BACHELOR
IN
ELECTRICAL ENGINEERING

Year : I **Part : I**

Teaching Schedule								Examination Scheme							
								Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	Credits	L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final			
									Duration hours	Marks		Duration hours	Marks		
1	SH 101	Engineering Mathematics I	3	3	2	-	5	40	3	60	-	-	-	100	
2	SH 102	Engineering Physics	4	4	1	2	7	40	3	60	25	-	-	125	
3	CT 101	Computer Programming	3	3	1	3	7	40	3	60	50	-	-	150	
4	ME 101	Engineering Drawing	2	2	-	4	6	20	3	30	50	-	-	100	
5	CE 104	Applied Mechanics	3	3	2	-	5	40	3	60	-	-	-	100	
6	EE 101	Electric Circuit I	3	3	1	3	7	40	3	60	50	-	-	150	
		Total	**18**	**18**	**7**	**12**	**37**	**220**	**-**	**330**	**175**	**-**	**-**	**725**	

Year : I **Part : II**

Teaching Schedule								Examination Scheme							
								Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	Credits	L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final			
									Duration hours	Marks		Duration hours	Marks		
1	SH 151	Engineering Mathematics II	3	3	2	-	5	40	3	60	-	-	-	100	
2	SH 153	Engineering Chemistry	3	3	1	3	7	40	3	60	25	-	-	125	
3	EX 154	Electronics Circuits	3	3	1	3	7	40	3	60	50	-	-	150	
4	CT 153	Advanced Computer Programming	3	3	1	3	7	40	3	60	50	-	-	150	
5	EE 151	Electric Circuit II	3	3	1	1.5	5.5	40	3	60	25	-	-	125	
6	EE 152	Electrical Installation Workshop	1	-	-	3	3	-	-	-	30	-	20	50	
		Total	**16**	**15**	**6**	**13.5**	**34.5**	**200**	**-**	**300**	**180**	**-**	**20.00**	**700**	

ENGINEERING MATHEMATICS I

SH 101

Lecture : 3 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objectives:
To equip the students with the essential mathematical skills and techniques that are relevant to the engineering fields and enable them to solve engineering problems using mathematical methods.

1 Derivatives and its Applications (10 hours)

1.1 Review of derivative and differentiability, mean value theorems with interpretations
1.2 Indeterminate forms, types and their real life examples, L-Hospital's Rule
1.3 Power series of single valued functions
  1.3.1 Taylor's series
  1.3.2 Maclaurin's series
1.4 Asymptotes to Cartesian and Polar curves
1.5 Pedal equation to Cartesian and Polar curves
1.6 Curvature and radius of curvature for Cartesian curves

2 Antiderivatives and its Applications (11 hours)

2.1 Review of definite and indefinite integrals
2.2 Differentiation under integral sign
2.3 Improper integrals
2.4 Application of Beta and Gamma functions
2.5 Area, arc length, volume and surface of revolution in plane for Cartesian curves
2.6 Centroid and moment of inertia under area of curve

3 Ordinary Differential Equations and its Applications (10 hours)

3.1 Review of: Order, degree, solution of first order first degree differential equations by variable separation method and solution of homogeneous equations.
3.2 Linear differential equation and equations reducible to linear differential equation of first order Bernoulli’s equation, modeling electric circuit
3.3 First order and higher degree differential equations; Clairaut’s form

3.4 Linear second order differential equations with constant coefficient and variable coefficients reducible to constant coefficients, Cauchy's equations and modeling mass spring system

3.5 Application in physical sciences and engineering

4 Plane Analytic Geometry (4 hours)

4.1 Transformation of coordinates: Translation and Rotation

4.2 Equation of conic in Cartesian and polar form, identification of conics

5 Three dimensional geometry (10 hours)

5.1 The Straight line: symmetrical and general form

5.2 Coplanar lines

5.3 Shortest Distance

5.4 Sphere: General equation, plane section by planes, tangent planes

5.5 Introduction to right circular cone and right circular cylinder

Tutorials

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Derivatives and its Applications
2. Antiderivatives and its Applications
3. Ordinary Differential Equations and its Applications
4. Plane Analytic Geometry
5. Three dimensional geometry

Reference

1. Jeffery A., (2001), Advanced Engineering Mathematics (1st ed.), Academic Press.
2. O'Neill, P.V., (2003), Advanced Engineering Mathematics (5th ed.), Thomson Learning.
3. Kreyszig , A. (1993), Advanced engineering Mathematics (7th ed.), John Wiley & Sons.
4. Sastry S.S. (2008), Engineering Mathematics Volume I and II (4th ed.). PHI India.
5. Wylie C. and Barrett L.(1995), Advanced Engineering Mathematics (6th ed.), McGraw-Hill College.
6. Thomas, T. and Finny, R. (1984), Calculus and Analytic Geometry (6th ed.), Addison-Wesley.

ENGINEERING PHYSICS

SH 102

Lecture : 4 **Year : I**
Tutorial : 1 **Part : I/II**
Practical : 2

Course Objectives:
To provide students a concept and sound knowledge of physics with the emphasis in present day applications to apply them in relevant fields. The background of physics corresponding to Proficiency Certificate Level is assumed.

1 Oscillation (6 hours)

- 1.1 Physical pendulum
  - 1.1.1 Bar pendulum
  - 1.1.2 Interchangeability of point of suspension and point of oscillation
  - 1.1.3 Minimum time period in case of physical pendulum
  - 1.1.4 Torsion pendulum
- 1.2 Damped and Forced Oscillation
  - 1.2.1 Damped harmonic oscillator
  - 1.2.2 Difference between free and damped oscillator
  - 1.2.3 Energy in damped oscillation
  - 1.2.4 Relaxation time
  - 1.2.5 Forced oscillation and resonance
  - 1.2.6 Sharpness of resonance
  - 1.2.7 Quality factor

2 Acoustics (3 hours)

- 2.1 Introduction
  - 2.1.1 Threshold of hearing and loudness
  - 2.1.2 Reverberation and reverberation time
  - 2.1.3 Absorption coefficient
  - 2.1.4 Sabine's Law
  - 2.1.5 Conditions for good acoustics
- 2.2 Ultrasound
  - 2.2.1 Production (piezoelectric) of ultrasound and its applications
  - 2.2.2 Test of structure and materials
  - 2.2.3 Medical uses

3 Heat and Thermodynamics (8 hours)

- 3.1 Quantity of Heat
  - 3.1.1 Calorific value of Foods and Fuels
  - 3.1.2 Bomb Calorimeter
  - 3.1.3 Specific heat of solid: Dulong - Petit law, Einstein's law
- 3.2 Nature of Heat
  - 3.2.1 Degree of freedom
  - 3.2.2 Maxwell's law of equipartition of energy
  - 3.2.3 atomicity of gases
  - 3.2.4 Vander-Waal's equation of real gases
  - 3.2.5 Critical constants
- 3.3 Thermodynamics
  - 3.3.1 Laws of Thermodynamics
  - 3.3.2 Clapeyron latent heat equation
  - 3.3.3 Entropy and Third law of thermodynamics
  - 3.3.4 Negative energy
  - 3.3.5 Maxwell's thermodynamic relations
  - 3.3.6 Gibb's free energy and phase transitions
- 3.4 Heat and Mass Transfer
  - 3.4.1 Fourier's law of thermal conductivity
  - 3.4.2 Use of thermal conductivity in building sciences
  - 3.4.3 Thermal resistance
  - 3.4.4 Types of convection
  - 3.4.5 Law of diffusion
  - 3.4.6 Relation between Stefan's law and Newton's law of Cooling
  - 3.4.7 Pyrheliometer and Pyrometer

4 Optics (17 hours)

- 4.1 Geometrical optics
  - 4.1.1 Lens separation
  - 4.1.2 Chromatism in lens combination
- 4.2 Interference
  - 4.2.1 Interference in thin films (reflected and transmitted light)
  - 4.2.2 fringes produced by a wedge-shaped thin film
  - 4.2.3 Newton's rings (both reflected and transmitted case)
  - 4.2.4 Determination of wavelength of light and refractive index of liquid by using Newton's rings.
- 4.3 Diffraction
  - 4.3.1 Introduction: Fresnel and Fraunhoffer's diffraction
  - 4.3.2 Fraunhoffer's diffraction at single slit
  - 4.3.3 Intensity distribution in the diffraction pattern due to a single slit
  - 4.3.4 Multiple slits, diffraction grating
  - 4.3.5 X-ray diffraction, X-rays in material testing

4.4 Polarization
- 4.4.1 Introduction: double refraction, Nichol prism (construction and uses)
- 4.4.2 Retardation plate (quarter and half wave plates), plane, elliptical and circular polarized light (theoretical and mathematical explanation)
- 4.4.3 Optical activity, specific rotation

4.5 Laser
- 4.5.1 Introduction: Laser and ordinary light, properties of laser
- 4.5.2 Induced absorption, spontaneous and Stimulated emission, active medium, population inversion, metastable state
- 4.5.3 Pumping (types: optical, electrical, chemical and heating)
- 4.5.4 He-Ne laser, semiconductor Laser
- 4.5.5 Uses of laser

4.6 Fiber Optics
- 4.6.1 Introduction: Propagation of light wave
- 4.6.2 Types of optical fiber: step index and graded index
- 4.6.3 Fiber transmission – single and multimode, self focusing, acceptance angle and numerical aperture
- 4.6.4 Applications

5 Electrostatics (8 hours)

5.1 Electric Field
- 5.1.1 Electric field due to a electric dipole (along axial line and equatorial line)
- 5.1.2 Electric dipole in an external electric field
- 5.1.3 Electric field due to linear electric quadrupole (along axial line)
- 5.1.4 Electric field: a ring of charge, circular ring and disc of charge

5.2 Electric Potential
- 5.2.1 Potential due to electric dipole
- 5.2.2 Potential due to linear quadrupole
- 5.2.3 potential due to continuous charge distribution, potential due to ring of charge and disc of charge

