheatstone bridge method to measure the medium resistance.
 - 5.3 Mention the advantages of Wheatstone bridge method.
 - 5.4 Discuss the precaution in measuring medium resistance by Wheatstone bridge method.
 - 5.5 Solve problems related to Wheatstone bridge method.
- 6 Understand the measurement of high resistance.**
 - 6.1 Describe dielectric test of insulating materials.
 - 6.2 List the methods to measure high resistance measurement.
 - 6.3 Describe the guard wire method of measurement of high resistance.
 - 6.4 Explain the construction and working principle of a Megger.
 - 6.5 Describe the method of measurement of high resistance Using a Megger.
 - 6.6 State the uses of Megger.
 - 6.7 Describe measurement of earth resistance using earth tester.
- 7 Perceive the Multimeter.**
 - 7.1 Explain the circuit of analog Multimeter.
 - 7.2 Describe the construction of analog Multimeter.
 - 7.3 Specify the construction of digital Multimeter.
 - 7.4 Describe the uses of Multimeter.
- 8 Illustrate the method of measurement of frequency and frequency meter**
 - 8.1 Name the methods of measuring frequency.
 - 8.2 Explain the principle of mechanical resonance and electrical resonance.
 - 8.3 Construct the variation of impedance of an inductive circuit with the variation of supply frequency.
 - 8.4 Mention different types of frequency meter.
 - 8.5 Explain the construction and working principle of electrical resonance frequency meter.
 - 8.6 Describe the construction and working principle of Weston frequency meter.
- 9 Understand the operation of digital frequency meter.**
 - 9.1 Describe the principle of operation of digital frequency meter.
 - 9.2 Sketch the block diagram of a digital frequency meter.
 - 9.3 Describe each block of a digital frequency meter.
 - 9.4 Describe the function of time base selector in digital frequency meter.
 - 9.5 Draw and Explain the operation of logic diagram of a digital frequency meter.
- 10 Realize the construction and principle of operation of power factor meter.**
 - 10.1 List different types of energy factor meter.
 - 10.2 Describe construction and principle of operation of single phase dynamometer type power factor meter.
 - 10.3 Narrate the construction and principle of operation of three phase dynamometer type power factor meter.
 - 10.4 Describe the principle of operation of digital power factor meter.
 - 10.5 Draw the block diagram of a digital power factor meter.
 - 10.6 Describe each block of a digital power factor meter.
- 11 Understand the principle of high voltage measurement and testing.**
 - 11.1 Describe the high voltage measurement of electrical quantities.
 - 11.2 List the equipment for high voltage measurement.
 - 11.3 Describe the sphere gap method of high voltage measurement.

- 11.4 Describe the potential divider method of high voltage measurement.
- 11.5 Mention the advantages of sphere gap method of high voltage measurement.
- 11.6 Mention the disadvantages of sphere gap method of high voltage measurement.

12 Understand the principle and operation of oscilloscope.

- 12.1 State the basic principle of oscilloscope.
- 12.2 Mention the types of oscilloscope.
- 12.3 Mention the important features of cathode ray oscilloscope
- 12.4 Describe the block diagram of oscilloscope.
- 12.5 Describe the operation of dual trace oscilloscope.
- 12.6 Describe the operation of digital oscilloscope.
- 12.7 Describe the Procedure of measurement voltage, current, phase & frequency using CRO.
- 12.8 Describe frequency and phase angle measurement using Lissagous Pattern.

Practical:

1 Determine the shunt resistance of an ammeter for extension of its range.

- 1.1 Sketch the circuit diagram for determining the shunt resistance of an ammeter.
- 1.2 Collect the tools, equipment and materials required.
- 1.3 Prepare the circuit according to the circuit diagram using proper equipment.
- 1.4 Check the equipment setting and connection before connecting Power supply.
- 1.5 Record the readings from the meter.
- 1.6 Calculate the value of shunt resistance.

2 Measure the value of resistance of a voltmeter multiplier.

- 2.1 Sketch the circuit diagram for determining the resistance of voltmeter multiplier.
- 2.2 Connect the tools, equipment and materials required.
- 2.3 Prepare the circuit according to the circuit diagram.
- 2.4 Check the circuit before connecting Power supply.
- 2.5 Record the reading from the meter.
- 2.6 Calculate the value of resistance of the multiplier.

3 Perform the handling of instrument transformer.

- 3.1 Select the current transformer and potential transformer.
- 3.2 Select required tools, equipment and materials.
- 3.3 Draw the circuit diagram.
- 3.4 Connect the equipment according to the circuit diagram.
- 3.5 Check all connection before supplying Power to the circuit.
- 3.6 Records reading from the meter and calculate the transformation ratio.

4 Prepare the excitation curve using CT (Current transformer).

- 4.1 Select the current transformer.
- 4.2 Select required tools, equipment and materials.
- 4.3 Draw the circuit diagram.
- 4.4 Connect the equipment according to the circuit diagram.
- 4.5 Check all connection before supplying Power to the circuit.
- 4.6 Record data by varying input current.
- 4.7 Plot the excitation curve.
- 4.8 Point out the Knee point and types of CT.

5 Measure of low resistance by Ammeter–Voltmeter method.

- 5.1 Draw the circuit diagram for the measurement of low resistance by ammeter-voltmeter method.
- 5.2 Connect the tools, equipment and materials required.
- 5.3 Prepare the circuit according to the circuit diagram using proper equipment.
- 5.4 Check the circuit before connecting Power supply.
- 5.5 Record the meter readings.
- 5.6 Calculate the resistance from the meter readings.

