

Math-233 APPLIED MATHEMATICS-II

Total Contact Hours

Theory	96		T	P	C
Practical	0	3	0	3	

Pre-requisite: Must have completed Mathematics-I.

AIMS At the end of the course, the students will be able to:

Solve problems of Calculus, Laplace Transformation and Fourier Series, and develop mathematical skills and logical perceptions in the use of mathematical instruments.

COURSE CONTENTS

- 1. FUNCTIONS & LIMITS. 6 hours**
 - 1.1 Constant & Variable Quantities
 - 1.2 Functions & their classification
 - 1.3 The concept of Limit
 - 1.4 Limit of a Function
 - 1.5 Fundamental Theorems on Limit
 - 1.6 Some important Limits
 - 1.7 Problems

- 2. DIFFERENTIATION 6 hours**
 - 2.1 Increments
 - 2.2 Differential Coefficient or Derivative
 - 2.3 Differentiation ab-initio or by first Principle
 - 2.4 Geometrical Interpretation of Differential Coefficient
 - 2.5 Differential Coefficient of X^n and $(ax + b)^n$
 - 2.6 Three important rules
 - 2.7 Problems

- 3. DIFFERENTIATION OF ALGEBRAIC FUNCTIONS 9 hours**
 - 3.1 Explicit Functions
 - 3.2 Implicit Functions
 - 3.3 Parametric forms
 - 3.4 Problems

- 4. DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS 6 hours**
 - 4.1 Differential Coefficient of Sin x, Cos x, Tan x from first principle.
 - 4.2 Differential Coefficient of Cosec x, Sec x, Cot x

4.3	Differential Coefficient of Inverse trigonometric functions.	
4.4	Problems.	
5.	DIFFERENTIATION OF LOGARITHMIC & EXPONENTIAL FUNCTIONS	6 hours
5.1	Differentiation of $\ln x$	
5.2	Differentiation of $\log a^x$	
5.3	Differentiation of a^x	
5.4	Differentiation of e^x	
5.5	Problems	
6.	RATE OF CHANGE OF VARIABLES	6 hours
6.1	Increasing and decreasing functions	
6.2	Maxima and Minima	
6.3	Criteria for maximum & minimum values	
6.4	Methods of finding maximum & minimum	
6.5	Rate measure	
6.6	Slope of a line	
6.7	Velocity and acceleration	
6.8	Problems	
7.	INTEGRATION(SIMPLE BASIC RULES)	9 hours
7.1	Concept	
7.2	Fundamental Formulas	
7.3	Important Rules	
7.4	Problems	
8.	METHODS OF INTEGRATION	9 hours
8.1	Integration by substitution	
8.2	Integration by parts	
8.3	Problems	
9.	DEFINITE INTEGRALS	6 hours
9.1	Properties	
9.2	Application to area	
9.3	Problems	
10.	DIFFERENTIAL EQUATIONS	6 hours
10.1	Introduction	
10.2	Order and Degree	
10.3	First order Differential Equation of 1st degree.	
10.4	Solution of problems	
10.5	Problems	

- 11. LAPLACE TRANSFORMATIONS** **9 hours**
11.1 Laplace Transformations
11.2 Inverse Laplace Transformations
11.3 Problems.
- 12. FOURIER SERIES.** **9 hours**
12.1 Introduction
12.2 Periodic Functions
12.3 Even and Odd Functions
12.4 Problems
- 13. STATISTICS** **9 hours**
13.1 Concept of mean, median and mode
13.2 Standard Deviation
13.3 Laws of probability
13.4 Problems

RECOMMENDED BOOKS

1. Thomas Finny, Calculus and Analytic Geometry
2. Ghulam Yasin Minhas, Technical Mathematics Vol - I & II, Ilmi Kitab Khana, Lahore.
3. Riaz Ali Khan, Polytechnic Mathematic Series Vol I & II, Majeed Sons, Faisalabad
4. Sana Ullah Bhatti, Calculus and Analytic Geometry, Punjab Text Book Board, Lahore.

INSTRUCTIONAL OBJECTIVES

- 1. USE THE CONCEPT OF FUNCTIONS AND THEIR LIMITS IN SOLVING SIMPLE PROBLEMS.**
 - 1.1 Define a function.
 - 1.2 List all types of functions.
 - 1.3 Explain the concept of limit and limit of a function.
 - 1.4 Explain fundamental theorems on limits.
 - 1.5 Derive some important limits.
 - 1.6 Solve simple problems on limits.

- 2. UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT.**
 - 2.1 Define differential coefficient.
 - 2.2 Derive mathematical expression of a derivative.
 - 2.3 Explain geometrically the meaning of differential coefficient.
 - 2.4 Differentiate ab-initio x^n and $(ax+b)^n$.
 - 2.5 Solve problems of these formulas.

- 3. USE RULES OF DIFFERENTIATION FOR SOLVING PROBLEMS OF ALGEBRAIC FUNCTIONS.**
 - 3.1 Derive product rule, quotient rule and chain rule.
 - 3.2 Interpret the chain rule.
 - 3.3 Differentiate explicit and implicit functions.
 - 3.4 Find derivatives of parametric forms of a function w.r.t another function, by rationalization.
 - 3.5 Use these important rules to find derivatives of relevant functions.

- 4. USE RULES OF DIFFERENTIATION TO SOLVE TRIGONOMETRIC FUNCTIONS.**
 - 4.1 Differentiate from first principle $\sin x$, $\cos x$, $\tan x$.
 - 4.2 Derive formulas for derivatives of $\sec x$, $\operatorname{cosec} x$, $\cot x$.
 - 4.3 Find derivatives of inverse trigonometric functions.
 - 4.4 Solve problems based on these formulas.

- 5. USE RULES OF DIFFERENTIATION TO LOGARITHMIC AND EXPONENTIAL FUNCTIONS.**
 - 5.1 Derive formulas for differential coefficients of logarithmic and exponential functions.
 - 5.2 Solve problems using these formulae.

- 6. UNDERSTAND RATE OF CHANGE OF ONE VARIABLE WITH ANOTHER**

- 6.1 Derive formulas for velocity, acceleration and slope of a line
 - 6.2 Use derivative as a measure of rate of change.
 - 6.3 Explain an increasing and a decreasing function.
 - 6.4 Show graphically maxima and minima values and point of inflexion.
 - 6.5 Explain criteria for finding maxima and minima.
 - 6.6 Solve problems based upon these topics.
- 7. USE PRINCIPLES OF INTEGRATION IN SOLVING RELEVANT PROBLEMS.**
- 7.1 Explain concept of integration.
 - 7.2 Write basic theorems of integration.
 - 7.3 Define fundamental formulas of integration.
 - 7.4 List some important rules of integration.
 - 7.5 Solve problems based on these rules.
- 8. UNDERSTAND VARIOUS METHODS OF INTEGRATION**
- 8.1 List standard formulas of integration.
 - 8.2 Integrate a function by substitution method.
 - 8.3 Use method of integration by parts for finding integrals.
 - 8.4 Employ these methods to solve problems.
- 9. UNDERSTAND THE METHODS OF SOLVING DEFINITE INTEGRALS.**
- 9.1 Define definite integral.
 - 9.2 List properties of definite integrals.
 - 9.3 Use definite integral in the computation of areas.
 - 9.4 Solve problems involving definite integrals.
- 10. USE DIFFERENT METHODS OF INTEGRATION TO SOLVE DIFFERENTIAL EQUATIONS.**
- 10.1 Define a differential equation, its degree and order.
 - 10.2 Explain method of separation of variables for solving differential equations of first order and first degree.
 - 10.3 Solve differential equations of first order and first degree.
- 11. USE LAPLACE AND INVERSE LAPLACE TRANSFORMATION FOR SOLVING PROBLEMS.**
- 11.1 Define Laplace and Inverse Laplace Transformation
 - 11.2 List properties of Laplace Transformation
 - 11.3 Solve problems using Laplace Transformations
- 12. EXPAND FUNCTIONS USING FOURIER SERIES**
- 12.1 Define a Fourier series.
 - 12.2 Write extended rule of integration by parts.
 - 12.3 Illustrate periodic functions, even and odd functions.

- 12.4 Explain Fourier expansion and Fourier constants.
- 12.5 Expand the given functions of Fourier series.

13. UNDERSTAND THE BASIC CONCEPTS OF STATISTICS

- 13.1 Define mean, median and mode
- 13.2 Explain standard deviation
- 13.3 State laws of probability
- 13.4 Calculate the above mentioned quantities using the proper formula

Phy-222 APPLIED PHYSICS

Total Contact Hours

Theory	32	T	P	C	
Practicals	96		1	3	2

AIMS The students will be able to understand the fundamental principles and concept of physics, use these to solve problems in practical situations/technological courses and understand concepts to learn advance physics/technical courses.

COURSE CONTENTS

- 1 MEASUREMENTS. 2 Hours.**
 - 1.1 Fundamental units and derived units
 - 1.2 Systems of measurement and S.I. units
 - 1.3 Concept of dimensions, dimensional formula
 - 1.4 Conversion from one system to another
 - 1.5 Significant figures

- 2 SCALARS AND VECTORS. 4 Hours.**
 - 2.1 Revision of head to tail rule
 - 2.2 Laws of parallelogram, triangle and polygon of forces
 - 2.3 Resolution of a vector
 - 2.4 Addition of vectors by rectangular components
 - 2.5 Multiplication of two vectors, dot product and cross product

- 3 WAVE MOTION. 5 Hours**
 - 3.1 Review Hooke's law of elasticity
 - 3.2 Motion under an elastic restoring force
 - 3.3 Characteristics of simple harmonic motion
 - 3.4 S.H.M. and circular motion
 - 3.5 Simple pendulum
 - 3.6 Wave form of S.H.M.
 - 3.7 Resonance
 - 3.8 Transverse vibration of a stretched string

- 4 SOUND. 5 Hrs**
 - 4.1 Longitudinal waves
 - 4.2 Intensity, loudness, pitch and quality of sound
 - 4.3 Units of Intensity of level and frequency response of ear
 - 4.4 Interference of sound waves silence zones, beats
 - 4.5 Acoustics
 - 4.6 Doppler effect.

- 5 LIGHT. 5 Hours**
- 5.1 Review laws of reflection and refraction
 - 5.2 Image formation by mirrors and lenses
 - 5.3 Optical instruments
 - 5.4 Wave theory of light
 - 5.5 Interference, diffraction, polarization of light waves
 - 5.6 Applications of polarization in sunglasses, optical activity and stress analysis
- 6 OPTICAL FIBER. 2 Hours**
- 6.1 Optical communication and problems
 - 6.2 Review total internal reflection and critical angle
 - 6.3 Structure of optical fiber
 - 6.4 Fiber material and manufacture
 - 6.5 Optical fiber - uses.
- 7 LASERS. 3 Hours**
- 7.1 Corpuscular theory of light
 - 7.2 Emission and absorption of light
 - 7.3 Stimulated absorption and emission of light
 - 7.4 Laser principle
 - 7.5 Structure and working of lasers
 - 7.6 Types of lasers with brief description.
 - 7.7 Applications (basic concepts)
 - 7.8 Material processing
 - 7.9 Laser welding
 - 7.10 Laser assisted machining
 - 7.11 Micro machining
 - 7.12 Drilling, scribing and marking
 - 7.13 Printing
 - 7.14 Lasers in medicine
- 8 HEAT. 4 hrs.**
- 8.1 Review of calorimetry and gas laws
 - 8.2 Thermal expansion of solids, liquids and gases
 - 8.3 Heat of fusion, vaporization
 - 8.4 Humidity, absolute and relative
 - 8.5 Law of cooling
 - 8.6 Thermoelectricity
 - 8.7 Thermocouple.
- 9 MAGNETIC MATERIALS. 2 Hours**
- 9.1 Magnetism

- 9.2 Domains theory
- 9.3 Para, dia and ferromagnetism and magnetic materials
- 9.4 B.H. curve and hysteresis loop.