5.3 Capacitors
- 5.3.1 Cylindrical Capacitor
- 5.3.2 Charging and discharging of capacitor
- 5.3.3 Capacitor with dielectrics: dielectrics and Gauss law
- 5.3.4 High intensity electrostatic fields: uses and hazards (xerography, inkjet, precipitation)

6 Electromagnetism (6 hours)

6.1 Electromagnetic induction
- 6.1.1 Faraday's laws
- 6.1.2 Induction and energy transformation
- 6.1.3 Induced electric field
- 6.1.4 Self-induction and mutual induction
- 6.1.5 LR circuit
- 6.1.6 Energy stored in a magnetic field and energy density
- 6.1.7 Induced magnetic field: modified Ampere's law and displacement current

6.2 Eddy Current
- 6.2.1 Introduction
- 6.2.2 Applications: Induction cooker, Electric Guitar, Metal Detector and Eddy Current Breaking
- 6.2.3 Cyclotron and Synchrotron

7 Electromagnetic waves (6 hours)

7.1 Maxwell's Equations
- 7.1.1 Differential and integral forms
- 7.1.2 Conversion of Maxwell's equations from integral form to differential form and differential form to integral form
- 7.1.3 Maxwell's equations in different media

7.2 Applications
- 7.2.1 Wave equations: non conducting and conducting medium and free space
- 7.2.2 Plane solution of wave equations, amplitude of electromagnetic waves, speed of electromagnetic waves, ratio of electric and magnetic fields
- 7.2.3 Continuity equation
- 7.2.4 Energy transfer and Poynting vector, Radiation pressure

8 Photon and matter waves (6 hours)

8.1 Quantum Physics
- 8.1.1 Inadequacy of classical mechanics and rise of quantum mechanics, Quantization of energy
- 8.1.2 Group velocity and phase velocity, electrons and matter waves
- 8.1.3 de-Broglie wavelength, its applications
- 8.1.4 Heisenberg uncertainty principle and its applications
- 8.1.5 Wave functions and its significance

8.2 Schrodinger wave equation
- 8.2.1 Time dependent and independent equation
- 8.2.2 Probability distribution
- 8.2.3 One dimensional infinite potential well, particle in a box
- 8.2.4 Barrier tunneling (reflection and transmission coefficient)

Laboratory

1. To determine the acceleration due to gravity and radius of gyration of the given metal bar using bar pendulum.
2. To determine the modulus of elasticity of the given material and moment of inertia of the circular disc about the wire as an axis passing through its center and perpendicular to its plane by using torsional Pendulum
3. To determine the coefficient of thermal conductivity of a bad conductor by Lee's method
4. To determine the mechanical equivalent of heat by given method
5. To determine the wavelength of the sodium light using Newton's rings
6. To determine the wavelength of sodium light using wedge-shaped method
7. To determine the wavelength of LASER light using diffraction grating and hence determine the particle size of lycopodium power
8. To determine the focal length of two lenses when they are separated by some finite distance
9. To determine the chromatic aberration of a convex lens between red and blue colors
10. To determine the capacitance of the given capacitor by the method of charging and discharging through resistor
11. To plot the graph between frequency and current in LCR series circuit and hence determine the quality factor of the circuit
12. To study the growth and decay of current in LR circuit then determine the self-inductance of the given inductor
13. To determine the dielectric constant of the given material

Reference

1. Halliday, Resnick, Walker, "Fundamentals of Physics', John Wiley & Sons. Lnc.
2. Pokharel, Bhattarai, and Paudel "Fundamentals of Engineering Physics", Benchmark Publication.
3. Brij Lal and Subrahmanyam, ''A text book of Optics", S. Chand Publisher.
4. Basudeva, A.S. 'Modern Engineering Physics", S. Chand Publisher.
5. Caur R. K. and Gupta, S. L., "Engineering Physics', Dhanpat Publisher.
6. Brij Lal and Subrahmanyam, 'Waves and Oscillation", S. Chand publisher.
7. Brij Lal and Subrahmanyam, 'Heat and Thermodynamics", S. Chand publisher
8. Avadhanulu, Kshirsaga and Arun Murthy, A text Book of Engineering Physics, S. Chand publisher.

COMPUTER PROGRAMMING

CT 101

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3

Course Objectives:

The primary goal of this course is to provide students with a solid foundation in the principles of programming and to impart practical skills in the C programming language. This course ensures that students comprehend the fundamental concepts of variables, data types, control structures, and functions within the context of C. Advanced topics such as pointers, structures, file handling and the Standard C Library are explored to broaden students' programming capabilities. Also, through project-based assessments and evaluations, students apply their knowledge to real-world scenarios, fostering creativity and project development skills.

1 Introduction to Computer Programming (3 hours)

1.1 Definition of a computer program and programming language
1.2 Types and Generations of Programming Languages
1.3 Problem-Solving using a Computer
  1.3.1 Problem Analysis
  1.3.2 Algorithm and Flowchart
  1.3.3 Programming
  1.3.4 Compilation, Linking and Execution
  1.3.5 Debugging and Testing
  1.3.6 Documentation

2 Overview of C Programming (3 hours)

2.1 Introduction to C programming
2.2 History and Importance of C
2.3 C Headers and Library Functions
2.4 Basic Structure of a C Program
2.5 Preprocessor Directives
2.6 Tokens in C (Character set, Keywords and Identifiers)
2.7 Type Casting (Implicit and Explicit)
2.8 Data Types, Variables and Constants
2.9 Compiler and IDE for C Programming

3 Operators and Expressions (4 hours)

- 3.1 Introduction to Operators and Expressions
- 3.2 Arithmetic, Relational and Logical Operators
- 3.3 Assignment, Increment and Decrement Operators
- 3.4 Conditional, Bitwise and Special Operators
- 3.5 Comma Operator, size of Operator
- 3.6 Evaluation and Type Conversion in Expressions
- 3.7 Operator Precedence and Associativity

4 Input and Output (3 hours)

- 4.1 Introduction to data I/O in C
- 4.2 Unformatted I/O
  - 4.2.1 Character I/O
  - 4.2.2 String I/O
- 4.3 Formatted I/O
  - 4.3.1 Control String (flags, field width, precision, and specifier)
  - 4.3.2 Formatted I/O (scanf(), printf())

5 Control Structures (8 hours)

- 5.1 Introduction to Simple and Compound Statement
- 5.2 Sequential Statement
- 5.3 Branching Statement
  - 5.3.1 Simple if Statement
  - 5.3.2 if-else Statement
  - 5.3.3 Nested if-else Statement
  - 5.3.4 else-if Ladder
  - 5.3.5 switch Statement
  - 5.3.6 go to statement
- 5.4 Looping Statement
  - 5.4.1 for loop
  - 5.4.2 while loop
  - 5.4.3 do while
  - 5.4.4 Nested loop
- 5.5 Loop Interruption
  - 5.5.1 break
  - 5.5.2 continue

6 Array and Pointer (7 hours)

6.1 Introduction to an Array
6.2 One-dimensional Array
6.3 Two-dimensional Array
6.4 Multidimensional Array
6.5 Introduction to String
6.6 String Handling Functions
6.7 Definition of a Pointer
6.8 Pointer Declaration
6.9 Pointer Arithmetic
6.10 Relationship between Pointer and Arrays

7 User-defined Functions (6 hours)

7.1 Introduction to Function
7.2 Advantages of Function
7.3 Elements of User-defined Function
  7.3.1 Function Definition
  7.3.2 Function Prototype
  7.3.3 Function Parameters
7.4 Storage Class
7.5 Scope Rules
7.6 Category of Functions
  7.6.1 Functions with no arguments and no return values
  7.6.2 Functions with arguments and no return values
  7.6.3 Functions with arguments and return values
  7.6.4 Functions with no arguments and return values
7.7 Recursive functions
7.8 Function Call by Values and Reference
7.9 Passing Array and String to Function

8 Structures (5 hours)

8.1 Defining a Structure
8.2 Declaring and Accessing Structure Elements
8.3 Initializing Structure
8.4 Array of Structure
8.5 Array as member to Structure
8.6 Pointer as member to Structure
8.7 Structure as a member to Structure
8.8 Passing and Returning Structures to/from Function

9 File management (4 hours)

- 9.1 Introduction
- 9.2 Binary and Text File in C
- 9.3 File Opening Modes
- 9.4 Defining, Opening and Closing File
- 9.5 Input-output operations on files
  - 9.5.1 Character I/O (fputc(), fgetc())
  - 9.5.2 String I/O (fgets(), fputs())
  - 9.5.3 Formatted I/O (fscanf(), fprintf())
  - 9.5.4 Record I/O (fwrite(), fread())
- 9.6 Overview of Random File Access
- 9.7 Error handling

10 Recent Trends in Programming (2 hours)

- 10.1 Introduction to Object Oriented Programming (OOP)
- 10.2 Definitions of Class, Method and Object in OOP
- 10.3 Difference between Procedure Oriented and OOP
- 10.4 Overview of other High Level Programming Languages

Laboratory

1. Lab 1: Introduction and Demonstrations of projects written in C
2. Lab 2: Formatted and Unformatted Input/output in C
3. Lab 3: Branching in Control Structure
4. Lab 4: Looping in Control Structure
5. Lab 5: Array in C
6. Lab 6: String in C
7. Lab 7: Pointers in C
8. Lab 8: User Defined functions in C
9. Lab 9: Structure in C
10. Lab 10: File handling in C
11. Group project on C maximum 4 students in a group at the end of the course.

Reference

1. Robert Lafore, “C Programming Using Turbo C++”, SAMS publication
2. E. Balagurusamy, “Programming in Ansi C”, McGraw Hill Education
3. Bryons S. Gotterfried, “Programming with C”, TMH ….

ENGINEERING DRAWING

ME 101

Lecture : 2 **Year : I**
Tutorial : 0 **Part : I**
Practical : 4

Course Objectives:

To develop basic projection concepts with reference to points, lines, planes and geometrical solids. Also, to develop sketching and drafting skills to facilitate communication.