- 6 Perform the measurement of earth resistance by earth tester.**
 - 6.1 Sketch the circuit diagram for the measurement of earth resistance by earth tester.
 - 6.2 Select a earth tester and required tools, equipment and materials.
 - 6.3 Connect the equipment according to the circuit diagram.
 - 6.4 Measure the earth resistance from the reading of the earth tester.
- 7 Perform the measurement of medium resistance by Wheatstone bridge.**
 - 7.1 Draw the circuit diagram for measuring medium resistance by Wheatstone bridge.
 - 7.2 Select tools, equipment and materials required.
 - 7.3 Prepare the circuit according to the circuit diagram.
 - 7.4 Check all the connection before connecting Power supply.
 - 7.5 Record the meter readings.
 - 7.6 Calculate the value of unknown resistance.
- 8 Perform the measurement of high resistance by a Megger.**
 - 8.1 Select a high resistance.
 - 8.2 Select a Megger.
 - 8.3 Connect the resistance with the Megger.
 - 8.4 Measure the resistance from the reading of the Megger.
- 9 Measure the frequency by a frequency meter.**
 - 9.1 Sketch the circuit diagram.
 - 9.2 Select a frequency meter.
 - 9.3 Select tools, equipment and materials.
 - 9.4 Connect the frequency meter to the supply or circuit whose frequency is to be measured.
 - 9.5 Measure the supply frequency from the meter.
- 10 Perform the measurement of Power factor by a Power factor meter.**
 - 10.1 Sketch the circuit diagram for measurement of Power factor of a load by a Power factor meter.
 - 10.2 Select the tools, equipment and materials required.
 - 10.3 Prepare the circuit according to the circuit diagram by using proper equipment.
 - 10.4 Check the circuit before connecting power supply.
 - 10.5 Record power factor from the power factor meter.
- 11 Perform the measurement of voltage, current and frequency by cathode ray oscilloscope (CRO).**
 - 11.1 Draw the circuit diagram for the measurement of voltage, current and frequency by CRO.
 - 11.2 Select the tools, equipment and materials required.
 - 11.3 Connect the equipment setting and connection according to the circuit diagram.
 - 11.4 Measure the voltage, current and frequency of the circuit by CRO.
 - 11.5 Prepare a report on it.

REFERENCE BOOKS

1. Electrical Measurements & Measuring Instruments
- Golding & Widdis.
2. *A Course in Electrical & Electronic Measurements and Instrumentation*
- A.K Sawhney
3. *A Text Book of Electrical Technology (volume-I)*
- B.L Theraja and A.K Theraja
4. *Measurement of measuring Instrument*
-

J.B.

Gupta

AIMS

To provide the students with opportunities to acquire knowledge, skills and attitude in the area of transmission and distribution electrical power with special emphasizes on:

- Different types of transmission and distribution systems of electrical power.
- Comparison of different types of transmission and distribution systems.
- Electrical and Mechanical design of overhead lines.
- Survey of transmission and distribution line routes.
- Voltage regulation and Efficiency of transmission lines.

SHORT DESCRIPTION

Different systems of transmission; Aspect of transmission system; Mechanical design of overhead lines: support of overhead lines; conductors & conductor materials; Insulators; Effect of sag; Methods for survey of transmission/distribution line route; Voltage distribution of suspension insulator; Corona; Erection of poles and drawing of conductors of overhead lines; Electrical design of overhead line: Resistance of the line conductor; Skin effect of transmission line; Effect of inductance on transmission line; Effect of capacitance of overhead transmission line; Voltage regulation and efficiency of short transmission line.

DETAIL DESCRIPTION**Theory:**

- 1 Understand different systems of transmission of electrical power.**
 - 1.1 Explain the transmission and distribution system of electrical power.
 - 1.2 Categorize various systems of transmission and distribution of electrical power.
 - 1.3 Define Feeder and Distributor.
 - 1.4 Compare between Feeder & Distributor.
 - 1.5 Distinguish between overhead and underground transmission and distribution system.
 - 1.6 Explain the advantages of high voltage transmission over low voltage transmission.
 - 1.7 Compare the cost of conductor of different overhead systems.
 - 1.8 Compare the cost of conductor of underground system with overhead system.
 - 1.9 Describe the process of choosing the working voltage for transmission and distribution system.
 - 1.10 Calculate the most economic working voltage for transmission of electrical power.
- 2 Perceive different aspects of transmission system.**
 - 2.1 Express the equation for the most economic size of conductor using Kelvin's law.
 - 2.2 Describe the limitations of the application of Kelvin's law to find out the economic size of the conductor.
 - 2.3 Solve problems on Kelvin's law.
 - 2.4 Explain the term system losses.
 - 2.5 List the factors involved in system loss.
 - 2.6 Explain how the system losses can be minimized.
 - 2.7 Discuss the most economic power factor.
 - 2.8 Derive the equation for most economic power factor.
 - 2.9 Solve problems on most economic power factor.
- 3 Recognize the supports of overhead lines.**
 - 3.1 Mention the main components of overhead lines.
 - 3.2 Categorize the line supports.
 - 3.3 Describe different types of line supports.
 - 3.4 Mention the characteristics of line supports.
 - 3.5 Explain the vibration dampers.