10 SEMI CONDUCTOR MATERIALS.

2 Hours

- 10.1 Crystalline structure of solids
- 10.2 Conductors, semiconductors, insulators
- 10.3 P-type and N-type materials
- 10.4 P-N junction
- 10.5 P-N junction as a diode
- 10.6 Photovoltaic cell (solar cell)

RECOMMENDED BOOKS

- 1 Tahir Hussain, Fundamentals of Physics Vol-I and II
- 2 Farid Khawaja, Fundamentals of Physics Vol-I and II
- 3 Wells and Slusher, Schaum's Series Physics .
- 4 Nelkon and Oyborn, Advanced Level Practical Physics
- 5 Mehboob Ilahi Malik and Inam-ul-Haq, Practical Physics
- 6 Wilson, Lasers - Principles and Applications
- 7 M. Aslam Khan and M. Akram Sandhu, Experimental Physics Note Book

INSTRUCTIONAL OBJECTIVES

1 USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS.

- 1.1 Write dimensional formulae for physical quantities
- 1.2 Derive units using dimensional equations
- 1.3 Convert a measurement from one system to another
- 1.4 Use concepts of measurement and Significant figures in problem solving.

2 USE CONCEPTS OF SCALARS AND VECTORS IN SOLVING PROBLEMS INVOLVING THESE CONCEPTS.

- 2.1 Explain laws of parallelogram, triangle and polygon of forces
- 2.2 Describe method of resolution of a vector into components
- 2.3 Describe method of addition of vectors by rectangular components
- 2.4 Differentiate between dot product and cross product of vectors
- 2.5 Use the concepts in solving problems involving addition resolution and multiplication of vectors.

3 USE CONCEPTS OF WAVE MOTION IN SOLVING RELEVANT PROBLEMS.

- 3.1 Explain Hooke's Law of Elasticity
- 3.2 Derive formula for Motion under an elastic restoring force
- 3.3 Derive formulae for simple harmonic motion and simple pendulum
- 3.4 Explain wave form with reference to S.H.M. and circular motion
- 3.5 Explain Resonance
- 3.6 Explain Transverse vibration of a stretched string
- 3.7 Use the above concepts and formulae of S.H.M. to solve relevant problems.

4 UNDERSTAND CONCEPTS OF SOUND.

- 4.1 Describe longitudinal wave and its propagation
- 4.2 Explain the concepts: Intensity, loudness, pitch and quality of sound
- 4.3 Explain units of Intensity of level and frequency response of ear
- 4.4 Explain phenomena of silence zones, beats
- 4.5 Explain Acoustics of buildings
- 4.6 Explain Doppler effect giving mathematical expressions.

5 USE THE CONCEPTS OF GEOMETRICAL OPTICS TO MIRRORS and LENSES.

- 5.1 Explain laws of reflection and refraction
- 5.2 Use mirror formula to solve problems
- 5.3 Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g. microscopes, telescopes, camera and sextant.

- 6 UNDERSTAND WAVE THEORY OF LIGHT**
- 6.1 Explain wave theory of light
 - 6.2 Explain phenomena of interference, diffraction, polarization of light waves
 - 6.3 Describe uses of polarization given in the course contents.
- 7 UNDERSTAND THE STRUCTURE, WORKING AND USES OF OPTICAL FIBER.**
- 7.1 Explain the structure of the Optical Fiber
 - 7.2 Explain its principle of working
 - 7.3 Describe use of optical fiber in industry and medicine.
- 8 UNDERSTAND THE STRUCTURE, WORKING AND USES OF LASERS.**
- 8.1 Explain the stimulated emission of radiation
 - 8.2 Explain the laser principle
 - 8.3 Describe the structure and working of lasers
 - 8.4 Distinguish between types of lasers
 - 8.5 Describe the applications of lasers in the fields mentioned in the course contents.
- 9 UNDERSTAND TYPES AND USES OF ARTIFICIAL SATELLITES.**
- 9.1 Explain escape velocity
 - 9.2 Explain orbital velocity
 - 9.3 Distinguish between geosynchronous and geostationary satellites
 - 9.4 Describe uses of artificial satellites in data communication.
- 10 UNDERSTAND BASIC CONCEPTS AND CLASSIFICATION OF MAGNETIC MATERIALS.**
- 10.1 Explain domains theory of magnetism
 - 10.2 Distinguish between para, dia and ferromagnetism and magnetic materials
 - 10.3 Distinguish between B and H
 - 10.4 Describe B.H. Curve
 - 10.5 Describe hysteresis loop.
- 11 UNDERSTAND BASIC CONCEPTS OF SEMI-CONDUCTOR MATERIALS AND THEIR USES.**
- 11.1 Explain crystalline structure of solids
 - 11.2 Distinguish between conductors, semiconductors and insulators
 - 11.3 Describe semiconductors giving examples with reference to their structure
 - 11.4 Distinguish between P-type and N-type materials
 - 11.5 Explain working of P-N junction as a diode
 - 11.6 Explain working of solar cell.

LIST OF PRACTICALS.

- 1 Draw graphs representing the functions:
 - a) $y=mx$ for $m=0, 0.5, 1, 2$
 - b) $y=x^2$
 - c) $y=1/x$
- 2 Find the volume of a given solid cylinder using vernier callipers.
- 3 Find the area of cross-section of the given wire using micrometer screw gauge.
- 4 Prove that force is directly proportional to (a) mass, (b) acceleration, using fletchers' trolley.
- 5 Verify law of parallelogram of forces using Grave-sands apparatus.
- 6 Verify law of triangle of forces and Lami's theorem
- 7 Determine the weight of a given body using
 - a) Law of parallelogram of forces
 - b) Law of triangle of forces
 - c) Lami's theorem
- 8 Verify law of polygon of forces using Grave-sands apparatus.
- 9 Locate the position and magnitude of resultant of like parallel forces.
- 10 Determine the resultant of two unlike parallel forces.
- 11 Find the weight of a given body using principle of moments.
- 12 Locate the centre of gravity of regular and irregular shaped bodies.
- 13 Find Young's Modules of Elasticity of a metallic wire.
- 14 Verify Hooke's Law using helical spring.
- 15 Study of frequency of stretched string with length.
- 16 Study of variation of frequency of stretched string with tension.
- 17 Study resonance of air column in resonance tube and find velocity of sound.
- 18 Find the frequency of the given tuning fork using resonance tube.
- 19 Find velocity of sound in rod by Kundt's tube.
- 20 Verify rectilinear propagation of light and study shadow formation.
- 21 Study effect of rotation of plane mirror on reflection.
- 22 Compare the refractive indices of given glass slabs.
- 23 Find focal length of concave mirror by locating centre of curvature.
- 24 Find focal length of concave mirror by object and image method
- 25 Find focal length of concave mirror with converging lens.
- 26 Find refractive index of glass by apparent depth.
- 27 Find refractive index of glass by spectrometer.
- 28 Find focal length of converging lens by plane mirror.
- 29 Find focal length of converging lens by displacement method.
- 30 Find focal length of diverging lense using converging lens.
- 31 Find focal length of diverging lens using concave mirror.
- 32 Find angular magnification of an astronomical telescope.
- 33 Find angular magnification of a simple microscope (magnifying glass)

- 34 Find angular magnification of a compound microscope.
- 35 Study working and structure of camera.
- 36 Study working and structure of sextant.
- 37 Compare the different scales of temperature and verify the conversion formula.
- 38 Determine the specific heat of lead shots.
- 39 Find the coefficient of linear expansion of a metallic rod.
- 40 Find the heat of fusion of ice.
- 41 Find the heat of vaporization.
- 42 Determine relative humidity using hygrometer.

Mgm 221 BUSINESS MANAGEMENT AND INDUSTRIAL ECONOMICS

Total Contact Hours

Theory	32	T	P	C
Practical	0	1	0	1

AIMS The students will be able to develop management skills, get acquainted the learner with the principles of management and economic relations and develop commercial/economic approach to solve the problems in the industrial set-up.

COURSE CONTENTS

- 1. ECONOMICS** **2 Hours**
 - 1.1 Definition: Adam Smith, Alfred Marshall, Prof. Robins.
 - 1.2 Nature and scope
 - 1.3 Importance for technicians.

- 2. BASIC CONCEPTS OF ECONOMICS** **1 Hour**
 - 2.1 Utility
 - 2.2 Income
 - 2.3 Wealth
 - 2.4 Saving
 - 2.5 Investment
 - 2.6 Value.

- 3. DEMAND AND SUPPLY.** **2 Hours**
 - 3.1 Definition of demand.
 - 3.2 Law of demand.
 - 3.3 Definition of supply.
 - 3.4 Law of supply.

- 4. FACTORS OF PRODUCTION.** **2 Hours**
 - 4.1 Land
 - 4.2 Labour
 - 4.3 Capital
 - 4.4 Organization.

- 5. BUSINESS ORGANIZATION.** **3 Hours**
 - 5.1 Sole proprietorship.
 - 5.2 Partnership
 - 5.3 Joint stock company.

6.	ENTREPRENEURIAL SKILLS	4 Hours
6.1	Preparing, planning, establishing, managing, operating and evaluating relevant resources in small business.	
6.2	Business opportunities, goal setting.	
6.3	Organizing, evaluating and analyzing opportunity and risk tasks.	
7.	SCALE OF PRODUCTION.	2 Hours
7.1	Meaning and its determination.	
7.2	Large scale production.	
7.3	Small scale production.	
8.	ECONOMIC SYSTEM	3 Hours
8.1	Free economic system.	
8.2	Centrally planned economy.	
8.3	Mixed economic system.	
9.	MONEY.	1 Hour
9.1	Barter system and its inconveniences.	
9.2	Definition of money and its functions.	
10.	BANK.	1 Hour
10.1	Definition	
10.2	Functions of a commercial bank.	
10.3	Central bank and its functions.	
11.	CHEQUE	1 Hour
11.1	Definition	
11.2	Characteristics and kinds of cheque.	
11.3	Dishonour of cheque.	
12.	FINANCIAL INSTITUTIONS	2 Hours
12.1	IMF	
12.2	IDBP	
12.3	PIDC	
13.	TRADE UNION	2 Hours
13.1	Introduction and brief history.	
13.2	Objectives, merits and demerits.	
13.3	Problems of industrial labour.	
14.	INTERNATIONAL TRADE.	2 Hours
14.1	Introduction	
14.2	Advantages and disadvantages.	

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| 15. MANAGEMENT | 1 Hour |
| 15.1 Meaning | |
| 15.2 Functions | |
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| 16. ADVERTISEMENT | 2 Hours |
| 16.1 The concept, benefits and draw-backs. | |
| 16.2 Principal media used in business world. | |
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| 17. ECONOMY OF PAKISTAN | 1 Hour |
| 17.1 Introduction | |
| 17.2 Economic problems and remedies. | |

BOOKS RECOMMENDED

1. Nisar-ud-Din, Business Organization, Aziz Publisher, Lahore
2. M. Saeed Nasir, Introduction to Business, Ilmi Kitab Khana, Lahore.
3. S.M. Akhtar, An Introduction to Modern Economics, United Limited, Lahore.

INSTRUCTIONAL OBJECTIVES

- 1. UNDERSTAND THE IMPORTANCE OF ECONOMICS.**
 - 1.1 State definition of economics given by Adam Smith, Alfred Marshall and Professor Robins.
 - 1.2 Explain nature and scope of economics.
 - 1.3 Describe importance of study of economics for technicians.

- 2. UNDERSTAND BASIC TERMS USED IN ECONOMICS.**
 - 2.1 Define basic terms, utility, income, wealth, saving, investment and value.
 - 2.2 Explain the basic terms with examples

- 3. UNDERSTAND LAW OF DEMAND AND LAW OF SUPPLY.**
 - 3.1 Define Demand.
 - 3.2 Explain law of demand with the help of schedule and diagram.
 - 3.3 State assumptions and limitation of law of demand.
 - 3.4 Define Supply.
 - 3.5 Explain law of Supply with the help of schedule and diagram.
 - 3.6 State assumptions and limitation of law of supply.

- 4. UNDERSTAND THE FACTORS OF PRODUCTION**
 - 4.1 Define the four factors of production.
 - 4.2 Explain labour and its features.
 - 4.3 Describe capital and its peculiarities.

- 5. UNDERSTAND FORMS OF BUSINESS ORGANIZATION.**
 - 5.1 Describe sole proprietorship, its merits and demerits.
 - 5.2 Explain partnership, its advantages and disadvantages.
 - 5.3 Describe joint stock company, its merits and demerits.
 - 5.4 Distinguish public limited company and private limited company.