1 Instrumental Drawing, Technical Lettering Practices and Techniques (1 hour)

1.1 Equipment, materials and drawing sheets (paper)
1.2 Description of drawing instruments, auxiliary equipment and drawing materials
1.3 Techniques of instrumental drawing
1.4 Pencil sharpening, securing paper, proper use of T- squares, triangles, scales dividers, compasses, erasing shields, French curves, inking pens
1.5 Line types and uses, thickness

2 Dimensioning (1 hour)

2.1 Fundamentals and techniques
2.2 Size and location dimensioning, SI conversions
2.3 Scales: Types and Representative factor
2.4 Use of scales, measurement units, reducing and enlarging drawings
2.5 Placement of dimensions: aligned and unidirectional, chain, parallel/baseline and combined type
2.6 Tolerance Dimensioning

3 Geometrical Construction (2 hours)

3.1 Plane geometrical construction: Proportional division of lines, Trisection of angles, smooth arc & line tangents
3.2 Methods for drawing regular polygons and standard curves such as ellipses, parabolas, hyperbolas, involutes, spirals, cycloids and helices (cylindrical and conical), ogee curve
3.3 Techniques to reproduce a given drawing (by construction)

4 Basic Descriptive Geometry (4 hours)

4.1 Introduction to Orthographic projection, Principal Planes, Four Quadrants or Angles
4.2 Projection of points on first, second, third and fourth quadrants
4.3 Projection of Lines: Parallel to one of the principal planes, Inclined to one of the principal plane and parallel to other, Inclined to both principal planes, Traces of a Line
4.4 Projection Planes: Perpendicular to both principal planes, Parallel to one of the principal planes and Inclined to one of the principal planes, perpendicular to other and Inclined to both principal planes
4.5 True length of lines: horizontal, inclined and oblique lines
4.6 Rules for parallel and perpendicular lines
4.7 Point view or end view of a line
4.8 Shortest distance from a point to a line
4.9 Edge View and True shape of an oblique plane
4.10 Angle between two intersecting lines
4.11 Intersection of a line and a plane, visible portion of line
4.12 Angle between a line and a plane
4.13 Dihedral angle between two planes
4.14 Shortest distance between two skew lines
4.15 Angle between two non- intersecting (skew) lines

5 Multi view (orthographic) projections (8 hours)

5.1 Orthographic Projections
- 5.1.1 First and third angle projection
- 5.1.2 Principal views: methods for obtaining orthographic views, Projection of lines, angles and plane surfaces, analysis in three views, projection of curved lines and surfaces, object orientation and selection of views for best representation, full and hidden lines
- 5.1.3 Orthographic drawings: making an orthographic drawing, visualizing objects (pictorial view) from the given views
- 5.1.4 Interpretation of adjacent areas, true-length lines, representation of holes, conventional practices

5.2 Sectional Views: Full, half, offset, broken (partial), rotated/aligned, revolved, removed (detail) sections, phantom of hidden section, specifying cutting planes for sections, conventions practices
5.3 Auxiliary views: Basic concept and use, drawing methods and types, symmetrical and unilateral auxiliary views, auxiliary sectional views

6 Developments and Intersections (7 hours)

6.1 Introduction and Projection of Solids with points transfer
6.2 Developments: general concepts and practical considerations, Triangulation method for approximate development of surfaces of a right/oblique; prism, cylinder, pyramid, cone, prism and cylinder cut by

oblique planes, frustum/truncated pyramid and cone, transition pieces for connecting different shapes and sphere

6.3 Intersections: lines of intersection of geometric surfaces, piercing point of a line and a geometric solid, intersection lines of two planes, intersections of – prism and prism, cylinder and prism, cylinder and cylinder, pyramid and prism, cone and prism, pyramid and cylinder, cone and cylinder.

7 Pictorial Drawings (7 hours)

7.1 Classifications: Advantages and Disadvantages

7.2 Isometric View

- 7.2.1 Axonometric Projection
- 7.2.2 Isometric Projection and Isometric Drawing (View)
- 7.2.3 Isometric and Non-isometric Lines; Isometric and Non-isometric Surfaces
- 7.2.4 Angles in Isometric Drawing
- 7.2.5 Circles and Circular Arcs in Isometric and Non-isometric Surfaces (slopes)
- 7.2.6 Irregular Curves in Isometric Drawing
- 7.2.7 Isometric sectional Views

7.3 Oblique Drawing

- 7.3.1 Procedure for making an Oblique drawing
- 7.3.2 Rules for Placing Objects in Oblique drawing
- 7.3.3 Angles, Circles and Circular Arcs in Oblique drawing

7.4 Perspective Projection

- 7.4.1 Terms used in Perspective Projection
- 7.4.2 Parallel and Angular Perspective
- 7.4.3 Selection of Station Point
- 7.4.4 Perspective projection of right prism and pyramid solid

Assignments

1. Geometrical Construction
2. Descriptive Geometry
3. Multi-view Projection I
4. Multi-view Projection II
5. Surface Development and Intersection
6. Isometric Drawing
7. Oblique Drawing and Perspective Projection

Laboratory

1. Drawing Sheet Layout, Freehand Lettering, Scale, Common Graphical Symbols, Sketching of parallel lines, circles, Dimensioning
2. Geometrical Construction (Sketch and Instrumental Drawing)
3. Descriptive Geometry I (Sketch and Instrumental Drawing)
4. Descriptive Geometry II (Sketch and Instrumental Drawing)
5. Multiview Drawings I (Sketch and Instrumental Drawing)

6. Multiview Drawings II (Sketch and Instrumental Drawing)
7. Multiview, Sectional Drawings and Dimensioning (Sketch and Instrumental Drawing)
8. Auxiliary View, Sectional Drawings and Dimensioning (Sketch and Instrumental Drawing)
9. Projection of Regular Geometrical Solids with point transfer (Sketch and Instrumental Drawing)
10. Surface Development of solids I (Sketch and Instrumental Drawing)
11. Surface Development of solids II (Sketch and Instrumental Drawing)
12. Intersection of solids (Sketch and Instrumental Drawing)
13. Isometric Drawing I (Sketch and Instrumental Drawing)
14. Isometric Drawing II (Sketch and Instrumental Drawing)
15. Oblique Drawing and Perspective Projection (Sketch and Instrumental Drawing)

Reference

1. "Fundamentals of Engineering Drawing", W. J. Luzadder, Prentice Hall.
2. "Engineering Drawing and Graphic Technology", T. E. French, C. J. Vierck, and R. J. Foster, Mc Graw Hill Publshing Co.
3. "Technical Drawing", F. E. Giescke, A. Mitchell, H. C. Spencer and J. T. Dygdone, Macmillan Publshing Co.
4. "Elementary Engineering Drawing", N. D. Bhatt, Charotar Publshing House, India.
5. "A Text Book of Engineering Drawing", P. S. Gill, S. K. Kataria and Sons, India
6. "A Text Book of Engineering Drawing", R. K. Dhawan, S. Chand and Company Limited, India
7. "Engineering Drawing I" and "Engineering Drawing II", M. C. Luintel, Heritage Publishers and Distributors Pvt. Ltd., Bhotahity, Kathmdu, Nepal

APPLIED MECHANICS

CE 104

Lecture : 3 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objectives:
This course helps to analyze the effect of various types of Forces on the particle and rigid body at rest. It also provides concept and knowledge of Engineering Application and helps to understand Structural Engineering in later courses by using basics of Mechanics in their branch of engineering.

1 Basic Concept of Mechanics and Static Equilibrium (6 hours)

1.1 Definitions, Type and Scope of Mechanics
1.2 Fundamental Concepts and Principles of Engineering Mechanics
1.3 Concept of Particle, Rigid and Deformed Bodies
1.4 Physical Meaning of Equilibrium and its Essence in Structural Application
1.5 Equation of Equilibrium in 2D and 3D Analysis of Particle and Rigid Body
1.6 Concept of Free Body Diagram with Examples

2 Forces Acting on Particle and Rigid Body (10 hours)

2.1 Different Types of Forces: Internal/External Force, Adhesive/ Cohesive Force, Point/ Line/ Surface Force and Contact/ Body Force
2.2 Resolution and Composition of Forces
2.3 Principle of Transmissibility and Equivalent Forces
2.4 Varignon's Theorem and it's Application
2.5 Moments of a Force About a Point and About an Axis
2.6 Definition, Types and Characteristics of Couple
2.7 Resolution of a Force into a Force and a Couple

3 Friction (5 hours)

3.1 Definition, Types and Uses of Friction, Laws of Friction, Static and Dynamic Coefficient of Friction, Angle of Friction
3.2 Sliding and Overturning Condition of a Body
3.3 Practical Examples of Dry Friction (Ladder and Wedge Friction)

4 Analysis of Simple Beams and Frames (12 hours)

4.1 Introduction to Structures
4.2 Various Types of Load on the Structure
4.3 Various Types of Supports; Reactions and Degree of Freedom
4.4 Internal and External Forces in the Structure
4.5 Relationship Between Load, Shear Force and Bending Moment
4.6 Statically and Geometrically Stable/ Unstable Beams and Frames
4.7 Statically Determinate and Indeterminate Beams and Frames, Degree of Static Indeterminacy
4.8 Axial Force, Shear Force and Bending Moment Diagrams for Determinate Beams and Frames

5 Analysis of Plane Trusses (6 hours)

5.1 Definition of Truss, Assumption of Ideal Truss, Types and Uses of Truss in Engineering
5.2 Statically and Geometrically Stable and Unstable Truss
5.3 Statically Determinate and Indeterminate Truss, Degree of Static Indeterminacy
5.4 Analysis of Truss by the Method of Joint and Section/ Moment

6 Centre of Gravity, Centroid, Moment of Inertia, and Mass Moment of Inertia (6 hours)

6.1 Concepts of Centre of Gravity and Centroid of Line, Area and Volume
6.2 Second Moment of Area/Moment of Inertia and Radius of Gyration
6.3 Perpendicular and Parallel Axis Theorem for Moment of Inertia

Tutorials

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Basic Concept of Mechanics and Static Equilibrium (2 hours)
2. Forces Acting on Particle and Rigid Body (6 hours)
3. Friction (3 hours)
4. Analysis of Simple Beams and Frames (8 hours)
5. Analysis of Plane Trusses (5 hours)
6. Centre of Gravity, Centroid, Moment of Inertia and Mass Moment of Inertia (6 hours)

Reference

1. Beer F.P. and E.R. Johntson “Vector Mechanics for Engineers”, Tata McGraw Hill Publishing Co.Ltd.
2. R.C. Hibbler, Ashok Gupta, “Engineering Mechanics –Statics and Dynamics”, New Delhi, Pearson,
3. I.C. Jong and B.G. Rogers, “Engineering Mechanics- Statics and Dynamics”,

4. R. Suwal, “A Text Book of Applied Mechanics” Second Edition, Mark Line Publication
5. H.R. Parajuli and S. Neupane “Applied Mechanics for Engineers” M.K. Publishers and Distributors
6. M.R. Dhital, “A Course Manual on Applied Mechanics I (Statics)”, TU, IOE, CIMDU,
7. Shame, I.H., “Engineering Mechanics- Statics and Dynamics”, Prentice Hall of India, New Delhi,
8. R.S. Khurmi, “A Text Book of Engineering Mechanics”,

ELECTRIC CIRCUIT I

EE 101

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3

Course Objectives:
To understand the fundamental concept and analysis of AC and DC electrical circuits.