- 4 Interpret the conductors and conductor materials.**
- 4.1 List different types of line conductors used in overhead transmission and distribution lines.
 - 4.2 Mention at least five properties of conductor materials.
 - 4.3 Compare the properties of Copper, Aluminum and ACSR conductors.
- 5 Realize the line insulators and their characteristics.**
- 5.1 List different types of insulators.
 - 5.2 Specify various types of insulating materials.
 - 5.3 Describe the properties of insulating materials.
 - 5.4 Explain the Pin and Suspension type insulators.
 - 5.5 Compare the advantages and disadvantages of Pin and Suspension type insulator.
 - 5.6 Mention the uses of different types of insulators.
 - 5.7 List the causes of failure of insulators.
 - 5.8 Explain different types of test of insulators.
- 6 Understand sag and its effect.**
- 6.1 Explain the sag of transmission line.
 - 6.2 List the factors affecting the sag.
 - 6.3 Explain the spacing between conductors and span length.
 - 6.4 Derive the formula to calculate the sag of conductors between two poles of equal height.
 - 6.5 Derive the formula to calculate the sag of conductors between two poles of unequal heights considering effect of ice and wind pressure.
 - 6.6 Solve problems on sag of transmission lines.
 - 6.7 Explain the effects of vibration on the transmission line and prevention of vibration.
 - 6.8 Describe the measure for the prevention of vibration.
- 7 Perceive the methods for survey of transmission / distribution line route.**
- 7.1 List the Surveying Instruments required to survey of transmission / distribution lines.
 - 7.2 Explain the uses, errors and accuracy of surveying instruments.
 - 7.3 Describe the process of measuring the angles by compass, level and Theodolite.
 - 7.4 Enumerate leveling, alignment, surveying and pegging of the route.
 - 7.5 Explain the methods of measuring vertical and horizontal heights of T/D.
 - 7.6 List the principle factors in routing overhead energy lines.
- 8 Understand the voltage distribution of suspension insulator.**
- 8.1 Explain string efficiency.
 - 8.2 Describe the methods of improving string efficiency.
 - 8.3 Solve problems on string efficiency.
 - 8.4 Deduce the equation of voltage distribution across each unit of a string of suspension insulators.
 - 8.5 Describe the methods of voltage grading in suspension insulators.
 - 8.6 Illustrate the methods of equalization of voltage of suspension insulators by guard ring.
 - 8.7 Solve problems on voltage distribution and voltage grading.
- 9 Understand the phenomenon of corona.**
- 9.1 Define corona of overhead transmission line.
 - 9.2 Discuss the effect of corona.
 - 9.3 Explain at least four factors that affect corona.
 - 9.4 Describe the advantages and disadvantages of corona.
 - 9.5 Express the derivation of the relation for disruptive critical voltage, visual critical voltage and energy loss due to corona.
 - 9.6 Discuss the methods for minimizing corona.
- 10 Recognize the erection of poles / towers and drawing of conductors of overhead line.**
- 10.1 Describe the procedure of erection of poles of overhead transmission / distribution line.
 - 10.2 Explain the procedure of erection of towers of overhead transmission line.
 - 10.3 Describe the procedure of fixing cross arm and insulator.
 - 10.4 Interpret the drawing of conductors of overhead lines.
 - 10.5 Narrate the erection of stay / guy wire.

- 11 View the resistance of line conductor.**
- 11.1 Describe the line constants of transmission line.
- 11.2 Express the deduction of the equation for calculating resistance of the line conductor.
- 11.3 Solve problems on the resistance of the line conductor.
- 12 Understand the skin effect of transmission line.**
- 12.1 Explain the skin effect of transmission line.
- 12.2 Express the equation for calculating skin effect.
- 12.3 Describe the proximity effect.
- 13 Realize the effect of inductance on transmission line.**
- 13.1 Explain the flux linkage of a conductor due to internal and external flux.
- 13.2 Express the deduction of the equation for inductance of a single phase and three phase overhead transmission line in terms of Geometrical Mean Distance (GMD) and Geometrical Mean Radius (GMR).
- 13.3 Solve problems on inductance of single phase and three phase lines.
- 13.4 Describe the inductance of three-phase line with double circuit.
- 13.5 Explain the transposition of line conductors.
- 14 Understand the effect of capacitance of overhead transmission line.**
- 14.1 Explain the electric potential of a transmission line.
- 14.2 Express the derivation of the equation to calculate the capacitance of single phase and three phase overhead transmission line.
- 14.3 Solve problems on capacitance of single phase and three phase overhead transmission line.
- 14.4 Explain the capacitance of double circuit three phase overhead line.
- 14.5 Narrate Ferranti effect.
- 15 Interpret the voltage regulation and efficiency of short transmission line.**
- 15.1 Classify overhead transmission line.
- 15.2 Express the equation to calculate the voltage regulation of overhead short transmission line.
- 15.3 Derive the equation to calculate efficiency of overhead short transmission line.
- 15.4 Identify the effect of load energy factor on voltage regulation and efficiency of overhead short transmission line.
- 15.5 Draw vector diagram of a short transmission line.
- 15.6 Solve problems on voltage regulation and efficiency of overhead short transmission line.