- 6. UNDERSTAND ENTREPRENEURIAL SKILLS**
 - 6.1 Explain preparing, planning, establishing and managing small business set up
 - 6.2 Explain evaluating all relevant resources
 - 6.3 Describe organizing analyzing and innovation of risk of task

- 7. UNDERSTAND SCALE OF PRODUCTION.**
 - 7.1 Explain scale of production and its determination.
 - 7.2 Describe large scale production and it merits.
 - 7.3 Explain small scale of production and its advantages and disadvantages.

- 8. UNDERSTAND DIFFERENT ECONOMIC SYSTEMS.**
 - 8.1 Describe free economic system and its characteristics.
 - 8.2 Explain centrally planned economic system, its merits and demerits.
 - 8.3 State mixed economic system and its features.

- 9. UNDERSTAND WHAT IS MONEY**
 - 9.1 Define money
 - 9.2 Explain barter system and its inconveniences.
 - 9.3 Explain functions of money.

- 10. UNDERSTAND BANK AND ITS FUNCTIONS.**
 - 10.1 Define bank.
 - 10.2 Describe commercial bank and its functions.
 - 10.3 State central bank and its functions.

- 11. UNDERSTAND CHEQUE AND DISHONOR OF CHEQUE.**
 - 11.1 Define cheque.
 - 11.2 Enlist the characteristics of cheque.
 - 11.3 Identify the kinds of cheque.
 - 11.4 Describe the causes of dishonor of a cheque.

- 12. UNDERSTAND FINANCIAL INSTITUTIONS.**
 - 12.1 Explain IMF and its objectives.
 - 12.2 Explain organisational set up and objectives of IDBP.
 - 12.3 Explain organisational set up and objectives of PIDC.

- 13. UNDERSTAND TRADE UNION, ITS BACKGROUND AND FUNCTIONS.**
 - 13.1 Describe brief history of trade union.
 - 13.2 State functions of trade union.
 - 13.3 Explain objectives, merits and demerits of trade unions.
 - 13.4 Enlist problems of industrial labour.

- 14. UNDERSTAND INTERNATIONAL TRADE.**
 - 14.1 Explain international trade.
 - 14.2 Enlist its merits and demerits.

- 15. UNDERSTAND MANAGEMENT**
 - 15.1 Explain meaning of management.
 - 15.2 Describe functions of management.
 - 15.3 Identify the problems of business management.

- 16. UNDERSTAND ADVERTISEMENT.**
 - 16.1 Explain the concept of advertisement.
 - 16.2 Enlist benefits and drawbacks of advertisement.
 - 16.3 Describe principal media of advertisement used in business world.

- 17. UNDERSTAND THE ECONOMIC PROBLEMS OF PAKISTAN.**
 - 17.1 Describe economy of Pakistan.
 - 17.2 Explain economic problems of Pakistan

17.3 Explain remedial measures for economic problems of Pakistan.
measure.

ET-213: D.C. MACHINES AND BATTERIES.

Total Contact Hours:

Theory: 64		T	P	C	
Practical: 96			2	3	3

AIM To enable students understand basic principles, construction, working and control techniques of DC machines. Also understand types, working and charging of secondary cells/batteries.

1. D.C. MACHINES FUNDAMENTALS 6 Hrs.

- 1.1 Faraday's Laws of Electromagnetic Induction, Principle of Dynamically induced e.m.f.
- 1.2 Flemings right hand rule, Lenz's Law.
- 1.3 Force on a current carrying conductor.
- 1.4 Parts of D.C Machines, body, yoke, field, poles, armature, commutator, etc.
- 1.5 Armature winding, single layer, double layer, simplex, duplex, lap and wave.

2. D.C MACHINE AS D.C. GENERATOR 20 Hrs.

- 2.1 Principle of working of elementary D.C generator.
- 2.2 E.M.F equation of D.C generator and problem solving.
- 2.3 Types of Generator, separately excited, self excited, shunt, series and compound.
- 2.4 No load characteristics of separately and self excited shunt generator, critical resistance solving problems.
- 2.5 On load, internal, external characteristics & problem solving of generators voltage regulation, method of compounding, degree of compounding.
- 2.6 Armature reaction & commutation.
- 2.7 Interpoles or composites.
- 2.8 Power stages, losses and efficiency, condition for maximum efficiency.
- 2.9 Parallel operation of shunt & compound generator, load sharing.
- 2.10 Safety while working on generators

3. D.C. MACHINES AS D.C. MOTOR 26 Hrs.

- 3.1 Principle & working of elementary D.C motor.
- 3.2 Back e.m.f and torque development in D.C motors, torque equation.
- 3.3 Electrical, Mechanical, V/I_a characteristics of series, shunt, compound (Differential) motors.
- 3.4 Comparison of D.C motors, and their applications.
- 3.5 Power stages, losses, BHP and efficiency of D.C. motors.
- 3.6 Speed control of D.C motor by changing field flux, armature current and voltage.
- 3.7 Merits and demerits of different speed controlling methods.
- 3.8 Necessity and design of motor starters, 3 & 4 point starter.
- 3.9 Controllers, manual, automatic magnetic, semi-automatic.
- 3.10 Testing of D.C machines, Dynamometer, Hopkinson tests.
- 3.11 Safety while working on motors.

4. BATTERIES 12 Hrs.

- 4.1 Primary cells, types, construction, dry cell.

- 4.2 Secondary cells, storage cells.
- 4.3 Types of storage cells, Lead Acid, Nickel iron, Nickel Cadmium.
- 4.4 Chemical action during charging and discharging of Lead Acid battery.
- 4.5 Construction and working of Lead Acid battery.
- 4.6 Preparation of electrolytes of given specific gravity.
- 4.7 Variation in specific gravity during charging & discharging.
- 4.8 Effect of specific gravity on e.m.f.
- 4.9 Construction & working of Nickel iron cell.
- 4.10 Construction & working of Nickel-Cadmium Cell.
- 4.11 Safety in preparation of electrolytes and handling acids.
- 4.12 Safe disposal of chemicals

ET-213: D.C. MACHINES & BATTERIES**INSTRUCTIONAL OBJECTIVES****TIME SCHEDULE**

S.NO.	MAJOR TOPICS	NO. OF PERIODS	NO. OF QUESTIONS IN Q. PAPER.
1.	D.C. Machine Fundamentals	6	1
2.	D.C. Generator	20	2
3.	D.C. Motor	26	2
4.	Batteries	12	1
	Total:	64	6

1. UNDERSTAND THE FUNDAMENTALS OF D.C. MACHINES

- 1.1. State Faraday's Laws of Electromagnetic induction
- 1.2. Derive $e=di/dt$ equation
- 1.3. State Fleming's right hand rule.
- 1.4. State Lenz's Law.
- 1.5. Explain force developed on a current carrying conductor lying in magnetic field.
- 1.6. State parts of D.C. machine, body, yoke, field poles and winding, commutators, armature
- 1.7. Draw Armature winding, lap, wave, single layer, double layer, simplex and duplex.
- 1.8. Calculate and develop given armature winding for lap & wave duplex winding.

2. UNDERSTAND THE WORKING OF D.C. MACHINES AS D.C. GENERATORS

- 2.1. Explain principle of single loop D.C. generator.
- 2.2. Derive EMF equation of a D.C. generator and solve related problems.
- 2.3. List types of D.C. generator depending upon excitation (self and separately excited).
- 2.4. List types of D.C. generator showing their connections (Shunt, series, compound).
- 2.5. Draw no load characteristics of separately and self-excited shunt generators.
- 2.6. Evaluate critical resistance from O.C.C for a given machine.
- 2.7. Solve problems relating to o.c.c critical resistance, emf and speed.
- 2.8. Draw on-load internal, external characteristics for series, shunt and compound generators.
- 2.9. Solve problems relating to load characteristics.
- 2.10. State levels of compounding of compound generator, as under & over compounding.
- 2.11. Explain armature reaction.
- 2.12. Define commutation.
- 2.13. Explain purpose of Inter-poles
- 2.14. Express power stages in D.C. generators and its efficiency.
- 2.15. Solve problems on power stages and efficiency of D.C. generator.

- 2.16 State conditions for maximum efficiency of a D.C. generator.
- 2.17 Solve problems on efficiency of D.C. generator.
- 2.18 Explain parallel operation of series shunt and compound generators.

3. UNDERSTAND CONSTRUCTION, TYPES AND USES OF D.C MOTORS

- 3.1 Explain working principle of an elementary D.C. motor.
- 3.2 State back e.m.f produced in motor armature.
- 3.3 Explain development of torque due to back e.m.f.
- 3.4 Derive motor torque equation.
- 3.5 Draw electrical,mechanical, N/I_a characteristics of series, shunt and compound (Differential/commulative) motors.
- 3.6 Classify dc motors (Series, shunt, compound).
- 3.7 State application of motors depending upon their characteristics.
- 3.8 Explain power stages in D.C. motors, BHP, losses, efficiency.
- 3.9 Solve problems on power stages of DC motors.
- 3.10 Describe speed control of dc motors, by changing field flux, armature current and voltage.
- 3.11 Compare different speed control methods
- 3.12 Design resistance type motors starter (3 points, 4 points.).
- 3.13 Explain controllers, manual, automatic and semi-automatic.
- 3.14 Describe importance of testing of dc machines.
- 3.15 Explain dynamometer, Hopkinson & Swinburn tests.

4. UNDERSTAND CONSTRUCTION, TYPES AND CHARGING OF BATTERIES

- 4.1 Define primary cell.
- 4.2 State type of cells
- 4.3 Describe working of primary cells.
- 4.4 State uses of Dry cell
- 4.5 Explain working of dry cell.
- 4.6 Explain the working of secondary cell and battery (Storage cell, accumulator, lead acid, and alkaline).
- 4.7 Sketch construction of lead acid battery.
- 4.8 Discuss chemical process in lead acid battery on charging and discharging.
- 4.9 State method of preparation of electrolyte for a given specific gravity.
- 4.10 State the effects of charging and discharging on the specific gravity of the electrolyte.
- 4.11 Draw sketch of Nickel iron cell
- 4.12 Describe working of Nickel iron battery.
- 4.13 Draw sketch of Nickel Cadmium battery.

ET-213: D.C. MACHINES AND BATTERIES

LIST OF PRACTICALS:

Note: Students should demonstrate concern for personal and equipment safety while working in Lab.

1. Study of constructional features of D.C machine.
2. Identification of terminals, polarity, determination of resistance of field and armature windings.
3. Developing Lap winding diagram for a given armature.
4. Develop wave winding diagram for a given armature.
5. Calculating winding factor, and develop winding diagram lap and wave for a given armature.
6. Rewinding an armature, session I.
7. Rewinding armature, session II.
8. Rewinding armature, session III (last).
9. Connecting and operating D.C machine as separately excited generator and to plot its O.C.C.
10. Connecting and operating D.C machine as self excited shunt generator and to plot its O.C.C. and to find critical resistance.
11. Operate a series generator and draw its external characteristics.
12. Operate a shunt generator and draw its external characteristics.
13. Plot external characteristics of compound generator for level, under and over compounding.
14. Parallel operation of two shunt generators.
15. Determination of copper, iron & friction losses by actual loading.
16. Study of starting and controlling equipment.
17. Connecting starter and controlling circuit with a shunt motor.
18. Connecting a machine as series motor (operation of fractional H.P series motor).
19. Determination of motor efficiency by direct loading.
20. Experimentally plot speed-torque characteristics of a shunt motor.
21. Plotting speed-current characteristics from data of a shunt motor.
22. Plotting Torque-current characteristics from experimental data of a shunt motor.
23. Plot torque-current characteristic of a series motor from experimental data.
24. Draw speed-torque characteristics of a series motor from experimental data.
25. Plot speed-current characteristic of compounded motor.
26. Draw Torque-current characteristics of compound motor.
27. Controlling speed of a shunt motor by changing field current & armature current.
28. Controlling speed of a series motor by armature and field diverter.
29. Determination of B.H.P of motor by brake test.
30. Determination of efficiency of motor by Swinburn test.
31. Determination of torque and efficiency by dynamo meter.
32. Regenerative or Hopkinsons test.

33. Study constructional features of lead acid battery.
34. Preparation of electrolyte (H_2SO_4) of a given specific gravity and charging lead acid battery.