1 Introduction to Electric Circuits (6 hours)

1.1 Overview of electrical supply
1.2 Electric current and potential
1.3 Circuit components
  1.3.1 Electrical sources: dependent and independent, voltage and current source
  1.3.2 Electrical load: Linear and nonlinear
1.4 Ohm's law, limitation and application
1.5 Resistance and resistivity
1.6 Factors affecting resistance
1.7 Effect of temperature on resistance
1.8 Conductance and conductivity
1.9 Power and energy
1.10. Series and parallel combination of resistor
1.11. Current and voltage divider rules

2 DC Network Analysis (16 hours)

2.1 Network terminology
2.2 Kirchhoff's laws
2.3 Nodal analysis method
2.4 Mesh analysis method
2.5 Star/Delta and Delta/Star transformation
2.6 Superposition theorem
2.7 Thevenin's theorem
2.8 Norton's theorem
2.9 Maximum power transfer theorem
2.10 Compensation theorem and reciprocity theorem

3 Capacitance and Inductance (4 hours)

3.1 General concept of capacitance and geometrical point of view
3.2 Factors affecting capacitance
3.3 Energy stored in capacitor
3.4 Capacitors in series, parallel combination
3.5 General concept of inductance and geometrical point of view
3.6 Inductance in series, parallel combination with mutual inductance.
3.7 Energy stored in an inductor

4 AC System (5 hours)

4.1 Introduction of AC quantities
4.2 Faraday's law of electromagnetic induction
4.3 Generation of alternating voltage
4.4 Waveform and its characteristics
4.5 Average value
4.6 Root mean square (rms) value
4.7 Phase and phase difference
4.8 Phasor representation

5. Single Phase AC Circuit (8 hours)

5.1 AC circuit analysis with resistive, inductive and capacitive load
5.2 AC circuit analysis comprising series configurations of RL, RC, and RLC loads.
5.3. AC parallel circuit analysis
5.4. Resonance in RLC series and parallel circuit, bandwidth and quality factor
5.5. Measurement of power in single phase AC system

6. Three Phase Circuit Analysis (6 hours)

6.1 Advantage of three phase AC system
6.2 Generation of three phase AC Voltage
6.3 Phase sequence and its importance
6.4 Interconnection of three phase coils
6.5 Phase and line quantities in star and delta connection
6.6 Analysis with balanced and unbalanced load
6.7 Power measurement in three phase AC circuit and Blondel theorem
6.8 Power factor and its correction

Tutorial

Tutorials will encompass numerical exercises from all chapters

Assignment

1. Numerical and theory works

Laboratory

1. Familiarization of electrical Elements, sources and measuring devices related to electrical circuits and safety rules to be followed in Labs
2. Verification of Ohms Law and effect of temperature on resistance.
3. Verification of Kirchhoff's Law and Series and Parallel Combination of Resistor
4. Verification of Thevenin Theorem and Maximum Power Transfer Theorem
5. Verification of Superposition and Reciprocity Theorem
6. Measurement of Inductance of a coil and perform series-parallel combination of Capacitor and Inductor.
7. Verifications of Faradays Law of Induction.
8. Measurement of AC Quantities using Oscilloscope and study phase relation of RL and RC load.
9. Measurement of Power and Power Factor in a Single-Phase AC Series RL Circuit and Study of Improvement of Power Factor using Capacitor
10. Study the Phenomenon of Resonance in RLC Series and parallel Circuit
11. Measurement of line, phase and neutral relations in three phases Balanced and unbalanced Load.
12. Phase Sequence Detection and Power Analysis using a Power Analyzer
13. To Study Power Measurement in a Three Phase AC Circuits by Two - Wattmeter Method.
14. Conduct a hands-on practical assessment
15. Conduct an oral examination

Reference

1. Cogdell, J. R. "" Foundations of electrical engineering," Prentice-Hall Inc., USA. pp. 11-16." (1996).
2. Hughes, Thomas P. Human-built world: How to think about technology and culture. University of Chicago Press, 2004.
3. Rizzoni, Giorgio, and James Kearns. Fundamentals of electrical engineering. New York: McGraw-Hill, 2009.
4. Alexander, Charles K. Fundamentals of electric circuits. McGraw-Hill,, 2013.
5. Mayergoyz, Isaak D., and Wes Lawson. Basic electric circuit theory: a one-semester text. Gulf Professional Publishing, 1997.
6. Theraja, B. L. A textbook of electrical technology. S. Chand Publishing, 2014.

ENGINEERING MATHEMATICS III
SH 501

Lecture : 3 **Year : II**
Tutorial : 2 **Part : I**
Practical : 0

Course Objective:
The purpose of this course is to round out the students' preparation for more sophisticated applications with an introduction to linear algebra, Fourier Series, Laplace Transforms, integral transformation theorems and linear programming.

1. Determinants and Matrices (11 hours)
- 1.1. Determinant and its properties
- 1.2. Solution of system of linear equations
- 1.3. Algebra of matrices
- 1.4. Complex matrices
- 1.5. Rank of matrices
- 1.6. System of linear equations
- 1.7. Vector spaces
- 1.8. Linear transformations
- 1.9. Eigen value and Eigen vectors
- 1.10. The Cayley-Hamilton theorem and its uses
- 1.11. Diagonalization of matrices and its applications

2. Line, Surface and Volume Integrals (12 hours)
- 2.1. Line integrals
- 2.2. Evaluation of line integrals
- 2.3. Line integrals independent of path
- 2.4. Surfaces and surface integrals
- 2.5. Green's theorem in the plane and its applications
- 2.6. Stoke's theorem (without proof) and its applications
- 2.7. Volume integrals; Divergence theorem of Gauss (without proof) and its applications

3. Laplace Transform (8 hours)
- 3.1. Definitions and properties of Laplace Transform
- 3.2. Derivations of basic formulae of Laplace Transform
- 3.3. Inverse Laplace Transform: Definition and standard formulae of inverse Laplace Transform
- 3.4. Theorems on Laplace transform and its inverse
- 3.5. Convolution and related problems
- 3.6. Applications of Laplace Transform to ordinary differential equations

4. Fourier Series ` (5 hours)
- 4.1. Fourier Series
- 4.2. Periodic functions
- 4.3. Odd and even functions
- 4.4. Fourier series for arbitrary range
- 4.5. Half range Fourier series

5. Linear Programming (9 hours)
- 5.1. System of Linear Inequalities in two variables
- 5.2. Linear Programming in two dimensions: A Geometrical Approach
- 5.3. A Geometric introduction to the Simplex method
- 5.4. The Simplex method: Maximization with Problem constraints of the form "≤"
- 5.5. The Dual: Maximization with Problem Constraints of the form "≥"
- 5.6. Maximization and Minimization with mixed Constraints. The two-phase method(Analternative to the Big M Method)

References :

1. E. Kreszig, "Advance Engineering Mathematics", Willey, New York.
2. M.M Gutterman and Z.N.Nitecki, "Differential Equation, a First Course", 2nd Edition, saunders, New York.

Evaluation Scheme:

The questions will cover all the chapters of syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	11	20
2	12	20
3	8	15
4	5	10
5	9	15
Total	**45**	**80**

*There may be minor deviation in marks distribution.

OBJECT ORIENTED PROGRAMMING
CT 501

Lecture : 3 **Year : II**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
The objective of the course is to familiarize students with the C++ programming language and use the language to develop pure object oriented programs.