Practical:

- 1 Make a table for cost of conductor by considering same distance and voltage level.**
- 1.1 Select different types of conductor.
- 1.2 Fix up distance and voltage level.
- 1.3 Collect price list of conductors.
- 1.4 Prepare a table.
- 2 Survey and estimate the electrical loads of an area.**
- 2.1 Select the area / section of which the electrical loads are to be surveyed.
- 2.2 Observe and record the load of each point of the area.
- 2.3 Calculate the average load of a specific area and the sub-area.
- 2.4 Calculate the load of main circuit and sub-circuits.
- 3 Plot the chronological load curve, integrated load curve, actual load curve and ideal load curve.**
- 3.1 Collect the data from data table of experiment number one.
- 3.2 Plot the chronological load curve
- 3.3 Draw the integrated load curve.
- 3.4 Sketch the actual load curve.
- 3.5 Draw the ideal load curve.
- 4 Perform the calculation of most economical Power factor (graphically).**
- 4.1 Select the formula to calculate the most economical Power factor.
- 4.2 Collect the data from a typical mathematical problem.
- 4.3 Calculate the most economical power factor.

- 5 Perform the selection of economical voltage for generation, transmission and distribution of electrical energy.**
 - 5.1 Select generating voltage.
 - 5.2 Choice voltage for transmission and distribution of electrical power.
 - 5.3 Specify required type of insulators and poles.
- 6 Prepare the layout diagram of an electrical project.**
 - 6.1 Draw the layout of the selected electrical project.
 - 6.2 Sketch the complete wiring diagram of the electrical project showing transmission line, distribution line and service mains.
 - 6.3 Indicate the energy source.
- 7 Perform the identification of different components of LT and HT over head lines.**
 - 7.1 Identify the components of LT over head lines.
 - 7.2 Specify the components of HT over head line.
 - 7.3 Follow safety practices.
 - 7.4 Prepare a report.
- 8 Perform the measurement of the horizontal distance between poles.**
 - 8.1 Collect the instruments/ equipment commonly used in surveying.
 - 8.2 Measure the horizontal distance between poles over different ground conditions by using tape, chain and Total station
 - 8.3 Record the measurement of distance.
 - 8.4 Plot the line route showing the measurements.
- 9 Perform the measurement of the angles and heights of poles / towers by using Theodolite/ Total station.**
 - 9.1 Select the instruments for measuring angles and heights of poles.
 - 9.2 Measure horizontal angles.
 - 9.3 Measure vertical angles.
 - 9.4 Measure vertical heights of poles / towers.
- 10 Perform the measurement of sag of a transmission / distribution line.**
 - 10.1 Set the Theodolite/Total station in first position and measure the angle.
 - 10.2 Set the Theodolite/Total station in second position and measure the angle.
 - 10.3 Calculate the sag of a transmission / distribution line using Theodolite/Total station.
 - 10.4 Prepare a report.

REFERENCE BOOKS

1. A Course in Electrical Energy
- J B Gupta.
2. Principles of Energy System
- V K Mehta.
3. Transmission & Distribution of Electrical Power
- H. Cotton.
4. Electrical Energy system 3rd Revised Edition
- Ashfaq Husain

AIMS

To provide the students with opportunities to acquire knowledge, skills and attitude in the area of communication engineering with special emphasizes on:

- Various types of modulation demodulation
- Radio receiver and transmitter
- Telephone system
- Digital communication system
- Communication switching system
- Optical fiber communication
- Satellite communication
- Modem and mobile communication

SHORT DESCRIPTION

Communication networks; Modulation; Demodulation Receiver and Transmitter; Telephone system; Digital communication; Communication switching system; Optical fiber; Satellite communication; Digital Communication, Modem and mobile communications.

DETAIL DESCRIPTION

Theory:

- 1 Understand the features of communication network.**
 - 1.1 Mention the allocation of frequency bands for various communication systems.
 - 1.2 Explain the nature of Audio, Video, Digital data.
 - 1.3 Explain Channel band width and Channel capacity.
 - 1.4 Describe different types of internal and external noise, noise figure and SNR (signal to noise ratio).
 - 1.5 State the variety of communication networks.
 - 1.6 State the nature of satellite communications.
 - 1.7 Basic communication system with block diagram.
- 2 Understand the features of modulation.**
 - 2.1 Explain the Amplitude Modulation.
 - 2.2 Drive the equation for the amplitude modulated wave.
 - 2.3 Define Modulation index, depth of modulation, SSB, SSB-SC, DSB, DSB-SC and VSB modulation.
 - 2.4 Derive the equation for frequency modulated wave (without analysis of Besel function).
 - 2.5 State the meaning of the terms Modulation index, Maximum frequency deviation and Deviation ratio of FM wave.
 - 2.6 Difference between Amplitude and Frequency modulation.
 - 2.7 Explain the PPM, PDM and PWM signals and describe its application.
 - 2.8 State the principles of Multiplexing and Demultiplexing.
 - 2.9 Explain the principles of FDM and TDM with block diagram.
- 3 Understand the Modulator and Demodulator.**
 - 3.1 Explain the principles of operation of Collector modulator, Base modulator, Balanced modulator, Suppressed carrier balanced modulator and Varactor diode modulator (without equation deduction).
 - 3.2 State the basic principles of SSB-SC generation and QAM.
 - 3.3 Mention the methods of AM detection.
 - 3.4 Explain the operation of a Linear (diode) detector.