** Students must prepare practical journal and get it checked weekly by the concerned teacher. He should produce it to external examiner for sessional work/marking check up at the time of final examination.

TEXT/REFERENCE BOOKS

1. A Course in Electrical Engineering Vol.I By Dawes, L. Chester.
2. Audel's Electric motor guide.
3. A Text Book of Electrical Technology by B.L. Theraja.
4. D.C Machines by Audel's.
5. Electrical Generator By Kates-Stafford.
6. Direct Current Motors & Generators by M.C. Mongal-Keth-Rouson.

ET-223: ELECTRICAL INSTRUMENTS AND MEASUREMENTS

Total Contact Hours:

Theory:	64	T	P	C
Practical:	96	2	3	3

AIM: To enable students understand fundamental forces acting in electrical measuring instruments, and the construction, working & applications of the whole range of measuring instruments. This range includes special purpose and electronic instruments. This course also provides information on measuring bridges in common use.

- 1. CLASSIFICATION OF INSTRUMENTS 6 Hrs.**
 - 1.1. Absolute instruments.
 - 1.2. Secondary instruments.
 - 1.3. Indicating instruments.
 - 1.4. Recording instruments.
 - 1.5. Integrating instruments.
 - 1.6. Digital instruments.
 - 1.7. Analog instruments.

- 2. EFFECTS UTILIZED IN MEASURING INSTRUMENTS**
 - 2.1. Magnetic effect.
 - 2.2. Heating effect
 - 2.3. Chemical effect.
 - 2.4. Electrostatic effect.
 - 2.5. Electromagnetic effect.

- 3. FORCES ACTING IN AN INSTRUMENT**
 - 3.1. Deflecting force.
 - 3.2. Controlling force.
 - 3.3. Damping force.

- 4. TANGENT GALVANOMETER**
 - 4.1. Theory of Tangent galvanometer.
 - 4.2. Parts of tangent galvanometer.

- 5. DISTINCTION BETWEEN INDICATING AND RECORDING INSTRUMENT**
 - 5.1. Construction, distinction.
 - 5.2. Working distinction

- 6. DEFLECTING FORCE ACTING IN THE INSTRUMENT 6 Hrs.**
 - 6.1. Calculation of Force/Torques.

- 7. CONTROLLING/RESTORING FORCES**
 - 7.1 Gravity control.
 - 7.2 Spring control.

- 8. DAMPING FORCES AND THEIR NECESSITY**
 - 8.1 Air damping.
 - 8.2 Fluid damping.
 - 8.3 Eddy current damping.

- 9. BALANCING OF MOVING PARTS**
 - 9.1 Torque/weight ratio calculation.
 - 9.2 Balancing weight.

- 10. METERS SCALES**
 - 10.1 Construction of scales.
 - 10.2 Reading of scales.

- 11. POINTERS**
 - 11.1 Types of pointers.
 - 11.2 Methods of mounting.
 - 11.3 Materials used for pointers.

- 12. CONTROL SPRINGS**
 - 12.1 Types of springs.
 - 12.2 Materials used for making spring.
 - 12.3 Merits and demerits of each material.
 - 12.4 Mounting of spring.

- 13. BEARINGS**
 - 13.1 Role of bearings in an instrument.
 - 13.2 Bearings types.
 - 13.3 Bearing materials.

- 14. CASING OF AN INSTRUMENT**
 - 14.1 Types
 - 14.2 Materials used with advantages and disadvantages.

- 15. PERMANENT MAGNET MOVING COIL INSTRUMENT** **6 Hrs.**
 - 15.1 Working Principle.
 - 15.2 Construction.
 - 15.3 Application.

- 16. RECTIFIER**
16.1 Types of rectifiers.
16.2 Working
16.3 Application with meters.
16.4 Advantages
- 17. SHUNTS** **8 Hrs.**
17.1 Construction of shunts purpose.
17.2 Calculation and application.
17.3 Material used for shunts.
- 18. MULTIPLIER**
18.1 Purpose of multiplier and calculations.
18.2 Construction
18.3 Material used for multipliers.
- 19. MOVING IRON ATTRACTION TYPE INSTRUMENT**
19.1 Working principle.
19.2 Construction
19.3 Application
- 20. MOVING IRON REPULSION TYPE INSTRUMENT**
20.1 Working principle.
20.2 Construction
20.3 Application.
- 21. ERRORS IN AM-METERS AND VOLTMETERS**
21.1 Causes of error.
21.2 Removing error.
21.3 Calibration.
- 22. BI METALLIC TYPE INSTRUMENT** **6 Hrs.**
22.1 Working principle.
22.2 Construction
22.3 Application.
- 23. THERMOCOUPLE TYPE INSTRUMENT**
23.1 Types of Thermocouples.
23.2 Working principle.
23.3 Application.
- 24. TEMPERATURE MEASUREMENT DEVICES**
24.1 Types (resistance, thermocouple, Radiation Pyrometers).

- 24.2 Working principle.
- 24.3 Application.

- 25. MOVING COIL DYNAMOMETER INSTRUMENT**
 - 25.1 Working Principles.
 - 25.2 Construction as Am-meter
 - 25.3 Construction as Voltmeter.
 - 25.4 Construction as Wattmeter.
 - 25.5 Errors and their remedies.
 - 25.6 Advantages and disadvantages over other types.

- 26. SHADED POLE TYPE INSTRUMENT** **6 Hrs.**
 - 26.1 Working Principle
 - 26.2 Construction.
 - 26.3 Application.

- 27. ENERGY METER SINGLE PHASE** **4 Hrs.**
 - 27.1 Types.
 - 27.2 Construction of single phase Energy meter (induction type).
 - 27.3 Working Principle.
 - 27.4 Types of scales in use and reading the scale.
 - 27.5 Errors in energy meter.
 - 27.6 Calibration of Energy meter.

- 28. THREE PHASE ENERGY METER**
 - 28.1 Construction of induction type.
 - 28.2 Working Principle.
 - 28.3 Application.

- 29. MAXIMUM DEMAND INDICATOR**
 - 29.1 Construction.
 - 29.2 Working Principle.
 - 29.3 Application & reading.

- 30. OHM METER**
 - 30.1 Working Principle.
 - 30.2 Construction.
 - 30.3 Application.

- 31. A.V.O. METER**
 - 31.1 Construction.
 - 31.2 Scale reading.
 - 31.3 Application.

- 32. MEAGER (INSULATION TESTER)**
 32.1 Working principle.
 32.2 Construction.
 32.3 Application.
- 33. EARTH RESISTANCE TESTER**
 33.1 Constructions.
 33.2 Operations.
 33.3 Application.
- 34. RESISTANCE MEASURING BRIDGES (WHEAT STONE & KELVIN'S DOUBLE BRIDGE)**
 34.1 Construction.
 34.2 Working Principle.
 34.3 Uses.
- 35. MURRAY LOOP TEST**
 35.1 Working Principle.
 35.2 Application.
- 36. BLAVIER & EARTH LOOP TEST**
 36.1 Working principle.
 36.2 Application.
- 37. INSTRUMENT TRANSFORMERS** **8 Hrs.**
 37.1 Types (C.T & P.T).
 37.2 Working and advantages.
 37.3 Vector diagram.
 37.4 Theory of C.T & P.T
 37.5 Phase angle.
 37.6 Standard ratios, rating, burden.
 37.7 Error reducing methods.
- 38. POWER FACTOR METERS**
 38.1 Types according to supply.
 38.2 Types according to construction.
 38.3 Working principle of each.
- 39. DIGITAL METERS** **8 Hrs.**
 39.1 Types.
 39.2 Uses.
 39.3 Explanation with the aid of block diagram.

- 39.4 Error.
- 40. F.E.T & TRANSISTOR VOLTMETER** **6 Hrs.**
40.1 Working (Block diagram).
40.2 Application.
- 41. CATHODE-RAY OSCILLOSCOPE**
41.1 Types.
41.2 Construction.
41.3 Operation.
- 42. SIGNAL GENERATORS** **4 Hrs.**
42.1 Types (AF & RF)
42.2 Working Principle.
42.3 Construction.
42.4 Application.
- 43. MEASUREMENT OF CAPACITANCE & INDUCTANCE**
43.1 Measuring Inductance
43.2 Measuring Capacitance.
- 44. FREQUENCY METER**
44.1 Types (Resonance and Weston, Digital).
44.2 Construction.
44.3 Working Principle.
44.4 Application.
- 45. LUX METERS**
45.1 Types.
45.2 Working principle.
45.3 Applications.
- 46. SYNCHRONOSCOPES**
46.1 Types.
46.2 Construction.
46.3 Working principle.
46.4 Uses.
- 47. TACHOMETERS** **6 Hrs.**
47.1 Types (Mechanical-Electrical & Electronic).
47.2 Construction.
47.3 Application.

ET-223:

ELECTRICAL INSTRUMENTS AND MEASUREMENTS

INSTRUCTIONAL OBJECTIVES

TIME SCHEDULE

S.NO.	MAJOR TOPICS	NO. OF PERIODS	NO. OF QUESTIONS IN Q. PAPER
1.	Classification, effect of current indicating, recording and integrating instruments. (1-5)	6	½
2.	Deflecting forces, controlling & damping. General constructions. (6-14)	6	½
3.	Permanent magnet moving coil & moving iron instruments (15-17) Cost estimation - Labour cost estimation	6	½
4.	Bi-Metal, thermocouple, dynamometer, shaded pole and rectifier instruments (18-22)	6	½
5.	Shunts, multipliers, Avo, Meager as insulation tester & Earth resistant tester (23-28)	8	1
6.	Energy meters and their errors. (29-31)	4	½
7.	Digital meters, frequency meter, resistance measuring bridges & their applications (32-36)	8	½
8.	Instrument transformers, power factor meters, temp. measurement & LUX meter (37-40)	8	1
9.	FET meter, C.R.O., VTVM & Synchronoscope (41-43)	6	½
10.	Tacho-meter, M.D.I., signal generator & capacitance measurement (44-47)	6	½
	Total:	64	6

1. UNDERSTAND THE DIFFERENCE BETWEEN PRIMARY AND SECONDARY INSTRUMENTS WITH FURTHER CATEGORIES OF SECONDARY INSTRUMENTS

- 1.1 Differentiate between the absolute and secondary instruments.
- 1.2 State the difference among indicating, recording and integrating instruments.
- 1.3 State apparent constructional difference.
- 1.4 Explain the applications of each type.

2. UNDERSTAND THE EFFECTS AND MEASURING INSTRUMENTS

- 2.1 Explain the magnetic effects and its sources.
- 2.2 Explain the heating effects and its sources.
- 2.3 Define the chemical effects and its sources.
- 2.4 Explain electrostatic effects and its sources.