1. Introduction to Object Oriented Programming (3 hours)
- 1.1 Issues with Procedure Oriented Programming
- 1.2 Basic of Object Oriented Programming (OOP)
- 1.3 Procedure Oriented versus Object Oriented Programming
- 1.4 Concept of Object Oriented Programming
  - 1.4.1 Object
  - 1.4.2 Class
  - 1.4.3 Abstraction
  - 1.4.4 Encapsulation
  - 1.4.5 Inheritance
  - 1.4.6 Polymorphism
- 1.5 Example of Some Object Oriented Languages
- 1.6 Advantages and Disadvantages of OOP

2. Introduction to C++ (2 hours)
- 2.1 The Need of C++
- 2.2 Features of C++
- 2.3 C++ Versus C
- 2.4 History of C++

3. C++ Language Constructs (6 hours)
- 3.1 C++ Program Structure
- 3.2 Character Set and Tokens
  - 3.2.1 Keywords
  - 3.2.2 Identifiers
  - 3.2.3 Literals
  - 3.2.4 Operators and Punctuators
- 3.3 Variable Declaration and Expression
- 3.4 Statements
- 3.5 Data Type
- 3.6 Type Conversion and Promotion Rules
- 3.7 Preprocessor Directives
- 3.8 Namespace
- 3.9 User Defined Constant const
- 3.10 Input/Output Streams and Manipulators
- 3.11 Dynamic Memory Allocation with new and delete
- 3.12 Condition and Looping
- 3.13 Functions
  - 3.13.1 Function Syntax
  - 3.13.2 Function Overloading
  - 3.13.3 Inline Functions
  - 3.13.4 Default Argument
  - 3.13.5 Pass by Reference
  - 3.13.6 Return by Reference
- 3.14 Array, Pointer and String
- 3.15 Structure, Union and Enumeration

4. Objects and Classes (6 hours)
- 4.1 C++ Classes
- 4.2 Access Specifiers
- 4.3 Objects and the Member Access
- 4.4 Defining Member Function
- 4.5 Constructor
  - 4.5.1 Default Constructor
  - 4.5.2 Parameterized Constructor
  - 4.5.3 Copy Constructor
- 4.6 Destructors
- 4.7 Object as Function Arguments and Return Type
- 4.8 Array of Objects
- 4.9 Pointer to Objects and Member Access
- 4.10 Dynamic Memory Allocation for Objects and Object Array
- 4.11 this Pointer
- 4.12 static Data Member and static Function
- 4.13 Constant Member Functions and Constant Objects
- 4.14 Friend Function and Friend Classes

5. Operator Overloading (5 hours)
- 5.1 Overloadable Operators
- 5.2 Syntax of Operator Overloading
- 5.3 Rules of Operator Overloading

5.4 Unary Operator Overloading
5.5 Binary Operator Overloading
5.6 Operator Overloading with Member and Non Member Functions
5.7 Data Conversion: Basic – User Defined and User Defined – User Defined
5.8 Explicit Constructors

6. Inheritance (5 hours)

6.1 Base and Derived Class
6.2 protected Access Specifier
6.3 Derived Class Declaration
6.4 Member Function Overriding
6.5 Forms of Inheritance: single, multiple, multilevel, hierarchical, hybrid, multipath
6.6 Multipath Inheritance and Virtual Base Class
6.7 Constructor Invocation in Single and Multiple Inheritances
6.8 Destructor in Single and Multiple Inheritances

7. Polymorphism and Dynamic Binding (4 hours)

7.1 Need of Virtual Function
7.2 Pointer to Derived Class
7.3 Definition of Virtual Functions
7.4 Array of Pointers to Base Class
7.5 Pure Virtual functions and Abstract Class
7.6 Virtual Destructor
7.7 reinterpret_cast Operator
7.8 Run-Time Type Information
7.8.1 dynamic_cast Operator
7.8.2 typeid Operator

8. Stream Computation for Console and File Input /Output (5 hours)

8.1 Stream Class Hierarchy for Console Input /Output
8.2 Testing Stream Errors
8.3 Unformatted Input /Output
8.4 Formatted Input /Output with ios Member functions and Flags
8.5 Formatting with Manipulators
8.6 Stream Operator Overloading
8.7 File Input/output with Streams
8.8 File Stream Class Hierarchy
8.9 Opening and Closing files
8.10 Read/Write from File
8.11 File Access Pointers and their Manipulators
8.12 Sequential and Random Access to File
8.13 Testing Errors during File Operations

9. Templates (5 hours)

9.1 Function Template
9.2 Overloading Function Template
9.2.1 Overloading with Functions
9.2.2 Overloading with other Template
9.3 Class Template
9.3.1 Function Definition of Class Template
9.3.2 Non-Template Type Arguments
9.3.3 Default Arguments with Class Template
9.4 Derived Class Template
9.5 Introduction to Standard Template Library
9.5.1 Containers
9.5.2 Algorithms
9.5.3 Iterators

10. Exception Handling (4 hours)

10.1 Error Handling
10.2 Exception Handling Constructs (try, catch, throw)
10.3 Advantage over Conventional Error Handling
10.4 Multiple Exception Handling
10.5 Rethrowing Exception
10.6 Catching All Exceptions
10.7 Exception with Arguments
10.8 Exceptions Specification for Function
10.9 Handling Uncaught and Unexpected Exceptions

Practical:

There will be about 12 lab exercises covering the course. At the end of the course students must complete a programming project on object oriented programming with C++.

References :

1. Robert Lafore, "Object Oriented Programming in C++", 4th Edition 2002, Sams Publication
2. Daya Sagar Baral and Diwakar Baral, "The Secrets of Object Oriented Programming in C++", 1st Edition 2010, Bhundipuran Prakasan

3. Harvey M. Deitel and Paul J. Deitel, “C++ How to Program”, 3rd Edition 2001, Pearson Education Inc.
4. D. S. Malik, “C++ Programming”, 3rd Edition 2007, Thomson Course Technology
5. Herbert Schildt, “C++: The Complete Reference”, 4th Edition 2003, Tata McGraw Hill

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1,2,4	11	20
3	6	10
5	5	10
6	5	10
8	5	10
7,9,10	13	20
Total	**45**	**80**

*There may be minor deviation in marks distribution

ELECTRIC CIRCUIT THEORY
EE 501

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objectives:
To continue work in Basic Electrical Engineering including the use of the Laplace Transform to determine the time and frequency domain responses of electric circuits.

1. Network Analysis of AC circuit & dependent sources (8 hours)
- 1.1 Mesh Analysis
- 1.2 Nodal Analysis
- 1.3 Series & parallel resonance in RLC circuits
  - 1.3.1 Impedance and phase angle of series Resonant Circuit
  - 1.3.2 Voltage and current in series resonant circuit
  - 1.3.3 Band width of the RLC circuit.
  - 1.3.4 High-Q and Low-Q circuits

2. Initial Conditions: (2 hours)
- 2.1 Characteristics of various network elements
- 2.2 Initial value of derivatives
- 2.3 Procedure for evaluating initial conditions
- 2.4 Initial condition in the case of R-L-C network

3. Transient analysis in RLC circuit by direct solution (10 hours)
- 3.1 Introduction
- 3.2 First order differential equation
- 3.3 Higher order homogeneous and non-homogeneous differential equations
- 3.4 Particular integral by method of undetermined coefficients
- 3.5 Response of R-L circuit with
  - 3.5.1 DC excitation
  - 3.5.2 Exponential excitation
  - 3.5.3 Sinusoidal excitation
- 3.6 Response of R-C circuit with
  - 3.6.1 DC excitation
  - 3.6.2 Exponential excitation
  - 3.6.3 Sinusoidal excitation
- 3.7 Response of series R-L-C circuit with
  - 3.7.1 DC excitation
  - 3.7.2 Exponential excitation
  - 3.7.3 Sinusoidal excitation
- 3.8 Response of parallel R-L-C circuit with DC excitation

4. Transient analysis in RLC circuit by Laplace Transform (8 hours)
- 4.1 Introduction
- 4.2 The Laplace Transformation
- 4.3 Important properties of Laplace transformation
- 4.4 Use of Partial Fraction expansion in analysis using Laplace Transformations
- 4.5 Heaviside's partial fraction expansion theorem
- 4.6 Response of R-L circuit with
  - 4.6.1 DC excitation
  - 4.6.2 Exponential excitation
  - 4.6.3 Sinusoidal excitation
- 4.7 Response of R-C circuit with
  - 4.7.1 DC excitation
  - 4.7.2 Exponential excitation
  - 4.7.3 Sinusoidal excitation
- 4.8 Response of series R-L-C circuit with
  - 4.8.1 DC excitation
  - 4.8.2 Exponential excitation
  - 4.8.3 Sinusoidal excitation
- 4.9 Response of parallel R-L-C circuit with exponential excitation
- 4.10 Transfer functions Poles and Zeros of Networks

5. Frequency Response of Network (6 hours)
- 5.1 Introduction
- 5.2 Magnitude and phase response
- 5.3 Bode diagrams
- 5.4 Band width of Series & parallel Resonance circuits

5.5 Basic concept of filters, high pass, low pass, band pass and band stop filters

6. Fourier Series and transform (5 hours)

6.1 Basic concept of Fourier series and analysis
6.2 Evaluation of Fourier coefficients for periodic non-sinusoidal waveforms in electric networks
6.3 Introduction of Fourier transforms

7. Two-port Parameter of Networks (6 Hours)

7.1 Definition of two-port networks
7.2 Short circuit admittance parameters
7.3 Open circuits impedance parameters
7.4 Transmission Short circuit admittance parameters
7.5 Hybrid parameters
7.6 Relationship and transformations between sets of parameters
7.7 Application to filters
7.8 Applications to transmission lines
7.9 Interconnection of two-port network (Cascade, series, parallel)

Practical:

1. Resonance in RLC series circuit
- measurement of resonant frequency

2. Transient Response in first Order System passive circuits
- measure step and impulse response of RL and RC circuit using oscilloscope
- relate time response to analytical transfer functions calculations

3. Transient Response in Second Order System passive circuits
- measure step and impulse response of RLC series and parallel circuits using oscilloscope
- relate time response to transfer functions and pole-zero configuration

4. Frequency Response of first order passive circuits
- measure amplitude and phase response and plot bode diagrams for RL, RC and RLC circuits
- relate Bode diagrams to transfer functions and pole zero configuration circuit

5. Frequency Response of second order passive circuits
- measure amplitude and phase response and plot bode diagrams for RL, RC and RLC circuits
- relate Bode diagrams to transfer functions and pole zero configuration circuit

References:

1. M. E. Van Valkenburg, "Network Analysis", third edition Prentice Hall, 2010.
2. William H. Hyat. Jr. & Jack E. Kemmerly, "Engineering Circuits Analysis", Fourth edition, McGraw Hill International Editions, Electrical Engineering Series, 1987.
3. Michel D. Cilletti, "Introduction to Circuit Analysis and Design", Holt, Hot Rinehart and Winston International Edition, New York, 1988.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	8	12
2	2	6
3	10	16
4	8	12
5	6	12
6	5	10
7	6	12
Total	**45**	**80**

* There could be a minor deviation in the marks distribution.