- 3.5 Mention the methods of FM detection.
- 3.6 Explain the working principle of various FM detectors.
- 3.7 List the advantages of Ratio detector over Foster seely discriminator circuit.
- 4 Understand the features of radio Receiver and Transmitter.**
 - 4.1 Explain the block diagram of AM transmitter.
 - 4.2 Explain the operation of SSB transmitter with block diagram.
 - 4.3 Explain the block diagram of Super heterodyne AM receiver with wave form.
 - 4.4 Explain the block diagram of Armstrong system FM transmitter.
 - 4.5 Explain the sensitivity, Selectivity, Fidelity and Signal to Noise Ratio (SNR).
- 5 Understand the features of a telephone system.**
 - 5.1 State telephone system.
 - 5.2 Describe the working principle of modern a Modern telephone hand set transmitter and receiver (without deduction of equation).
 - 5.3 Describe the operation of automatic subscriber telephone set.
 - 5.4 Describe advantages & disadvantages of side tone.
 - 5.5 Describe the tones used in automatic telephone.
 - 5.6 Describe about a digital telephone set.
 - 5.7 Define different types of telephone exchange.
- 6 Understand the concept of Digital communication.**
 - 6.1 State the advantages of Digital communication.
 - 6.2 Describe the sampling theorem.
 - 6.3 Describe the quantization and coding principle of PCM.
 - 6.4 Mention different types of media used for data transmission.
 - 6.5 Describe the function of line driver and line receiver.
 - 6.6 Describe synchronous and asynchronous mode of data transfer.
 - 6.7 Describe the function of USART.
- 7 Communication switching system.**
 - 7.1 Define communication switching.
 - 7.2 Mention different types of communication switching (analog and digital).
 - 7.3 Functions of switching system.
 - 7.4 Characteristics of switching system.
 - 7.5 Describe centralized and distributed stored program (SPC) switching system.
 - 7.6 Define the following: Message, Circuit and Packet switching, STS and TST switching.
 - 7.7 Mention the different types of cables and connectors.
- 8 Understand Optical Fiber.**
 - 8.1 Define Optical Fiber.
 - 8.2 Basic block diagram of Optical communication system.
 - 8.3 Construction of optical fiber.
 - 8.4 Advantages and disadvantages of optical fiber.
 - 8.5 Mention different types of light sources and detectors of optical fiber.
 - 8.6 Describe different types of optical fiber splices.
- 9 Understand the satellite communication.**
 - 9.1 Discuss the principles of satellite communication.
 - 9.2 Describe the advantages of satellite communication.
 - 9.3 Describe satellite earth station with block diagram.
 - 9.4 Describe the working principle of VSAT.
 - 9.5 Describe the applications of various satellites.
 - 9.6 List different locations of satellite earth station in Bangladesh.
 - 9.7 Describe the status and features of Bangabandhu Satellite-I.

- 10 Understand the digital communications.**
- 10.1 Describe the working principle of Facsimile.
 - 10.2 Function of MODEM in data communication.
 - 10.3 State the application of digital communication network.
 - 10.4 Describe the local area network.
 - 10.5 Describe the wide area network.
 - 10.6 Describe Ethernet.
 - 10.7 Define ISDN, SDH, STN, SONET, FDDI, Internet and WWW, WAP, VOIP.
- 11. Understand the Mobile communications.**
- 11.1 State the mobile communication systems.
 - 11.2 List the application of mobile communication.
 - 11.3 Describe the simple Mobile Network system.
 - 11.4 Describe the function of base station of mobile communication system.
 - 11.5 Define GSM, CDMA, FDMA, WIMAX, Bluetooth, Wi-fi.
 - 11.6 Describe briefly 1G, 2G, 3G, 3.5G, 4G and 5G.
- 12. Recognize Supervisory Control and Data Acquisition (SCADA) system**
- 12.1 Define Supervisory Control and Data Acquisition
 - 12.2 Describe General features of SCADA system
 - 12.3 Explain Functions and Applications of SCADA Networks
 - 12.4 Narrate Structure of a SCADA Communications Protocol
 - 12.5 Illustrate a Prototype View of SCADA Systems
 - 12.6 SCADA Communication protocols: Past, Present and Future.
 - 12.7 Describe Reliability, Redundancy and Safety Issues of SCADA system.

Practical:

- 1 Study the operation of Amplitude modulator.**
 - 1.1 Select the required equipment, tools and materials.
 - 1.2 Connect the circuit and equipment.
 - 1.3 Input different modulations and carrier signals.
 - 1.4 Record the required data.
 - 1.5 Calculate the modulation index for each set of data.
- 2 Study the operation of Frequency modulator.**
 - 2.1 Select the required equipment, tools and materials.
 - 2.2 Setup the circuit board and the equipment.
 - 2.3 Input the proper signals.
 - 2.4 Make the proper adjustment.
 - 2.5 Observe the FM wave.
- 3 Study the operation of Amplitude demodulator.**
 - 3.1 Select the required equipment, tools and materials.
 - 3.2 Connect the circuit and equipment.
 - 3.3 Input different modulated signals.
 - 3.4 Observe the output wave.
- 4 Study the operation of Frequency demodulator.**
 - 4.1 Select the required equipment, tools and materials.
 - 4.2 Setup the circuit board and the equipment.
 - 4.3 Input the proper signals.
 - 4.4 Make the proper adjustment.
 - 4.5 Observe the output wave.