- 2.5 Explain electro magnetic effect and its elements. (Amp-Turn)
- 3. UNDERSTAND VARIOUS FORCES ACTING IN A MEASURING INSTRUMENT**
- 3.1 Explain deflecting force and the methods of providing it.
3.2 Explain controlling force and the methods of providing it.
3.3 Explain damping force and the methods of providing it.
- 4. KNOW THE WORKING OF TANGENT GALVANOMETER**
- 4.1 State the working principle of Tangent Galvanometer.
4.2 State the applications of Tangent Galvanometer.
- 5. UNDERSTAND THE DIFFERENCE BETWEEN INDICATING AND RECORDING INSTRUMENTS**
- 5.1 Explain the construction and use of indicating instrument.
5.2 Explain the use of recording instruments.
5.3 Write its advantages over indicating instruments.
5.4 State common applications of recording instruments.
- 6. UNDERSTAND THE METHOD OF PRODUCING DEFLECTING FORCE/TORQUE**
- 6.1 Explain various methods of producing deflecting force.
6.2 Explain difference between force and torque.
6.3 Explain the factors on which its strength is based.
6.4 Derive formula for moving coil instrument.
- 7. UNDERSTAND THE TYPES OF CONTROLLING/RESTORING FORCES**
- 7.1 Explain Gravity force and its applications in instruments.
7.2 Understand spring control.
7.3 State types of springs
7.4 Explain materials of springs used in instruments.
7.5 Explain the method of mounting springs.
7.6 State its strength & position controlling system.
- 8. UNDERSTAND DIFFERENT DAMPING FORCES AND TECHNIQUES**
- 8.1 Explain Air, Oil & eddy current damping.
8.2 Explain the method of their production.
8.3 Draw the sketch of the systems.
8.4 Explain under, normal & dead beat damping.
- 9. UNDERSTAND PURPOSE AND TECHNIQUES OF BALANCING MOVING PARTS**

- 9.1 Explain the effect of unbalancing & balancing.
 - 9.2 Calculate torque weight ratio
 - 9.3 Explain types and weights used and their position.
 - 9.4 Describe fixing of balance weight.
- 10. UNDERSTAND METER SCALES, THEIR TYPES AND GRADUATION**
- 10.1 State types of scales (simple, mirror multiscales).
 - 10.2 Explain the parallax and its effect in reading.
 - 10.3 Explain reason for creeping wide range.
 - 10.4 State precautions for reading analog scale readings
 - 10.5 Explain why some scales are not uniform.
- 11. UNDERSTAND THE POINTER DESIGN AND MATERIALS USED**
- 11.1 Explain types of pointers in use .
 - 11.2 Explain the material used, with reasons.
 - 11.3 Explain their fixing techniques
 - 11.4 Explain the care required in using & repairing pointers.
- 12. UNDERSTAND CONTROL SPRING TYPES, MATERIALS AND THEIR FIXING**
- 12.1 Explain hair & helix spring.
 - 12.2 Explain characteristics of material.
 - 12.3 Explain the method of their fixing on post.
- 13. UNDERSTAND BEARING TYPES, MATERIALS NECESSITY AND LUBRICATION**
- 13.1 Explain need & types of bearing in use.
 - 13.2 Explain material used, their merits & demerits.
 - 13.3 Explain the lubrication techniques & lubricants used,
- 14. UNDERSTAND WORKING OF PERMANENT MAGNET MOVING COIL INSTRUMENT**
- 14.1 Explain the working principle.
 - 14.2 Explain the parts and their role in such instruments.
 - 14.3 Draw sketches of each part.
 - 14.4 Explain difference in winding and sensitivity when used as am-meter, volt meter and Ohm-meter.
- 15. UNDERSTAND THE WORKING PRINCIPLE, PARTS AND USES OF MOVING IRON ATTRACTION TYPE INSTRUMENTS**
- 15.1 Explain the working principle.
 - 15.2 Draw sketches to show the assembly.

- 15.3 Explain the applications of such instruments.
- 15.4 State names of parts.
- 16. **MOVING IRON REPULSION TYPE INSTRUMENTS**
 - 16.1 As above for serial-15 objective.
- 17. **KNOW BI-METALLIC INSTRUMENTS**
 - 17.1 State the working principle of Bi-metallic instruments and state materials used.
 - 17.2 State the applications of such instruments.
- 18. **UNDERSTAND THERMOCOUPLE TYPES OF INSTRUMENTS**
 - 18.1 Explain the working principle of thermocouples
 - 18.2 Draw sketch of thermocouples
 - 18.3 State various materials used.
 - 18.4 State the applications.
- 19. **UNDERSTAND ELECTRODYNAMIC INSTRUMENT**
 - 19.1 Explain the working principle
 - 19.2 Name various parts
 - 19.3 State working of each part.
 - 19.4 Draw internal sketch showing parts.
 - 19.5 State the uses of such instruments.
- 20. **UNDERSTAND SHADED POLE TYPE INSTRUMENTS**
 - 20.1 Explain the working principle
 - 20.2 State application.
 - 20.3 Name parts of the instrument
 - 20.4 Draw sketch.
 - 20.5 State the merits & demerits of such instruments.
- 21. **UNDERSTAND VARIOUS KINDS OF DYNAMOMETER TYPE INSTRUMENTS**
 - 21.1 Explain the working principle
 - 21.2 Explain connection as am meter, as voltmeter and as wattmeter.
 - 21.3 Draw sketches in each case.
 - 21.4 Enlist merits and demerits
 - 21.4 Explain errors and their remedies.
- 22. **UNDERSTANDING RECTIFIERS, THEIR TYPES AND APPLICATIONS**
 - 22.1 State the types of rectifiers
 - 22.2 Draw circuit diagram of single phase half and full wave rectification.
 - 22.3 Explain the uses of rectifiers in measuring instruments.

- 23. DESIGN SHUNTS FOR RANGE EXTENSION**
- 23.1 Explain purpose of shunt.
 - 23.2 Know kind of materials used.
 - 23.3 Calculate value for shunt resistor for given meter's range extension.
 - 23.4 Design physical dimensions & power rating of shunt.
- 24. DESIGN MULTIPLIER FOR RANGE EXTENSION**
- 24.1 Explain the purpose of multiplier.
 - 24.2 Calculate values for multiplier for given meter's range extension.
 - 24.3 Know the kinds of materials used.
 - 24.4 Design physical dimensions & power rating of multipliers.
- 25. UNDERSTAND OHM METERS**
- 25.1 Explain the working principle of Analog Ohm meter.
 - 25.2 Explain scale reading on different range settings.
 - 25.3 State precautions of using ohm meters.
- 26. UNDERSTAND THE WORKING AND USES OF AVO METER**
- 26.1 State kinds of AVO meter (Multimeters).
 - 26.2 Explain Working principle of analog multimeter
 - 26.3 Explain Working Of Digital type mete, using block diagram.
 - 26.4 Draw scales and state reading techniques.
 - 26.5 Explain use on live circuits as am-meter and voltmeter.
- 27. UNDERSTAND THE WORKING & USE OF MEAGER**
- 27.1 Explain working principle of meager.
 - 27.2 Explain operation for continuity, short circuit and open circuit tests.
 - 27.3 Explain scale reading
 - 27.4 Draw sketch, naming each part.
- 28. UNDERSTAND WORKING AND USE OF EARTH RESISTANCE TESTER**
- 28.1 Explain the working principle of earth tester.
 - 28.2 Draw sketch
 - 28.3 State applications
- 29. UNDERSTAND WORKING AND USE OF SINGLE PHASE INDUCTION TYPE ENERGY METER**
- 29.1 Explain the working principle
 - 29.2 Draw sketch showing assembly

- 29.3 Enlist name of the parts
 - 29.4 Explain working of each part
 - 29.5 Explain scale reading
 - 29.6 Enlist errors and their causes.
 - 29.7 Explain calibration techniques.
- 30. UNDERSTAND WORKING AND USE OF THREE PHASE ENERGY METERS**
- 30.1 Explain construction and working
 - 30.2 Enlist parts for such errors
 - 30.3 Explain calibration techniques
- 31. UNDERSTAND THE VARIOUS SOURCES OF ERROR IN METERS AND THEIR REMEDIES**
- 31.1 Explain reason and sources of errors in voltmeter and am- meter
 - 31.2 Enlist remedial measures.
 - 31.3 Explain calibration method with standard instrument
- 32. UNDERSTAND PRINCIPLE, TYPES AND USES OF DIGITAL METERS**
- 32.1 Explain working principle (Block diagram)
 - 32.2 Explain types in lab use
 - 32.3 Enlist possible causes of errors.
- 33. UNDERSTAND WORKING PRINCIPLE AND TYPES OF FREQUENCY METER**
- 33.1 Explain principle of resonance type meter.
 - 33.2 Explain principle of reed type meter.
 - 33.3 Explain principle of weston type.
 - 33.4 Explain principle of digital type (Block diagram only)
- 34. UNDERSTAND PRINCIPLE OF RESISTANCE MEASURING BRIDGES AND THEIR APPLICATION**
- 34.1 Explain working principle of wheat stone bridge.
 - 34.2 Calculate unknown resistance using wheat stone bridge.
 - 34.3 Explain its construction and use
 - 34.4 Explain working principle of Kelvin's double bridge.
 - 34.5 Explain construction and use.
 - 36.6 Calculate resistance value using Kelvin's Bridge.
- 35. UNDERSTAND MURRAY LOOP TEST AND ITS APPLICATION**
- 35.1 Explain working principle
 - 35.2 Explain its use for under ground cables.
 - 35.3 Calculate fault distance using loop test.

- 36. UNDERSTAND BLAVIOR AND EARTH OVER LAP TEST**
- 36.1 Explain working principle of each
 - 36.2 Explain applications.
- 37. UNDERSTAND WORKING PRINCIPLE OF INSTRUMENT TRANSFORMERS**
- 37.1 Explain working principle of P.T with vector diagram
 - 37.2 Explain application of P.T's.
 - 37.3 Explain construction and working principle of C.T with vector diagram
 - 37.4 Explain application of C.T's.
 - 37.5 Explain angle of phase difference, standard ratio, ratings and permissible errors.
 - 37.6 Enlist possible errors and their remedies.
 - 37.7 Explain personal and instrument safety
- 38. UNDERSTAND EFFECTS ON INSTRUMENT TRANSFORMERS**
- 38.1 Explain effect of burden
 - 38.2 Calculate burden on C.T. and P.T.
 - 38.3 Explain effect of frequency and variable current on C.T. and P.T.
 - 38.4 Draw circuit diagrams of a loaded C.T. and P.T.
- 39. UNDERSTAND POWER FACTOR METERS**
- 39.1 State types with respect of supply (Single and three phase)
 - 39.2 State types with respect to construction (Dynamometer,, moving iron).
 - 39.3 Explain working principle of each type.
 - 39.4 Draw circuit diagram.
- 40. UNDERSTAND TYPES OF TEMPERATURE MEASURING DEVICES**
- 40.1 Explain working of resistance type device
 - 40.2 Explain working of thermocouple
 - 40.3 Explain radiation type pyrometer
 - 40.4 Explain principle of each
 - 40.5 Explain the application of each.
- 41. KNOW ASSEMBLY AND WORKING OF LUX METER**
- 41.1 State the types and working principle.
 - 41.2 Enlist applications.
- 42. KNOW THE WORKING PRINCIPLE OF FET AND TRANSISTOR VOLTMETER**
- 42.1 State the working principle of F.E.T type voltmeter and its use.
 - 42.2 State the working principle of transistor type voltmeter (Block diagram only)
- 43. UNDERSTAND WORKING PRINCIPLE OF CATHODE RAY OSCILLOSCOPE**
- 43.1 Explain working of C.R.O. tube
 - 43.2 Enlist parts of C.R.O.

- 43.3 Explain applications for finding wave shape and frequency.
- 44. UNDERSTAND WORKING PRINCIPLE CONSTRUCTION AND APPLICATION OF SYNCHRONOSCOPE**
- 44.1 State types of synchrono scope
44.2 State working principle of each
44.3 Explain application of each type.
- 45. KNOW WORKING PRINCIPLE OF SPEED/R.P.M MEASURING INSTRUMENTS**
- 45.1 State working principle of speed counter (Mechanical)
45.2 State working principle of dynamometer type speedometer
45.3 State working principle of electronic counter.
45.4 State method of use of each
- 46. UNDERSTAND MAXIMUM DEMAND INDICATOR AND IT USE**
- 46.1 Explain construction and principle of working.
46.2 Draw connection diagram.
46.3 Explain the methods of taking and interpreting its readings.
- 47. KNOW WORKING OF SIGNAL GENERATOR**
- 47.1 State construction and use.
47.2 State types (AF & RF)
- 48. UNDERSTAND USE OF SIGNAL GENERATOR FOR MEASURING C. & L.**
- 48.1 Explain use of signal generator for inductance 'L' measurement
48.2 Explain use of signal generator for capacitance measurement

ET-223 ELECTRICAL INSTRUMENTS & MEASUREMENTS (2nd Year)

LIST OF PRACTICALS

Note: The students should show concern for personal and equipment safety while working in Lab. Also show safe handling of instruments.