ELECTRICAL ENGINEERING MATERIAL
EE 502

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 0

Course objectives:
To provide a basic understanding of the different materials used in electrical and electronics engineering.

1. Theory of Metals (8 hours)

1.1 Elementary quantum mechanical ideas: wave particle duality, wave function, schrodinger's equation, operator notation, expected value.
1.2 Infinite potential well: A confined electron.
1.3 Finite potential barrier: Tunneling phenomenon
1.4 Free electron theory of metals: electron in a linear solid, Fermi energy, Degenerate states, Number of states, Density of states, Population density.
1.5 Fermi-Dirac Distribution function
1.6 Thermionic emission: Richardson's equation, Schottky effect.
1.7 Contact potential: Fermi level at equilibrium.

2. Free electron theory of conduction in metal (6 hours)

2.1 Crystalline structure: Simple cubic structure, Body centered cubic, Face centered cubic.
2.2 Band theory of solids
2.3 Effective mass of electron
2.4 Thermal velocity of electron at equilibrium
2.5 Electron mobility, conductivity and resistivity

3. Dielectric materials (6 hours)

3.1 Matter polarization and relative permittivity: Relative permittivity, Dipole moment, Polarization vector, Local field, Clausius-Mossotti equation.
3.2 Types of Polarization: electronic polarization, ionic polarization, orientational polarization, Interfacial polarization.
3.3 Dielectric losses: frequency dependence.
3.4 Dielectric breakdown in solids
3.5 Ferro-electricity and Piezoelectricity

4. Magnetic materials (6 hours)

4.1 Magnetic material classification: Diamagnetism, Paramagnetism, Ferromagnetism, Anti-ferromagnetism, Ferrimagnetism.
4.2 Magnetic domains: Domain structure, domain wall motion, Hysteresis loop, Eddy current losses, demagnetization
4.3 Soft magnetic materials: Examples and uses
4.4 Hard magnetic materials: Examples and uses

5. Superconductivity (5 hours)

5.1 Zero Resistance and the Meissner effect
5.2 Type I and Type II superconductors
5.3 Critical current density

6. Semiconductors (14 hours)

6.1 Intrinsic semiconductors: Silicon crystal, energy band diagram, conduction in semiconductors, electrons and hole concentration.
6.2 Extrinsic semiconductors: n-type doping, p-type doping, compensation doping.
6.3 Introduction to GaAs semiconductor.
6.4 Temperature dependence of conductivity: Carrier concentration temperature dependence, drift mobility temperature and impurity dependence, conductivity temperature dependence, degenerate and non-degenerate semiconductors.
6.5 Diffusion on semiconductor: Einstein relationship
6.6 Direct and indirect generation and recombination
6.7 Pn junction: Forward biased, reverse biased pn- junction.

References:

1 Bhadra Prasad Pokharel and Nava Raj Karki,"Electrical Engineering Materials",Sigma offset Press,Kamaladi, Kathmandu, Nepal,2004.

2 R.C. Jaeger,"Introduction to Microelectronic Fabrication- Volume IV", Addison Wesley publishing Company,Inc., 1988.

3 Kasap.S.O, Principles of electrical engineering materials and devices, McGraw Hill, NewYork,2000.

4 R.A.Colcaser and S.Diehl-Nagle,"Materials and Devices for Electrical Engineers and Physicists,McGraw-Hill, New York, 1985.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapters	Hours	Marks distribution*	Theory	Numerical
1	8	12	8	4
2	6	10	6	4
3	6	10	10	X
4	6	10	10	X
5	5	8	8	X
6	14	30	18	12
Total	**45**	**80**	**60**	**20**

* There could be a minor deviation in the marks distribution

ELECTRONIC DEVICES AND CIRCUITS
EX 501

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

- To introduce the fundamentals of analysis of electronic circuits
- To provide basic understanding of semiconductor devices and analog integrated circuits

1. Diodes (5 hours)

1.1 The Ideal Diode
1.2 Terminal Characteristics of Junction Diodes
1.3 Physical Operation of Diodes
1.4 Analysis of Diode Circuits
1.5 Small Signal Model and Its Application
1.6 Operation in the Reverse Breakdown Region - Zener Diodes

2. The Bipolar Junction Transistor (10 hours)

2.1 Operation of the npn transistor in the Active Mode
2.2 Graphical Representation of Transistor Characteristics
2.3 Analysis of Transistor Circuits at DC
2.4 Transistor as an Amplifier
2.5 Small Signal Equivalent Circuit Models
2.6 Graphical Load Line Analysis
2.7 Biasing BJT for Discrete-Circuit Design
2.8 Basic Single-Stage BJT Amplifier Configurations (C-B, C-E, C-C)
2.9 Transistor as a Switch – Cutoff and Saturation
2.10 A General Large-Signal Model for the BJT: The Ebers-Moll Model
2.11 Field-Effect Transistor (9 hours)
2.12 Structure and Physical Operation of Enhancement-Type MOSFET
2.13 Current-Voltage Characteristics of Enhancement-Type MOSFET
2.14 The Depletion-Type MOSFET
2.15 MOSFET Circuits at DC
2.16 MOSFET as an Amplifier
2.17 Biasing in MOS Amplifier Circuits
2.18 Junction Field-Effect Transistor

3. Output Stages and Power Amplifiers (9 hours)

3.1 Classification of Output Stages
3.2 Class A Output Stage
3.3 Class B Output Stage
3.4 Class AB Output Stage
3.5 Biasing the Class AB Stage
3.6 Power BJTs
3.7 Transformer-Coupled Push-Pull Stages
3.8 Tuned Amplifiers

4. Signal Generator and Waveform-Shaping Circuits (6 hours)

4.1 Basic Principles of Sinusoidal Oscillator
4.2 Op Amp-RC Oscillator Circuits
4.3 LC and Crystal Oscillators
4.4 Generation of Square and Triangular Waveforms Using Astable Multivibrators
4.5 Integrated Circuit Timers
4.6 Precision Rectifier Circuits

5. Power Supplies, Breakdown Diodes, and Voltage Regulators (6 hours)

5.1 Unregulated Power Supply
5.2 Bandgap Voltage Reference, a Constant Current Diodes
5.3 Transistor Series Regulators
5.4 Improving Regulator Performance
5.5 Current Limiting
5.6 Integrated Circuit Voltage Regulator

Practical:

1. Bipolar Junction Transistor Characteristics and Single Stage Amplifier
2. Field-Effect Transistor Characteristics and Single Stage Amplifier
3. Power Amplifiers
4. Relaxation Oscillator and Sinusoidal Oscillator
5. Series and Shunt Voltage Regulators

References:

1. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", 6th Edition, Oxford University Press, 2006
2. David A. Bell, " Electronics Device and Circuits ", PHI; 3rd Edition, 1999.
3. Robert Boylestad and Louis Nashelsky, " Electronic Device and Circuit Theory", PHI; 9th Edition, 2007
4. Thomas L. Floyd, "Electronic Devices", 8th Edition, Pearson Education Inc., 2007
5. Mark N. Horenstein, "Microelectronic Circuits and Devices", PHI; 2nd Edition, 1997
6. Paul Horowitz and Winfield Fill, "The Art of Electornics", Cambridge Publication; 2 Edition
7. Jacob Millman and Christos C. Halkias,and Satyabrata Jit "Millman's Electronic Device and Circuits", Tata McGraw- Hill; 2nd Edition, 2007

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapters	Hours	Marks distribution*
1	6	8
2	10	16
3	9	16
4	9	14
5	6	8
6	6	8
1,2, 3, 4, 5, 6		10
Total	**45**	**80**

* There could be a minor deviation in the marks distribution.

DIGITAL LOGIC
EX 502

Lecture : 3 **Year : II**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
To introduce basic principles of digital logic design, its implementation and applications.

1. Introduction (3 hours)
- 1.1. Definitions for Digital Signals
- 1.2. Digital Waveforms
- 1.3. Digital Logic
- 1.4. Moving and Storing Digital Information
- 1.5. Digital Operations
- 1.6. Digital Computer
- 1.7. Digital Integrated Circuits
- 1.8. Digital IC Signal Levels
- 1.9. Clock wave form
- 1.10. Coding
  - 1.10.1. ASCII Code
  - 1.10.2. BCD
  - 1.10.3. The Excess – 3 Code
  - 1.10.4. The Gray Code

2. Digital Logic (1 hours)
- 2.1. The Basic Gates – NOT, OR, AND
- 2.2. Universal Logic Gates – NOR, NAND
- 2.3. AND-OR-INVERT Gates
- 2.4. Positive and Negative Logic
- 2.5. Introduction to HDL
- 2.6. Combinational Logic Circuits
- 2.7. Boolean Laws and Theorems
- 2.8. Sum-of-Products Method
- 2.9. Truth Table to Karnaugh Map
- 2.10. Pairs, Quads, and Octets
- 2.11. Karnaugh Simplifications
- 2.12. Don't Care Conditions
- 2.13. Product-of-Sums Method
- 2.14. Product-of-Sums Simplification
- 2.15. Hazards and Hazard Covers
- 2.16. HDL Implementation Models

3. Data Processing Circuits (5 hours)
- 3.1. Multiplexetures
- 3.2. Demultiplexetures
- 3.3. Decoder
- 3.4. BCD-to-Decimal Decoders
- 3.5. Seven-Segment Decoders
- 3.6. Encoder
- 3.7. Exclusive-OR Gates
- 3.8. Parity Generators and Checkers
- 3.9. Magnitude Comparator
- 3.10. Read-Only Memory
- 3.11. Programmable Array Logic
- 3.12. Programmable Logic Arrays
- 3.13. Troubleshooting with a Logic Probe
- 3.14. HDL Implementation of Data Processing Circuits