- 5 **Study the Super heterodyne AM radio receiver.**
 - 5.1 Select a radio receiver and required tools & materials.
 - 5.2 Identify the circuit diagram of receiver.
 - 5.3 Make the list of the components.
 - 5.4 Trace the circuit of the receiver.
- 6 **Study the modern telephone hand set transmitter and receiver.**
 - 6.1 Select a modern telephone set.
 - 6.2 Identify the transmitting and receiving section.
 - 6.3 Make a list of components.
- 7 **Study the Optical Fiber communication system.**
 - 7.1 Select the required equipment, tools and materials.
 - 7.2 Identify the transmitting and receiving section.
 - 7.3 Connect the circuit and equipment.
 - 7.4 Observe the output.
- 8 **Study the Optical Fiber joints and couplers.**
 - 8.1 Select required tools & materials.
 - 8.2 Make Optical Fiber joints.
 - 8.3 Test the joint.
- 9 **Study the satellite home receiving system.**
 - 9.1 Select required tools & materials.
 - 9.2 Connect the satellite receiver with antenna and TV receiver.
 - 9.3 Adjust the channel frequency.
 - 9.4 Observe different channels.
- 11 **Field visit for gathering practical experience on SCADA system.**
 - 11.1 Make a communication with the authority of PGCB.
 - 11.2 Arrange a field visit.
 - 11.3 Prepare a report on **SCADA system**.

The student will visit the nearest automatic telephone exchange, digital telephone exchange, Grameen phone network system, Bangladesh Railway, Ground satellite station and VSAT.

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 Marion Cole
2. Mobile Communications
 John Schiller
3. Satellite Communications
 DC Agarwal
4. Optical Fiber and Fiber Optic Communication system
 Subir Kumar Sarker.
5. Mobile and Personal Communication System and Service
 Raj Pandya.
6. Cellular Mobile system Engineering
 Saleh Faruque.

AIMS

To provide the students with opportunities to acquire knowledge, skills and attitude in the area of Microcontroller and PLC emphasizes on:

- The Fundamentals of microcontroller.
- The features of the 8051 microcontroller.
- The architecture of 8051 microcontroller.
- Develop C language program for the 8051 microcontroller.
- Understand I/O port Programming.
- Understand the Timer and Counter of the 8051.
- Interfacing LCD and Real world devices.
- Relay logic control
- Ladder diagram elements and programming.

SHORT DESCRIPTION

Fundamentals of microcontroller, hardware of 8051, instruction set, Assembly language programming, C programming, Timer, Interrupt, DC motor interfacing, Stepper motor interfacing, interfacing LCD display, Relay logic control, Fundamentals of PLC, PLC ladder diagram programming, Inter relay, Jump and Call, Timer and Counter.

DETAIL DESCRIPTION

Theory:

1 Understand the Fundamentals of Micro controller.

- 1.1 Define Microcontroller.
- 1.2 Mention the types of Microcontroller.
- 1.3 Compare CISC and RISC.
- 1.4 Mention the field of Microcontroller applications.
- 1.5 List the commercial Microcontrollers with salient features
- 1.6 Mention the criteria for choosing a microcontroller

2 Understand Features and Architecture of the Intel 8051 Microcontroller.

- 2.1 Define 8051 family.
- 2.2 Mention the features of the Intel 8051 microcontroller and PIC.
- 2.3 Compare the features of different member of the 8051 family.
- 2.4 Describe the simplified Block diagram of the Intel 8051 microcontroller.
- 2.5 Explain the programming model of the 8051 microcontroller.
- 2.6 Describe the memory organization of the 8051 microcontroller mentioning the function of SFR, Register bank, bit addressable & general purpose RAM.
- 2.7 State the function of each flag of the PSW register.
- 2.8 Explain the pins and signals of the 8051 microcontroller.
- 2.9 Describe the Clock and Reset circuits of the 8051.
- 2.10 Compare Atmel 89C2051 and 89C4051 with 8051.

3 Understand Programming 8051 using C programming.

- 3.1 Mention the reasons for writing program in C.
- 3.2 List C data types and operators for 8051
- 3.3 Describe creating time delay in C.
- 3.4 Write program in C for sending data to port, Accessing code ROM, Data serialization and Interrupt operation.

4 Understand the 8051 Timer and Counter

- 4.1 List the function of a timer.
- 4.2 Discuss the mode of operation of a timer.
- 4.3 Describe the function of each bit of TMOD & TCON Register.

- 4.4 Write code for setting timer in different mode.
- 4.5 Explain the procedure of starting, stopping and controlling timer.
- 4.6 Calculate the initial value of timer for creating a certain delay.
- 4.7 Write subroutine for creating delay of certain amount of time using Timer.
- 4.8 Develop program for generating square wave.
- 4.9 Describe the Timer as an event counter.
- 5 Understand the Interrupt of the 8051 Microcontroller.**
 - 5.1 List the source of interrupt of the 8051.
 - 5.2 Define Interrupt service routine (ISR).
 - 5.3 Mention the interrupt priority and vector locations.
 - 5.4 Describe each bit of the interrupt enable (IE) register.
 - 5.5 Describe the procedure of enabling and disabling interrupt.
 - 5.6 Mention the steps in executing an interrupt.
 - 5.7 Describe the register protection during interrupt.
 - 5.8 Describe External Hardware, Timer and Serial communication Interrupt.
 - 5.9 State the common problem with interrupt.
- 6 Understand LCD and Real world Interfacing.**
 - 6.1 Describe the pin diagram of LCD.
 - 6.2 Describe the Instruction register, data register and busy flag.
 - 6.3 List the LCD command codes,
 - 6.4 Write Program for displaying data to LCD.
 - 6.5 Describe the organization of a matrix Keyboard.
 - 6.6 Explain the steps to detect and identify the key pressed.
 - 6.7 Describe interfacing ADC/DAC chips to the 8051.
 - 6.8 Develop program for Speed control a DC motor, a Stepper motor, display a word by DOT matrix display.
- 7 Understand PLC and its Input output (I/O) module.**
 - 7.1 Define PLC.
 - 7.2 Describe Historical background of a PLC.
 - 7.3 Mention the difference between PLC and computer.
 - 7.4 Explain the block diagram of a PLC.
 - 7.5 Mention the configuration of a PLC.
 - 7.6 Define I/O module.
 - 7.7 Mention the functions of input and output module.
- 8 Recognize Switch, Sensors and Relays.**
 - 8.1 Define Switch, Sensors and Relay.
 - 8.2 Mention various types of Switches using symbol and narrate it briefly.
 - 8.3 Classify the Sensors.
 - 8.4 Explain Photo sensor, Proximity sensor, RTD and thermocouple.
 - 8.5 Define Relay.
 - 8.6 Describe the types of relay with symbol.
 - 8.7 Illustrate internal structure and pin configuration of Relay.
- 9 Understand the PLC Ladder Diagram Programming.**
 - 9.1 List the PLC languages defined by International Electro-technical Commission (IEC).
 - 9.2 Define ladder diagram.
 - 9.3 Identify the standard IEC symbols used for input and output devices.
 - 9.4 Mention the notation used for I/O address.
 - 9.5 Draw the ladder diagram for Logic functions, latching and multiple outputs.
- 10 Understand the Internal Relay (IR), Jump, Call and Comparator in PLC.**
 - 10.1 State the meaning of Internal relay.
 - 10.2 Describe the method of using internal relay.
 - 10.3 Mention the different ways of expressing internal relay addresses.
 - 10.4 Describe the one-shot and Set/Reset operation.