1. a. Demonstration of Absolute & Secondary instruments.
 b. Study of constructional features of tangent galvanometer and its use for finding current.
2. Demonstration of various effects used as forces in instrument (magnetic heating, electrostatic etc.)
3. Comparative study of indicating, integrating & recording instruments.
4. Study of methods of Damping forces (Air friction, fluid friction, eddy current) in instruments.
5. a. Making sketches of different types of pointers fitted on shafts with weight.
 b. Study of hair spring their mounting on shaft tension/position adjustment.
6. Dismantling and assembling of moving iron attraction type instrument and making sketch.
7. Dismantling and assembling of permanent magnet instrument and making sketch.
8. Dismantling and assembling of moving iron repulsion type instrument and making sketch.
10. a. Study of Thermocouple, their variety and shapes used in measuring instruments.
 b. Study of thermistor used for control of current.
11. Demonstration of various pyrometers and their use in measuring instruments.
12. Study of dynamometer parts and making their sketch.
13. Demonstration of shaded pole type instruments and sketch the parts and assembly.
14. Study of various types of rectifiers and their use for half wave and full wave rectification.
15. a) Study of shunts and making a shunt for extending range of D.C. Am meter.
 b) Study and make multiplier for extending the range of a galvanometer.
16. a) Study the parts of induction type wattmeter with their sketches.
 b) Using an induction type wattmeter for measuring power of a lamp.
17. a) Study of ohm-meter, its scale and practice of using it.
18. a) Study of Avometer (analog type), its scale reading practice and use as Voltmeter and Ammeter.
 b) Practice the use of A.V.O meter analog & digital for low and high resistance measurements.
19. Study of meager and practice of its use for continuity, short circuit and insulation testing.
20. Using an earth resistance tester for finding earth resistance.
21. Study of single phase energy meter and its connections, meter reading.
22. Study of three phase energy meter and its connections, meter reading.

23. Study the types of frequency meter & to use it on lines.
24. Using wheat stone bridge for resistance measurement.
25. Study of C.T. & P.T. their use with instruments & relays (A power station may also be visited).
26. Study of P.F. meter and finding power factor of all kind of loads (Resistive, Inductive Capacitive, and Mixed).
27. Connecting power factor meter for measuring P.F.of an un balanced load 3-phase.
28. Study and use of LUX METER.
29. Study of Flux meter and measuring field strength.
30. Practice the use of C.R.O for displaying & measuring of Electrical quantities.
31. Study of synchronoscope and practice of using for operation of alternators in parallel.
32. Study of M.D.I meter and its use on line.
33. Measurement of capacitance & inductance.

Note: * Industrial visits for this course are recommended.

** Students must prepare theory and practical note books and get it checked weekly by the concerned teacher. They should produce these to external examiner for sessional work/marking check up at the time of final exam.

RECOMMENDED BOOKS

1. Testing Instruments by Audel's.
2. Electrical Instruments & Measurement by E.W. Golding.
3. Electronic Measuring Instruments by G.D. Link.
4. Elect. Technology by B.L. Theraja.
5. Industrial Electrical Measurement & Instruments by Kenelm Edgeumbe.
6. Fundamentals of Electrical Measurements by C.T. Baldwin.
7. A Text Book of Electrical Engineering by S.L. Uppal.
8. Electronics for Today & Tomorrow. by Tom Duncan.
9. Electrical and Electronics Instruments and Measurements by Syed Muhammad Azeem Urdu Bazar Lahore.
10. An introduction to Electrical Instrumentation by B.A. GREGORY

ET-233 UTILIZATION OF ELECTRICAL ENERGY

Total Contact Hours:

Theory:	64	T	P	C
Practical:	96	2	3	3

AIM Electrical Energy is used in Industry for various job and operations including Illumination, Electroplating, Heating and Ventilation and Locomotives etc. This course will give an understanding of the principles and practices related to efficient and safe industrial use of electrical energy in some of the selected fields.

COURSE CONTENTS

- 1 ILLUMINATION. 18 Hrs.**
- 1.1 Modern theory of light and radiation from hot body.
 - 1.2 Terms; black-body: like hot body, solid angle,
 - 1.3 Law's of illumination: inverse square law, Lambert's cosine law.
 - 1.4 Depreciation factor, utilization factor, light factor.
 - 1.5 Lighting scheme and its design.
 - 1.6 Lamps, their bases and reflectors.
 - 1.7 Flood lighting and its purpose and arrangements.
 - 1.8 Incandescent lamps, gas filled, clear and frosted.
 - 1.9 Discharge lamps, sodium vapour, high pressure mercury vapour.
 - 1.10 Flourescent lamps, stroboscopic effect.
- 2 ELECTRO PLATING. 10 Hrs.**
- 2.1 Fundamental principles of chemistry and metallurgy relating to electroplating.
 - 2.2 Properties of metals, acids, alkalies and neutralization.
 - 2.3 Faraday's law of Electrolysis.
 - 2.4 Electrodes, electrolytes and polarization.
 - 2.5 Principle of chemical analysis, its types and standard solution.
 - 2.6 Acid used in electroplating H_2SO_4 , HNO_3 , HCL , aqua-regia.
 - 2.7 Salts used in electroplating.
 - 2.8 Alkalies used in electroplating.
 - 2.9 Electroplating plants, electroplating tank.
 - 2.10 Rheostatic current control in electroplating.
 - 2.11 Electroplating process.
 - 2.12 Cleaning of objects mechanically and chemically.
 - 2.13 Copper and silver plating.

- 2.14 Current densities for various thicknesses and materials of jobs.
- 2.15 Planning of electroplating shop.

3 REFRIGERATION. 10 Hrs.

- 3.1 Introduction to refrigeration and air conditioning.
- 3.2 Types of refrigeration.
- 3.3 Electrical accessories and circuits of a refrigerator.
- 3.4 Introduction to air conditioning.
- 3.5 Types of domestic airconditioning plants and their capacities: window, split.
- 3.6 Electrical accessories and circuit for air conditioner.

4 ELECTRIC TRACTION. 18 Hrs.

- 4.1 Introduction to Electric Traction, its advantages and disadvantages.
- 4.2 Systems of electric traction
- 4.3 Electrification systems of Electric Traction.
- 4.4 Mechanical consideration of electric traction, locomotive drives.
- 4.5 Mechanics of train movement.
- 4.6 Speed time curves, its effect on schedule speed, acceleration, braking distance.
- 4.7 Application of series motor in electric traction and characteristics.
- 4.8 Starting and speed control of traction motor, series parallel control.
- 4.9 Drum type controllers.
- 4.10 Field weakening and tapped field control.
- 4.11 A.C motors used in traction.
- 4.12 Electric braking, plugging rheostatic, regenerative.
- 4.13 Trolley and bus control equipment, master controllers.
- 4.14 Overhead feeding and distributing equipment, trolley wires, trolley wheels, frogs, pentagraph.
- 4.17 Introduction to booster, negative booster.

5 ELECTRIC HEATING. 8 Hrs.

- 5.1 Introduction to Electric Heating, advantages.
- 5.2 Resistance wire heating furnace.
- 5.3 Infrared radiation heater.
- 5.4 Induction furnace & high frequency eddy current heating, electrostatic heating.
- 5.5 Arc furnaces.
- 5.6 Spot welding.

INSTRUCTIONAL OBJECTIVES

TIME SCHEDULE

S.NO.	MAJOR TOPICS	NO. OF PERIODS	NO. OF QUESTIONS
1.	Illumination	18	2
2.	Electroplating	10	1
3.	Refrigeration	10	1
4.	Electric traction	18	1½
5.	Electric Heating	8	½
	Total:	64	6

1. APPLIES CONCEPTS OF ILLUMINATION TO SIMPLE LIGHTING DESIGNS

- 1.1 Explain modern theory of light.
- 1.2 Define term, hot body, solid angle.
- 1.3 Define luminous flux, luminous intensity.
- 1.3 Define MSCP, MHSCP, lumen hour and candela
- 1.4 State law's of illumination, inverse square law, Lambert's cosine law.
- 1.5 Explain, Depreciation factor, utilization factor, height factor.
- 1.6 Identify qualities of good lighting scheme.
- 1.7 Design a given lighting scheme.
- 1.8 Give types of lamps & their bases.
- 1.9 Explain polar curves for different type of reflectors.
- 1.10 Define flood lighting.
- 1.11 Explain purposes of flood lighting.
- 1.12 Sketch diagram of lamps, incandescent, sodium vapour and mercury vapour.
- 1.13 Describe working of lamps, incandescent, sodium vapour, mercury vapour & fluorescent
- 1.14 State stroboscopic effect.

2. UNDERSTAND ELECTROPLATING PROCESS AND PLANTS

- 2.1 State fundamental principles of chemistry and metallurgy relating to electroplating.
- 2.2 List properties of metals, acids, alkalies used in electroplating.
- 2.3 State Faraday's law of Electrolysis
- 2.4 Define neutralization
- 2.5 List types of electrolytes, electrodes.
- 2.6 Describe chemical equations used in electroplating process.
- 2.7 Define standard solution.
- 2.8 Enumerate acids used in electroplating, H₂SO₄, HNO₃, HCl
- 2.9 Enlist salts used in electroplating.
- 2.10 Name alkalies, caustic potash, caustic soda, mixed alkalies, alkali cyanide.
- 2.11 Sketch parts of electroplating plant.
- 2.12 State rheostatic current control in electroplating.
- 2.13 Explain electroplating process.

- 2.14 Give process of cleaning objects, mechanically, chemically.
 - 2.15 Describe copper & silver plating.
 - 2.16 Give solution addition agents.
 - 2.17 Give current densities for various thicknesses and materials of jobs.
 - 2.18 Plan electroplating shop.
- 3. UNDERSTAND COMPONENTS AND WORKING OF SIMPLE REFRIGERATION AND AIRCONDITIONING SYSTEMS**
- 3.1 Define terms used in refrigeration and airconditioning systems.
 - 3.2 Describe mechanical cycle of refrigeration.
 - 3.3 Enlist electrical accessories used in refrigeration system.
 - 3.4 Draw electrical circuit diagram of a refrigerator.
 - 3.5 Explain types of airconditioning plants.
 - 3.6 Draw electrical circuit diagram of an air-conditioner.
- 4. UNDERSTAND ELECTRIC TRACTION SYSTEMS AND THEIR CONTROL**
- 4.1 Define electric traction.
 - 4.2 List merits & demerits of electric traction.
 - 4.3 Explain systems of electric traction.
 - 4.4 Describe electrification systems of electric traction.
 - 4.5 Enlist mechanical considerations of locomotive drives.
 - 4.6 Describe mechanics of train movement.
 - 4.7 Define, speed/time curve, scheduled speed, acceleration & braking distance.
 - 4.8 Solve problems on speed time curves.
 - 4.9 Enlist the characteristics of D.C. series motor due to which it is preferred for traction purposes.
 - 4.10 Describe starting and speed control of traction motors (series, parallel control).
 - 4.11 Describe bridge transition method of speed control.
 - 4.12 Explain drum type controller.
 - 4.13 Explain method of speed control by tapped field (field weakening).
 - 4.14 Enlist A.C. motors used in traction.
 - 4.15 Define methods of braking: plugging rheostatic, regenerative braking.
 - 4.16 Describe trolley and bus control equipment, master controller.
 - 4.17 Explain over-head feeding and distributing equipment (trolley wire, trolley wheel, frogs, pentograph).
 - 4.18 Define booster (negative booster)
- 5. UNDERSTAND ELECTRIC HEATING FURNACES**
- 5.1 Describe Electric Heating.
 - 5.2 List merits and demerits of Electric Heating.
 - 5.3 Describe electric furnace (Resistance wire heating).
 - 5.4 Define infrared (radiation) heater.
 - 5.5 Describe induction furnace.
 - 5.6 Describe high frequency eddy current heating and electrostatic heating.

- 5.7 Explain working of an arc furnace.
- 5.8 Describe spot welding.

LIST OF PRACTICALS

1. Verification of inverse square law.
2. Verification of Lambert's cosine law.
3. Study of various reflectors and their polar curves.
4. Plotting of Illumination level profile along a given X-section of a room.
5. Sketch the various parts of incandescent and gas filled lamps.
6. Visit and preparing a report of electroplating plant.
7. Project of lighting scheme design.
8. Project continued.
9. Study of various materials used in electroplating and preparation of job for electroplating.
10. Study of equipment used in electroplating shop planning of electroplating shop, according to sequence of process.
11. Electroplating a prepared job.
12. Study of an air conditioner, its components and tracing electric circuit.
13. Study of refrigerator and tracing its electric circuit.
14. Visit to an electric traction workshop, study of electric traction engine & diesel electric engine.
15. Sketching various parts of a series motor.
16. Draw the speed characteristic curves of series motor.
17. Demonstrate series parallel control of series motor drawing curve between speed and line current.
18. Study and used of drum type controller.
19. Designing and making a 1000 W electric heating element.
20. Study of an electric resistance heating furnace.
21. Study of an electric arc furnace.
22. Study of spot welding unit.
23. Visit to hospital physiotherapy ward and operation theater.
24. Visit to a cycle factory (electroplating plant).
25. Visit to an airconditioning factory.
26. Visit to a stadium (flood light).
27. Visit to a bulb factory.
41. Visit to a cold storage.