4. Arithmetic Circuits (5 hours)
- 4.1. Binary Addition
- 4.2. Binary Subtraction
- 4.3. Unsigned Binary Numbers
- 4.4. Sign-Magnitude Numbers
- 4.5. 2's Complement Representation
- 4.6. 2's Complement Arithmetic
- 4.7. Arithmetic Building Blocks
- 4.8. The Adder-Subtracter
- 4.9. Fast Adder
- 4.10. Arithmetic Logic Unit
- 4.11. Binary Multiplication and Division (5 hours)
- 4.12. Arithmetic Circuits Using HDL

5. Flip Flops **(5 hours)**

5.1. RS Flip-Flops
5.2. Gated Flip-Flops
5.3. Edge-Triggered RS Flip-Flops
5.4. Egde Triggered D Flip-Flops
5.5. Egde Triggered J K Flip-Flops
5.6. Flip-Flop Timing
5.7. J K Mater- Slave Flip-Flops
5.8. Switch Contacts Bounds Circuits
5.9. Varius Representation of Flip-Flops
5.10. Analysis of Sequencial Circuits

6. Registers **(2 hours)**

6.1. Types of Registers
6.2. Serial In – Serial Out
6.3. Serial In – Parallel Out
6.4. Parallel In – Serial Out
6.5. Parallel In – Parallel Out
6.6. Applications of Shift Registers

7. Counters **(5 hours)**

7.1. Asynchronous Counters
7.2. Decoding Gates
7.3. Synchronous Counters
7.4. Changing the Counter Modulus
7.5. Decade Counters
7.6. Presettable Counters
7.7. Counter Design as a Synthesis Problem
7.8. A Digital Clock

8. Sequential Machines **(8 hours)**

8.1. Synchronous machines
  8.1.1. Clock driven models and state diagrams
  8.1.2. Transition tables, Redundant states
  8.1.3. Binary assignment
  8.1.4. Use of flip-flops in realizing the models
8.2. Asynchronous machines
  8.2.1. Hazards in asynchronous system and use of redundant branch
  8.2.2. Allowable transitions
  8.2.3. Flow tables and merger diagrams
  8.2.4. Excitation maps and realization of the models

9. Digital Integrate Circuits **(4 hours)**

9.1. Switching Circuits
9.2. 7400 TTL
9.3. TTL parameters
9.4. TTL Overvew
9.5. Open Collecter Gates
9.6. Three-state TTL Devices
9.7. External Drive for TTL Lods
9.8. TTL Driving External Loads
9.9. 74C00 CMOS
9.10. CMOS Characteristics
9.11. TTL- to –CMOS Interface
9.12. CMOS- to- TTL Interface

10. Applications **(2 hours)**

10.1. Multiplexing Displays
10.2. Frequency Counters
10.3. Time Measurement

Practical:

1. DeMorgan's law and it's familiarization with NAND and NOR gates
2. Encoder, Decoder, and Multiplexer
3. Familiarization with Binary Addition and Subtraction
4. Construction of true complement generator
5. Latches, RS, Master-Slave and T type flip flops
6. D and JK type flip flops
7. Ripple Counter, Synchronous counter
8. Familiarization with computer package for logic circuit design
9. Design digital circuits using hardware and software tools
10. Use of PLAs and PLDs

References:

1. Donald P. Leach, Albert Paul Malvino and Goutam Saha, " Digital Principles and Applications", 6th edition , Tata McGraw-Hill, 2006
2. David J Comer "Digital Logic And State Machine Design" 3rd edition, Oxfored University Press, 2002
3. William I. Fletcher "An Engineering Approach to Digital Design" Printice Hall of India, New Delhi 1990
4. William H. Gothmann, "Digital Electronics, An Introduction to Theory and Practice", 2nd edition, PHI, 2009

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapters	Hours	Marks distribution*
1	3	6
2	1	4
3	5	8
4	5	10
5	5	8
6	5	8
7	2	4
8	5	8
9	8	12
10	4	8
11	2	4
Total	**45**	**80**

* There could be a minor deviation in the marks distribution.

ELECTROMAGNETICS
EX 503

Lecture : 3 **year : II**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:
To provide basic understanding of the fundamentals of Electromagnetics.

1. Introduction (3 hours)
- 1.1 Co-ordinate system.
- 1.2 Scalar and vector fields.
- 1.3 Operations on scalar and vector fields.

2. Electric field (11 hours)
- 2.1 Coulomb's law.
- 2.2 Electric field intensity.
- 2.3 Electric flux density.
- 2.4 Gauss's law and applications.
- 2.5 Physical significance of divergence, Divergence theorem.
- 2.6 Electric potential, potential gradient.
- 2.7 Energy density in electrostatic field.
- 2.8 Electric properties of material medium.
- 2.9 Free and bound charges, polarization, relative permittivity, electric dipole.
- 2.10 Electric Boundary conditions.
- 2.11 Current, current density, conservation of charge, continuity equation, relaxation time.
- 2.12 Boundary value problems, Laplace and Poisson equations and their solutions, uniqueness theorem.
- 2.13 Graphical field plotting, numerical integration.

3. Magnetic field (9 hours)
- 3.1 Biot-Savart's law.
- 3.2 Magnetic field intensity.
- 3.3 Ampere's circuital law and its application.
- 3.4 Magnetic flux density.
- 3.5 Physical significance of curl, Stoke's theorem.
- 3.6 Scalar and magnetic vector potential.
- 3.7 Magnetic properties of material medium.
- 3.8 Magnetic force, magnetic torque, magnetic moment, magnetic dipole, magnetization.
- 3.9 Magnetic boundary condition.

4. Wave equation and wave propagation (12 hours)
- 4.1 Faraday's law, transformer emf, motional emf.
- 4.2 Displacement current.
- 4.3 Maxwell's equations in integral and point forms.
- 4.4 Wave propagation in lossless and lossy dielectric.
- 4.5 Plane waves in free space, lossless dielectric, good conductor.
- 4.6 Power and pointing vector.
- 4.7 Reflection of plane wave at normal and oblique incidence.

5. Transmission lines (5 hours)
- 5.1 Transmission line equations.
- 5.2 Input impedance, reflection coefficient, standing wave ratio.
- 5.3 Impedance matching, quarter wave transformer, single stub matching, double stub matching.

6. Wave guides (4 hours)
- 6.1 Rectangular wave guide.
- 6.2 Transverse electric mode, transverse magnetic mode.

7. Antennas (1 hour)
- 7.1 Introduction to antenna, antenna types and properties.

Practical:
1. Teledeltos (electro-conductive) paper mapping of electrostatic fields.
2. Determination of dielectric constant, display of a magnetic Hysteresis loop
3. studies of wave propagation on a lumped parameter transmission line
4. microwave sources, detectors, transmission lines
5. Standing wave patterns on transmission lines, reflections, power patterns on transmission lines, reflections, power measurement.

6. Magnetic field measurements in a static magnetic circuit, inductance, leakage flux.

References:

1. W. H. Hayt, “Engineering Electromagnetics”, McGraw-Hill Book Company.
2. J. D. Kraus, “Electromagnetics”, McGraw-Hill Book Company.
3. N. N. Rao, “Elements of Engineering Electromagnetics”, Prentice Hall.
4. Devid K. Cheng, “Field and Wave Electromagnetics”, Addison-Wesley.
5. M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford University Press.

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapters	Hours	Marks distribution*
1	3	5
2	11	20
3	9	16
4	12	21
5, 6, 7	10	16
Total	45	80

* There could be a minor deviation in the marks distribution.

ELECTRICAL MACHINES I
EE 501

Lecture : 4 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
To impart knowledge on constructional details, operating principle and performance of Transformers, DC Machines, and 3-phase Induction Machines.

1.0 Magnetic Circuits and Induction (4 hours)
- 1.1 Magnetic Circuits: Series and Parallel Magnetic Circuits
- 1.2 Core with air gap
- 1.3 B-H relationship (Magnetization Characteristics)
- 1.4 Hysteresis with DC and AC excitation
- 1.5 Hysteresis Loss and Eddy Current Loss
- 1.6 Faraday's Law of Electromagnetic Induction, Statically and Dynamically Induced EMF
- 1.7 Force on Current Carrying Conductor

2.0 Transformer (12 hours)
- 2.1 Constructional Details, recent trends
- 2.2 Working principle and EMF equation
- 2.3 Ideal Transformer
- 2.4 Mutual Inductance and Coupled Circuit model
- 2.5 No load and Load operation
- 2.6 Equivalent Circuits and Phasor Diagram
- 2.7 Capacity of Transformers
- 2.8 Exciting Current harmonics
- 2.9 Transformer Inrush Current
- 2.10 Tests: Polarity Test, Open Circuit Test, Short Circuit test
- 2.11 Voltage Regulation
- 2.12 Losses in a Transformer
- 2.13 Efficiency, condition for maximum efficiency and all day efficiency
- 2.14 Instrument Transformers: Potential Transformer (PT) and Current Transformer (CT)
- 2.15 Auto transformer: construction, working principle and Cu saving
- 2.16 Three phase Transformers
- 2.17 Three phase transformer connections: Y/Y, Y/Δ, Δ/Y, Δ/Δ and V/V (or open Δ) connections
- 2.18 Choice between star and delta connection, Choice of Transformer connections
- 2.19 Three phase to two phase conversion: Scott connection
- 2.20 Three winding Transformer
- 2.21 Parallel operation of single phase and three phase Transformers

3.0 DC Generator (7 hours)
- 3.1 Constructional Details and Armature Windings
- 3.2 Working principle and Commutator Action
- 3.3 EMF equation
- 3.4 Method of excitation: separately and self excited, Types of DC Generator
- 3.5 Characteristics of series, shunt and compound generator
- 3.6 Voltage build up in a self excited DC generator
- 3.7 Armature Reaction
- 3.8 Commutation: Interpoles and Compensating Windings
- 3.9 Losses in DC generators
- 3.10 Efficiency and Voltage Regulation

4.0 DC Motor (7 hours)
- 4.1 Working principle and Torque equation
- 4.1 Back EMF
- 4.2 Method of excitation, Types of DC Motor
- 4.3 Performance Characteristics of D.C. motors
- 4.4 Losses and Efficiency
- 4.5 Starting of D.C. Motors: 3 point and 4 point starters
- 4.6 Speed control of D.C. Motors: Field Control, Armature Control, Reversing of DC Motors

5.0 Three-Phase Induction Machines (12 hours)
- 5.1 Three Phase Induction Motor
  - 5.1.1 Constructional Details and Types
  - 5.1.2 Operating Principle, Rotating Magnetic Field, Synchronous Speed,
  - 5.1.3 Slip, Induced EMF, Rotor Current and its frequency, Torque Equation
  - 5.1.4 Torque-Slip characteristics, Effect of rotor resistance on Torque-Slip characteristics
  - 5.1.5 Testing of Induction Motor
  - 5.1.6 Losses, Power stages and Efficiency
  - 5.1.7 Starting Methods
  - 5.1.8 Speed Control Methods
  - 5.1.9 Double Cage Induction Motor

5.2 Three Phase Induction Generator
- 5.2.1 Working Principle, voltage build up in an Induction Generator
- 5.2.2 Power Stages
- 5.2.3 Isolated and Grid connected mode

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicates in the table below.