- 10.5 Discuss the conditional Jump in ladder diagram.
- 10.6 Describe the use of subroutine in ladder diagram.
- 10.7 Discuss the comparator instruction in ladder diagram.
- 10.8 Draw the ladder diagram for Logic functions, latching and multiple outputs.

11 Understand the Timer and Counter in PLC.

- 11.1 State the necessity of Timer and Counter in PLC.
- 11.2 Describe the types of Timer with symbol.
- 11.3 Explain the function of Timer in PLC.
- 11.4 Classify the types of Counter with symbol.
- 11.5 Narrate the counter application in PLC Programming.
- 11.6 Draw the ladder diagram for Blinking light, Automatic Traffic light control, Batch mixing operation control, Water level control.

12 Perceive the 4th Industrial revolution.

- 12.1 State the necessity of realizing 4th Industrial revolution.
- 12.2 Mention the major factors need to considering the 4th Industrial revolution .
- 12.3 Define Robotics and its application
- 12.4 Explain Big data and information.
- 12.5 Describe cloud computing.
- 12.6 Discuss about Cyber physical system

Practical:

1 Test a program to take a value of X and get the value of X² and see the output on port P2.

- 1.1 Draw the flow chart of the program.
- 1.2 Start an IDE .
- 1.3 Type the program.
- 1.4 Save the program.
- 1.5 Compile the program
- 1.6 Run the Simulator and observe the execution of the program.

2 Develop and test a program for displaying 0 to 9 using 7-Segment display.

- 2.1 Draw the Flow chart of the program.
- 2.2 Type and save the program.
- 2.3 Compile the program.
- 2.4 Download the Hex code program to 8051 code memory.
- 2.5 Construct the circuit.
- 2.6 Energy the circuit and observe the output.

3 Develop and test a program for Interfacing LCD.

- 3.1 Draw the Flow chart of the program.
- 3.2 Type and save the program.
- 3.3 Compile the program.
- 3.4 Download the Hex program to 8051 code memory.
- 3.5 Construct the circuit.
- 3.6 Energy the circuit and observe the output.

4 Develop and test a program to Interface a DC Motor.

- 4.1 Draw the Flow chart.
- 4.2 Type and save the program.
- 4.3 Compile the program.
- 4.4 Download the Hex program to 8051 code memory.
- 4.5 Construct the circuit.
- 4.6 Energy the circuit and observe the output.

- 5 Develop and test a program to Interface a Stepper Motor.**
 - 5.1 Draw the Flow chart of the program.
 - 5.2 Type and save the program.
 - 5.3 Compile the program.
 - 5.4 Download the Hex program to 8051 code memory.
 - 5.5 Construct the circuit.
 - 5.6 Energy the circuit and observe the output.
- 6 Develop and test a program for automatic Star-Delta starter for a three phase induction motor using PLC.**
 - 6.1 Draw the ladder diagram.
 - 6.2 Sketch a connection diagram with PLC and I/O devices
 - 6.3 Upload the program in PLC.
 - 6.4 Test the program.
- 7 Develop and test a program for automatic forward-reverse of a three phase induction motor using PLC.**
 - 7.1 Draw the ladder diagram.
 - 7.2 Sketch a connection diagram with PLC and I/O devices
 - 7.3 Upload the program in PLC.
 - 7.4 Test the program.
- 8 Develop and test a program for automatic traffic light control using PLC.**
 - 8.1 Draw the ladder diagram.
 - 8.2 Sketch the connection diagram with PLC and I/O devices
 - 8.3 Upload the program in PLC.
 - 8.4 Test the program.
- 9 Develop and test a program for water level control using PLC.**
 - 9.1 Draw the ladder diagram.
 - 9.2 Sketch the connection diagram with PLC and I/O devices
 - 9.3 Upload the program in PLC.
 - 9.4 Test the program.
- 10 Develop and test a program for Batch mixing using PLC.**
 - 10.1 Draw the ladder diagram.
 - 10.2 Sketch the connection diagram with PLC and I/O devices
 - 10.3 Upload the program in PLC.
 - 10.4 Test the program.