** Students must prepare theory and practical note books and got it checked weekly by the concerned teacher. They should produce these to the external examiner for sessional work/marking check up at the time of final exam.

RECOMMENDED BOOKS

1. Electrical Power by Soni Gupta.
2. A Course in Electrical Engineering by Soni Gupta.
3. Illumination Engineering, by Boast.
4. Refrigeration & Air Conditioning Principles.

5. Generation, Transmission and Utilization of Electrical Power by A.T. Star.
6. Electrical Power by S.L. Uppal.

ET-242 INSTALLATION PLANNING AND ESTIMATING

Total contact hours:		T	P	C	
Theory:	32		1	3	2
Practical:	96				

AIM The course provides necessary insight and skill in the designing and planning an electrical installation keeping in view the necessary rules and regulations. It also gives practice for preparing estimates of the installation project following standard practice.

COURSE CONTENTS

- 1. INSTALLATION:** **8 Hrs.**
 - 1.1 Earthing system and testing of installation.
 - 1.2 Service lines, methods of installations of service lines for single storey, multi storey buildings.
 - 1.3 Sub stations, types of substations according to service, indoor, outdoor, their advantages and disadvantages.
 - 1.4 Equipment used in substation, their classifications and ratings.
 - 1.5 Signal communication circuits, system used in industrial and commercial buildings, fire alarm, sprinkler, smoke alarm, burglar alarm, intercom, float switches and their applications.

- 2. PLANNING.** **12 Hrs.**
 - 2.1 Planning and design of electrical installation, steps of planning, estimating residential building, determining number of light point and number of out lets.
 - 2.2 Determining number of circuits for residential installation, factors for selecting conductor size, main and sub main cables.
 - 2.3 Earthing system for industrial installation.
 - 2.4 Review of rules and regulation pertaining to earthing.

- 3. ESTIMATING.** **12 Hrs.**
 - 3.1 Importance of estimating, tools, stationery, forms used for estimating.
 - 3.2 Cost estimate: labor cost, material cost, transport cost, factors affecting cost.
 - 3.3 Tables used in planning and estimating.
 - 3.4 Estimation of quantity of material required for industrial-residential wiring.
 - 3.5 Steps and factors to be considered in preparation of cost estimate.

TIME SCHEDULE

S.No.	Major Topics	No. of Periods	No. of Questions in Q.Paper
1.	Installations. Earthing, service lines, sub-stations installations.	8	1
2.	Planning. No. of light and power points in buildings. Wiring drawings and planning.	12	2
3.	Estimating. Material estimation. Cost estimation. Labour cost estimation.	12	2
	Total:	32	5

INSTRUCTIONAL OBJECTIVES

1. UNDERSTAND THE ELECTRICAL INSTALLATIONS.

- 1.1 Name types wiring systems.
- 1.2 Describe types of earthing systems.
- 1.3 List methods of testing electrical installations.
- 1.4 List types of service lines in single storey/multi storey buildings.
- 1.5 Enlist types of substations, (indoor, out door service).
- 1.6 Give merits and demerits of substations, (indoor, out door).
- 1.7 List the equipment used in substations
- 1.8 Classify the equipment used in substations.
- 1.9 List the ratings of equipment used in substations.
- 1.10 Draw circuit diagram for signal communication system in commercial and industrial buildings, used for fire alarm, sprinkler.
- 1.11 Describe the working of fire alarm, burglar alarm circuits by drawing circuit diagrams.
- 1.12 Explain inter-com system, with and without secrecy.
- 1.13 Explain float switches and give its applications.

2. UNDERSTAND THE PLAN OF ELECTRICAL INSTALLATIONS.

- 2.1 Explain planning & Design of electrical installations.
- 2.2 List the steps necessary for planning residential building.

- 2.3 Determine number of light points and out-lets required for a given residential building.
- 2.4 Determine number of circuits required for a given residential building, with respect to main circuit and sub main circuit.
- 2.5 Select size of cables and circuit breakers for given circuits.
- 2.6 State rules and regulation relating to earthing.
- 2.7 Explain earthing for industrial installations.
- 2.8 For given industrial load, plan an electrical installation showing cable sizes, ratings of CB, earthing system.

3. PREPARE ESTIMATES OF ELECTRICAL INSTALLATIONS.

- 3.1 Explain importance of estimating.
- 3.2 List tools required for estimating.
- 3.3 Depict stationary forms required for estimating.
- 3.4 List factors affecting cost. (material cost, labour cost, transport cost).
- 3.5 Explain importance of tables,useful for planning and estimating.
- 3.6 Estimate quantity of material required for a given residential plan for batten wiring.
- 3.7 Estimate quantity of material required for a given residential plan for concealed wiring.
- 3.8 Give steps necessary for preparing a cost estimate.
- 3.9 Prepare a cost estimate for a given residential electrical installation according to the given rate list.
- 3.10 Use standard format for preparing/presenting report of the estimates of the given installation.

ET-242 INSTALLATION, ESTIMATING AND PLANNING

LIST OF PRACTICALS

1. Drawing of a building plan for 3-bed room house.
2. Drawing of a plan of 4 bed room house.
3. Drawing of service connection diagram.
4. Drawing of alarm system.
5. Drawing of line diagrams of various types of substations, using standard symbols (two sessions).
6. Planning of electrical installation 3 bed room house for batten wiring (use plan drawn for sr. No.1 above.)
7. Planning of electrical installation for concealed conduit wiring (use plan of Sr.No.2 above.
8. Planning of Multiple earthing system for an industrial installation.
9. Load survey for one workshop in institute.
10. Work shop drawing (as surveyed at Sr.No.9 above) showing the details of electrical installations.
11. Project for planning of service and distribution of multi-storey building.
12. Planning of equipment arrangement of a panel board for the multi-storey building at Sr.No.12.
13. Drawing of connection for a panel board for each floor of building at Sr.No.12.
14. Preparation of estimation list for equipment & materials, for building as at Sr.No.12.
15. Estimation of material and quantity of material required for residential building.(planned at Sr.No.1 & 7 above) for light, and power circuits.
16. Prepare take-off sheet for the installation at Sr.No.12; pricing; time scheduling (the project from Sr.No.12 to 16 may be prepared as per commercial standards).
17. Preparation of cost estimate for concealed wiring for a given plan at Sr. 2 & 8 above)
18. Visit to see use of cathodic protection station & its earthing system (gas pumping station) at any one local station (sui gas plant).
19. Study of cathodic protection system (Bridge, port, pipeline cathodic protection).

** Students must prepare theory and practical note books and got it checked weekly by the concerned teacher. They should produce these to external examiner for sessional work/marking check up at the time of final exam.

REFERENCE BOOKS.

1. Electrical Estimating by Ashlay.
2. Electrical Installation, Planning and Estimating by Gupta.
3. Wiring Manual by Pakistan Cables Ltd.
4. Cables and Tables by Pakistan Cables Ltd.
5. Interior Electrical Wiring & Estimating (Residential) by Uhl-Dunlah.
6. Interior Electric Wiring & Estimating (Industrial) by Graham.

ET-251 APPLICATION OF COMPUTER IN ELECTRICAL TECHNOLOGY

Total Contact Hours	T	P	C
Practical 96	0	3	1

AIM The course aims at providing practice in the development and use of simple computer programmes in low and high level languages such as BASIC and MACHINE LANGUAGE. It an opportunity for the use of dedicated software packages for solving electrical networks.

LIST OF PRACTICALS

- 1 To use Basic as a tool for problem solving in Electrical Technology such as: -
 - 1.1 Application for multiplication, division, and calculation of powers, roots and exponentials etc.
 - 1.2 Application for trigonometric and inverse trigonometric functions.
 - 1.3 Calculation of impedances in polar form.
 - 1.4 Calculation of impedances in rectangular form.
 - 1.5 Combination of impedances in series involving conversion from polar to rectangular and vice versa.
 - 1.6 Repeated use of rectangular to polar conversion as a part of subroutine of a file.
 - 1.7 Solution of R.L.C. series and parallel circuits.
 - 1.8 Calculation of A.C. powers, active and reactive components.
 - 1.9 Calculation for improvement of power factor.
- 2 Use of following computer software for developing/analyzing electrical networks:-
 - 2.1 ORCAD
 - 2.2 EASYPC
 - 2.3 SMARTWORK
 - 2.4 PSPICE
- 3 Use of machine language for developing simple software related to electrical technology practice on 8085 microprocessor trainer.
- 4 Developing PLC software.

TEXT/REFERENCE BOOKS

- 1 BASIC Applied to Circuit Analysis by Nashelsky & Boylestad.
- 2 Programming with Assembly Language, Schauam Series.
- 3 Manuals for
 - 3.1 ORCAD
 - 3.2 EASYPC
 - 3.3 SMARTWORK
 - 3.4 PSPICE
- 4 Basic Principles and Practice of Microprocessors by Heffer, King, Keith.
- 5 BASIC, a Modular Approach by Thompson.

ET-263 BASIC ELECTRONICS

Total Contact Hours:		T	P	C	
Theory:	64		2	3	3
Practical:	96				

AIMS This course is designed to enable the students to understand the basic principles of semiconductor electronics devices. It also provides basic insight in the working and applications of power electronic devices in control circuits.

The course also includes simple problem solving.

1 ELECTRON EMISSION AND BASIC SEMI CONDUCTOR THEORY. 4 Hrs.

- 1.1 Electron emission and fundamentals of solid state electronics.
 - 1.1.1 Introduction to electronics.
 - 1.1.2 Introduction to various types of electron emission and their characteristics.
 - 1.1.3 History of electron tubes their construction and uses.
 - 1.1.4 Semiconductors, intrinsic, extrinsic, doping.
 - 1.1.5 P type and N type materials, carriers.

2 SEMICONDUCTOR DIODES. 8 Hrs.

- 2.1 PN Junction Diode.
 - 2.1.1 Diode construction, operation and applications.
 - 2.1.2 Half-wave & full wave rectifiers.
- 2.2 D.C Power supply.
 - 2.2.1 Ripple factor and filtering.
 - 2.2.2 Circuit and block diagram of full-wave bridge rectifier with filter.
 - 2.2.3 Diode as a switch.

3 SPECIAL DIODES. 8 Hrs.

- 3.1 Zener Diode.
 - 3.1.1 Construction, operation and rating of zener diode.
 - 3.1.2 Zener diode voltage regulators, series & shunt.
- 3.2 Photodiode and photo conductive cells.
 - 3.2.1 Construction and working of photodiode
 - 3.2.2 Photodiode as light sensor.
 - 3.2.3 Use of photo conductive cell.

4 BIPOLAR JUNCTION TRANSISTOR(BJT) & FIELD EFFECT TRANSISTOR (FET) 12 Hrs.

- 4.1 BJT Construction And Operation.
 - 4.1.1 BJT, construction and types.

- 4.1.2 BJT, operation and characteristics transistor biasing.
- 4.2 BJT Application
- 4.2.1 BJT as amplifier.
- a) Types of BJT amplifier and their characteristics.
 - b) CE as current and voltage amplifier.
 - c) Applications of BJT amplifiers.
- 4.2.2 BJT as a switch
- a) Characteristics of a BJT switch.
 - b) Use of BJT as switch.
- 5 SPECIAL TRANSISTORS. 8 Hrs.**
- 5.1 Field Effect Transistor (FET)
- 5.1.1 FET transistor types.
 - 5.1.2 Application of various types of FETs,
 - 5.1.3 FET amplifiers.
 - 5.1.3.1 Characteristics of FET amplifier.
 - 5.1.3.2 FET as a voltage amplifier.
- 5.2 MOSFET & CMOS.
- 5.2.1 MOSFET as a switch and its characteristics.
 - 5.2.2 CMOS as switch.
- 6 SILICON CONTROLLED RECTIFIERS. 6 Hrs.**
- 6.1 Silicon Controlled Rectifiers.
- 6.1.1 Silicon controlled Rectifier (SCR)
 - a. SCR, construction, operation and triggering pulses.
 - b. SCR application, power control of AC and DC.
 - c. Phase control of SCR's.
- 7 THYRISTORS. 10 Hrs.**
- 7.1 Other Thyristors.
- 7.1.1 Construction and operation of TRIAC & DIAC.
 - 7.1.2. DIAC/TRIAC power control circuits.
 - 7.1.3 UJT, operation, working and applications.
 - 7.1.4 Photo transistor, operation, rating and application.
 - 7.1.5 Light activated SCR (LASCR), rating and application.
 - 7.1.6 Opto-coupler, ratings & application.
- 8 INTEGRATED CIRCUITS. 8 Hrs.**
- 8.1 Integrated Circuits (IC's) and Op-amps.
- 8.1.1 Types of IC's

- 8.1.2 Monolithic IC's, fabrication of components
- 8.1.3 Types of integration.
- 8.1.4 Operational amplifiers (op-amps), characteristics and applications.
- 8.1.5 Basic op-amp circuits.

TIME SCHEDULE

S.No.	Major Topics	No. of Periods	No. of Questions
1.	Electron Emission	4	½
2.	Semiconductor diodes and power supply	8	1
3.	Special diodes	8	½
4.	Bi-polar Junction Transistor (BJT)	12	1
5.	Field Effect Transistor (FET)	8	½
6.	Thyristors and special devices	6	1
7.	i. Diac & Triac	4	½
	ii. Special solid state devices	6	½
8.	Integrated circuits & op-amps.	8	½
Total:		64	6

INSTRUCTIONAL OBJECTIVES.

1 UNDERSTAND TYPES OF ELECTRON EMISSIONS AND BASIC SEMI-CONDUCTOR THEORY

- 1.1 Explain types of electron emission
- 1.2 Explain the terms-semi-conductor, intrinsic and extrinsic
- 1.3 Explain P and n type doping
- 1.4 State majority and minority charge carriers in P & N type semi-conductors
- 1.5 Name types of electron tubes and their uses.

2 UNDERSTAND THE CONSTRUCTION AND APPLICATIONS OF PN DIODES AS RECTIFIER

- 2.1 Explain formation of PN-junction.
- 2.2 Define potential barrier of PN junction.
- 2.3 Compare forward bias and reverse bias.
- 2.4 Discuss static volt ampere characteristics of diode (forward and reverse bias).
- 2.5 State applications of diode.
- 2.6 Draw and discuss half wave rectification circuit (with wave forms).
- 2.7 Draw and discuss full wave rectification circuit (with waveforms) by using:
 - a. Centre tapped transformer.
 - b. Bridge rectifier.
- 2.8 Explain the need of filters in DC power supply
- 2.9 Draw circuit diagram of filtering network (T & Pi).
- 2.10 Define term ripple factor.
- 2.11 Describe use of diode as a switch.

3 UNDERSTAND WORKING AND USES OF ZENER AND PHOTO DIODES

- 3.1 Explain the working and construction of zener diode
- 3.2 Explain the behaviour of Zener diode in Breakdown region
- 3.3 give ratings of zener diode.
- 3.4 Explain the Zener diode in power supplies and voltage regulation circuits.
- 3.5 Describe construction & working of photodiode.
- 3.6 Draw photodiode control circuit.

4 UNDERSTAND CONSTRUCTION, WORKING AND USES OF ABOUT BIPOLAR JUNCTION TRANSISTOR

- 4.1 Explain construction of transistors.
- 4.2 Enlist types (PNP and NPN).
- 4.3 Draw PNP and NPN transistor circuits with proper biasing.
- 4.4 Describe principle of working of transistor as amplifier.
- 4.5 Describe current gain, voltage gain & power gain of a CE amplifier.
- 4.6 List uses of transistors.
 - a. As a switch.
 - b. As voltage & current amplifier.

5 UNDERSTAND THE WORKING AND USES OF FIELD EFFECT TRANSISTORS

- 5.1 Explain the construction & working of JFET.
- 5.2 List types with their uses.
- 5.3 Describe use of JFET as amplifier.
- 5.4 Draw characteristics curves of JFET.
- 5.5 Explain construction of MOSFET
- 5.6 State types of MOSFET(depletion mode and enhancement mode)
- 5.7 Draw symbols of IGFET and MOSFETS
- 5.8 State special handling procedures of MOSFETS

6 UNDERSTAND THE TYPES, WORKING AND USES OF THYRISTORS SPECIALLY SILICON CONTROLLED RECTIFIER, DIAC, TRIAC

- 6.1 Define a thyristor.
- 6.2 Explain construction and working operation of SCR's.
- 6.3 Draw equivalent model of SCR by two transistors analogy.
- 6.4 Draw characteristics waveforms of SCR's.
- 6.5 Explain phase control of SCR.
- 6.6 Explain use SCR's as AC & DC Power control circuits with the help of circuit diagrams.
- 6.7 Explain the operation of Diac.
- 6.8 Draw characteristics & waveforms of Diac.
- 6.9 Explain the construction and working of TRIAC
- 6.10 Enlist applications of Diac & Triac.

7 UNDERSTAND WORKING AND USES OF SPECIAL SOLID STATE DEVICES

SUCH AS UNI-JUNCTION TRANSISTOR (UJT), PHOTO TRANSISTOR, LIGHT ACTIVATED SILICON CONTROLLED RECTIFIER (LASCR), OPTO COUPLER

- 7.1 Explain the construction and working of UJT
- 7.2 Define Intrinsic stand off Ratio of UJT
- 7.3 State the equation for Peak Firing Voltage
- 7.4 Draw characteristic curve of UJT
- 7.5 Enlist common applications of UJT
- 7.6 Explain Saw-tooth oscillator using UJT , with the help of circuit diagram
- 7.7 Explain the working of photo transistor
- 7.8 State common uses of photo transistor with circuits
- 7.9 Explain the working of LASCR with the help of circuit
- 7.10 Explain the working of opto-coupler
- 7.11 State the need of opto-coupling in electronic circuits

8 UNDERSTAND BASIC WORKING AND APPLICATIONS OF IC'S AND OP-AMPS

- 8.1 Explain the term IC.
- 8.2 Define SSI, LSI, VLSI
- 8.3 Sketch a monolithic IC cross section.
- 8.4 Explain the term op-amp.
- 8.5 State the main characteristics of op-amp
- 8.6 Draw a symbol of op-amp and label it
- 8.7 Explain the working of a common op-amp with the help of block diagram

ET-263 BASIC ELECTRONICS

LIST OF PRACTICALS

1. To study vacuum tubes.
2. To construct a half wave rectifier circuit and to check its output on oscilloscope.
3. To construct a full wave rectifier circuit and measure the input & outputs wave forms.
4. Demonstrate the effects of filter capacitance on DC output voltage and ripple.
5. Measure and plot the forward and reverse characteristics of a typical Zener-diode using an Electronic VOM.
6. Measure and plot the line voltage regulation properties of a typical shunt-type Zener diode voltage regulator.
7. Assemble an alarm circuit using a photo conductive cell (Project).
8. Assemble a Regulated Power Supply Circuit (Project)
9. Identify base - emitter and collector terminals and connections of NPN and PNP transistors.
10. Demonstrate and measure the effects on base current of forward and Reverse bias in the emitter - base circuit.
11. Demonstrate and measure the effects on collector current of forward and reverse bias in the emitter - base circuit and change in collector voltage.
12. Assemble a simple transistor radio circuit (Project)
13. Determine the type of transistor, NPN or PNP, using an ohmmeter to measure the forward and reverse resistance of the emitter - base Junction.
14. Assemble a Bird Bell (Project)
15. Assemble water level alarm using transistors (Project)
16. Demonstrate and measure the effect of drain voltage on drain current with Zero gate bias, and determine the value of drain source (Pinch - off) voltage required to produce constant drain current.
17. Measure the DC operating voltages of a typical JFET voltage amplifier.
19. Demonstrate the operation and determine the voltage gain of a typical JFET voltage amplifier.
19. Demonstrate and measure the Zero bias characteristics of a metal oxide semiconductor field effect transistor.
20. Demonstrate and measure the depletion mode characteristics of a metal oxide semiconductor field effect transistor.
21. Measure the DC operating voltage of a MOSFET voltage amplifier.
22. Measure the DC operating voltages of a Dual gate MOSFET RF amplifier.
23. Test a silicon controlled rectifier (SCR) using an Ohmmeter.
24. Demonstrate the effect of Negative gate current in an SCR.
25. Verify that an SCR operates as a semiconductor switch by using it to control DC voltage applied to a load.
26. Familiarize with the operations of a half wave variable resistor phase - control circuit of SCR.
27. Demonstrate bidirectional conduction of a gated TRIAC and DIAC.
28. Demonstrate the four triggering modes of a TRIAC.
29. Assemble a switching circuit using TRIAC-DIAC (Project)

30. Measure the interbase resistance and determine the emitter base PN Junction diode characteristics of a uni-junction transistor.
31. Measure the peak emitter firing voltage of a uni-junction transistor.
32. Demonstrate the operation and determine the frequency of a UJT relaxation oscillator.
33. Determine the effect of a change in timing circuit time constant and measure the pulse width of a triggered IC timing circuit monostable pulse generator.
34. Study various IC's and their pin configuration and packages.
35. Connect op-amps in functional circuits and observe their working and outputs.

* Students should prepare the projects mentioned above and retain them for final evaluation.

** Students should also prepare practical note books and get it checked weekly by the concerned teacher. They should also produce it to external examiner for sessional work/marking check up at the time of final exam.

Note: The Projects shown are only a reference to their level of complexity. The teachers may select other projects involving solid state devices and/or IC's.

BOOKS:

1. Basic Electronics by B.Grob.
2. Electronic Devices & Circuits by Bogart.
3. Experiments in Electronic Devices by Berlin (2nd Edition).
4. Electronics for Today & Tomorrow by Tom Duncan.
5. Fundamentals of Pulse & Digital Circuit by Tocci.
6. Electronics (Vol.1) by Manzar Saeed.

ET-271 WORKSHOP PRACTICE-II (Basic Machine Shop)

Total contact hours		T	P	C
Practical 96		0	3	1

AIM The course aims at providing necessary skill in the use of tools/machines for basic machine shop operations. Also, this will provide an opportunity for the familiarization with the basic production processes in the factory.

COURSE CONTENTS

1. SHOP ORIENTATION.

- 1.1 Shop policies - rules and regulation.
- 1.2 Workshop safety practices.

2. INTRODUCTION TO MACHINES AND TOOLS.

- 2.1 Grinder.
- 2.2 Lathe and allied equipments.
- 2.3 Micrometer, outside and inside calipers.
- 2.4 Knurling tools.
- 2.5 Thread gauge.

INSTRUCTIONAL OBJECTIVES

- 1. KNOW THE ESSENTIAL PARTS AND FUNCTIONS OF GRINDERS AND LATHE.**

- 2. UNDERSTAND THE OPERATIONS OF LATHE AND GRINDERS.**
 - 1.1. Identify parts of lathe and grinder.
 - 1.2. State the functions of lathe.
 - 1.3. Know different types of threads and their measuring tools.
 - 1.4. Practice turning by observing proper procedure (Simple turning, taper turning, Knurling).
 - 1.5. Measure thread with thread gauge.
 - 1.6. Observe safety precautions in machine shop.
 - 1.7. Appreciate quality of workmanship in the job.
 - 1.7. Realise the use of connect type of tool and operation for a given job.

ET-271 WORKSHOP PRACTICE-II (Basic Machine Shop)

LIST OF PRACTICALS

96 Hrs.

- 1-2. Practice for centering the job by surface gauge method.
3. Tool bit grinding.
- 4-5. Simple turning and facing practice.
6. Practice of counter-sinking.
7. Practice drilling on lathe.
8. Practice of step turning.
9. Knurling practice.
- 10-11. Practice of taper turning by compound rest method.
- 12-13. Practice of taper turning by offset method.
- 14-15. Metric thread cutting practice.
- 16-17. Practice of V-threads in inch system.
- 18-19. Drilling practice.
20. Drill grinding practice on tool grinder.