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1. The 8051 Microcontroller and Embedded system
- Mazidi
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- I. Scott MacKenzie
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5. Microcontrollers Theory and Application
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6. Modern Control Technology Components and Systems.
- Kilian
7. Programmable Logic Controllers.
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_ John R. Hackworth
_ Frederick D. Hackworth, Jr.
9. Basic Instrumentation System & Programmable Logic Controller.
_ Umesh Rathore.

AIMS

- To be able to develop the working condition in the field of industrial or other organization.
- To be able to understand develop the labor management relation in the industrial sector.
- To be able to develop the management techniques in the process of decision making.
- To be able to manage the problems created by trade union.
- To be able to understand Planning
- To be able to perform the marketing.
- To be able to maintain inventory.

Course Outline

Basic concepts of management; Principles of management; Planning, Organization, Scientific management; Span of supervision; Motivation; Personnel management and human relation; Staffing and manpower planning ; Training of staff; Concept of leadership; Concepts and techniques of decision making; Concept of trade union; Inventory control; Economic lot size ; Break even analysis; Trade Union and industrial dispute, Marketing;

1 Basic concepts & principles of management.

- 1.1 Define management and industrial management.
- 1.2 State the objectives of modern management.
- 1.3 Describe the scope and functions of management.
- 1.4 State the principles of management.
- 1.5 State the activity level of industrial management from top personnel to workmen.
- 1.6 Describe the relation among administration, organization & management.

2. Concept of Planning

- 2.1 Define Planning
- 2.2 Discuss the importance of Planning
- 2.3 Discuss the Types of Planning.
- 2.4 Discuss the steps in Planning

3 . Concepts of organization and organization structure.

- 3.1 Define management organization.
- 3.2 State the elements of management organization.
- 3.3 Describe different forms of organization structure.
- 3.4 Distinguish between line organization and line & staff organization.
- 3.5 Distinguish between line organization and functional organization.
- 3.6 Describe the features, advantages and disadvantages of different organization structure.

4. Concept of scientific management.

- 4.1 Define scientific management.
- 4.2 Discuss the basic principles of scientific management.
- 4.3 Explain the different aspects of scientific management.
- 4.4 Discuss the advantages and disadvantages of scientific management.
- 4.5 Describe the difference between scientific management and traditional management.

5. Concept of span of supervision.

- 5.1 Define span of supervision and optimum span of supervision.
- 5.2 Discuss the considering factors of optimum span of supervision.
- 5.3 Discuss advantages and disadvantages of optimum span of supervision.
- 5.4 Define delegation of authority.
- 5.5 Explain the principles of delegation of authority.
- 5.6 Explain the terms: authority, responsibility and duties.

6 . Concept of motivation.

- 6.1 Define motivation.
- 6.2 Discuss the importance of motivation.
- 6.3 Describe financial and non-financial factors of motivation.
- 6.4 Special Motivational Techniques.
- 6.5 Discuss the motivation theory of Maslow and Herzberg.
- 6.6 Differentiate between theory-X and theory-Y.

7. Concept of leadership.

- 7.1 Define leadership.
- 7.2 Discuss the importance and necessity of leadership.
- 7.3 Discuss the functions of leadership.
- 7.4 Describe the qualities of a leader.

8. Basic concepts and techniques of decision making.

- 8.1 Define decision making.
- 8.2 Discuss the importance and necessity of decision making.
- 8.3 Discuss different types of decision making .
- 8.4 Describe the steps in decision making.

9. Concept of personnel management and human relation.

- .9.1 Define personnel management.
- .9.2 Discuss the functions of personnel management.
- 9.3 Define staffing.
- 9.4 Define recruitment and selection of employees.
- 9.5 Describe various sources of recruitment of employees.
- 9.6 Describe the methods of selection of employees.
- 9.7 Define training and orientation of employee.
- 9.8 Discuss the importance and necessity of training.
- 9.9 Discuss the various methods of training of workmen, technicians and executive personnel.

10. Concept of inventory control & Economic lot size

- 10.1 Define inventory.& inventory control.
- 10.2 Describe the function of inventory control.
- 10.3 Define Economic lot size and the Method of determination of economic lot size.
- 10.4 Discuss the effects of over supply and under supply.
- 10.5 Explain the following terms :
 - Bin card or Bin tag.
 - Purchase requisition.
 - Store requisition.
 - Material transfer note.
 - First in first out (FIFO).
 - Last in first out(LIFO).
 - Safety stock
 - Lead time

11. Concept of Break Even Point(BEP)

- 11.1 Define Break Even Point and Break Even Chart.
- 11.2 Describe the method of determination of BEP
- 11.3 Explain the terms :
 - Break even analysis.
 - Fixed cost.
 - Variable cost

12 . Concept of Marketing

- 12.1 Define marketing.
- 12.2 Discuss the function of marketing.
- 12.3 State the objectives of marketing.
- 12.4 Explain the terms :
 - Purchase
 - Brand
 - Producer
 - Consumer
 - Customer
 - Copyright
 - Trade mark
- 12.5 Discuss product life -cycle and marketing strategies in different stages of a product life-cycle

13. Concept of trade union and industrial dispute

13.1 Define trade union.

13.2 Mention the objectives of trade union.

13.3 Discuss the function of trade union.

13.4 Describe different types of trade union.

13.5 Define industrial dispute

13.6 Discuss different type of industrial dispute

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