Chapter	*Lecture Hours*	*Marks**
1	*4*	*8*
2	*12*	*24*
3	*7*	*12*
4	*7*	*12*
5	*12*	*24*
Total	***42***	***80***

* There could be a minor deviation in the marks distribution.

References:

1. I.J. Nagrath & D.P.Kothari," Electrical Machines", Tata McGraw Hill
2. S. K. Bhattacharya, "Electrical Machines", Tata McGraw Hill
3. Husain Ashfaq ," Electrical Machines", Dhanpat Rai & Sons
4. A.E. Fitzgerald, C.Kingsley Jr and Stephen D. Umans,"Electric Machinery", Tata McGraw Hill
5. P. S. Bhimbra, "Electrical Machines"' Khanna Publishers
6. Irving L.Kosow, "Electric Machine and Tranformers", Prentice Hall of India.
7. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.
8. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers"
9. Oxford University Press, 2001.

Practical:

1. Magnetic Circuits
- To draw B-H curve for two different sample of Iron Core
- Compare their relative permeabilities

2. Two Winding Transformers
- To perform turn ratio test
- To perform open circuit (OC) and short circuit (SC) test to determine equivalent circuit parameter of a transformer and hence to determine the regulation and efficiency at full load
- To examine exciting current harmonics

3. DC Generator
- To draw open circuit characteristic (OCC) of a DC shunt generator and to calculate: (a)Maximum voltage built up (a)Critical resistance and critical speed of the machine
- To draw load characteristic of shunt generator

4. DC Motor
- Speed control of DC Shunt motor by (a) armature control method (b) field control method
- To observe the effect of increasing load on DC shunt motor's speed, armature current, and field current.

5. 3-phase Induction Machines
- To draw torque-speed characteristics and to observe the effect of rotor resistance on torque-speed characteristics
- To perform no load and blocked rotor test to evaluate equivalent circuit parameters

NUMERICAL METHODS
SH 553

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3

Course objective:
The course aims to introduce numerical methods used for the solution of engineering problems. The course emphasizes algorithm development and programming and application to realistic engineering problems.

1. Introduction, Approximation and errors of computation (4 hours)
- 1.1. Introduction, Importance of Numerical Methods
- 1.2. Approximation and Errors in computation
- 1.3. Taylor's series
- 1.4. Newton's Finite differences (forward , Backward, central difference, divided difference)
- 1.5. Difference operators, shift operators, differential operators
- 1.6. Uses and Importance of Computer programming in Numerical Methods.

2. **Solutions of Nonlinear Equations (5 hours)**
- 2.1. Bisection Method
- 2.2. Newton Raphson method (two equation solution)
- 2.3. Regula-Falsi Method , Secant method
- 2.4. Fixed point iteration method
- 2.5. Rate of convergence and comparisons of these Methods

3. **Solution of system of linear algebraic equations (8 hours)**
- 3.1. Gauss elimination method with pivoting strategies
- 3.2. Gauss-Jordan method
- 3.3. LU Factorization
- 3.4. Iterative methods (Jacobi method, Gauss-Seidel method)
- 3.5. Eigen value and Eigen vector using Power method

4. **Interpolation (8 hours)**
- 4.1. Newton's Interpolation (forward, backward)
- 4.2. Central difference interpolation: Stirling's Formula, Bessel's Formula
- 4.3. Lagrange interpolation
- 4.4. Least square method of fitting linear and nonlinear curve for discrete data and continuous function
- 4.5. Spline Interpolation (Cubic Spline)

5. **Numerical Differentiation and Integration (6 hours)**
- 5.1. Numerical Differentiation formulae
- 5.2. Maxima and minima
- 5.3. Newton-Cote general quadrature formula
- 5.4. Trapezoidal, Simpson's 1/3, 3/8 rule
- 5.5. Romberg integration
- 5.6. Gaussian integration (Gaussian – Legendre Formula 2 point and 3 point)

6. Solution of ordinary differential equations (6 hours)
- 6.1. Euler's and modified Euler's method
- 6.2. Runge Kutta methods for 1st and 2nd order ordinary differential equations
- 6.3. Solution of boundary value problem by finite difference method and shooting method.

7. Numerical solution of Partial differential Equation (8 hours)
- 7.1. Classification of partial differential equation(Elliptic, parabolic, and Hyperbolic)
- 7.2. Solution of Laplace equation (standard five point formula with iterative method)
- 7.3. Solution of Poisson equation (finite difference approximation)
- 7.4. Solution of Elliptic equation by Relaxation Method
- 7.5. Solution of one dimensional Heat equation by Schmidt method

Practical:
Algorithm and program development in C programming language of following:
1. Generate difference table.
2. At least two from Bisection method, Newton Raphson method, Secant method
3. At least one from Gauss elimination method or Gauss Jordan method. Finding largest Eigen value and corresponding vector by Power method.
4. Lagrange interpolation. Curve fitting by Least square method.
5. Differentiation by Newton's finite difference method. Integration using Simpson's 3/8 rule
6. Solution of 1^{st} order differential equation using RK-4 method
7. Partial differential equation (Laplace equation)
8. Numerical solutions using Matlab.

References:

1. Dr. B.S.Grewal, " Numerical Methods in Engineering and Science ", Khanna Publication, 7th edition.
2. Robert J schilling, Sandra l harries , " Applied Numerical Methods for Engineers using MATLAB and C.", 3rd edition Thomson Brooks/cole.
3. Richard L. Burden, J.Douglas Faires, "Numerical Analysis 7th edition" , Thomson / Brooks/cole
4. John. H. Mathews, Kurtis Fink ," Numerical Methods Using MATLAB 3rd edition " ,Prentice Hall publication
5. JAAN KIUSALAAS , " Numerical Methods in Engineering with MATLAB" , Cambridge Publication

Evaluation scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapters	Hours	Marks distribution*
1 & 2	9	16
3	8	16
4	8	16
5	6	10
6	6	10
7	8	12
Total	**45**	**80**

* There could be a minor deviation in the marks distribution

APPLIED MATHEMATICS
SH 551

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective

This course focuses on several branches of applied mathematics. The students are exposed to complex variable theory and a study of the Fourier and Z-Transforms, topics of current importance in signal processing. The course concludes with studies of the wave and heat equations in Cartesian and polar coordinates.

1. Complex Analysis (18 hours)

1.1 Complex Analytic Functions
- 1.1.1 Functions and sets in the complex plane
- 1.1.2 Limits and Derivatives of complex functions
- 1.1.3 Analytic functions. The Cauchy –Riemann equations
- 1.1.4 Harmonic functions and it's conjugate

1.2 Conformal Mapping
- 1.2.1 Mapping
- 1.2.2 Some familiar functions as mappings
- 1.2.3 Conformal mappings and special linear functional transformations
- 1.2.4 Constructing conformal mappings between given domains

1.3 Integral in the Complex Plane
- 1.3.1 Line integrals in the complex plane
- 1.3.2 Basic Problems of the complex line integrals
- 1.3.3 Cauchy's integral theorem
- 1.3.4 Cauchy's integral formula
- 1.3.5 Supplementary problems

1.4 Complex Power Series, Complex Taylor series and Lauren series
- 1.4.1 Complex power series
- 1.4.2 Functions represented by power series
- 1.4.3 Taylor series, Taylor series of elementary functions
- 1.4.4 Practical methods for obtaining power series, Laurent series
- 1.4.5 Analyticity at infinity, zeros, singularities, residues, Cauchy's residue theorem
- 1.4.6 Evaluation of real integrals

2. The Z-Transform (9 hours)

2.1 Introduction
2.2 Properties of Z-Transform
2.3 Z- transform of elementary functions
2.4 Linearity properties
2.5 First shifting theorem, second shifting theorem, Initial value theorem,
2.6 Final value theorem, Convolution theorem
2.7 Some standard Z- transform
2.8 Inverse Z-Transform
2.9 Method for finding Inverse Z-Transform
2.10 Application of Z-Transform to difference equations

3. Partial Differential Equations (12 hours)

3.1 Linear partial differential equation of second order, their classification and solution
3.2 Solution of one dimensional wave equation, one dimensional heat equation, two dimensional heat equation and Laplace equation (Cartesian and polar form) by variable separation method

4. Fourier Transform (6 hours)

4.1 Fourier integral theorem, Fourier sine and cosine integral; complex form of Fourier integral
4.2 Fourier transform, Fourier sine transform, Fourier cosine transform and their properties
4.3 Convolution, Parseval's identity for Fourier transforms
4.4 Relation between Fourier transform and Laplace transform

References:

1. E. Kreyszig, “Advance Engineering Mathematics”, Fifth Edition, Wiley, New York.
2. A. V. Oppenheim, “Discrete-Time Signal Processing”, Prentice Hall, 1990.
3. K. Ogata, “Discrete-Time Control System”, Prentice Hall, Englewood Cliffs, New Jersey, 1987.

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hour	Marks distribution*
1	18	30
2	9	20
3	12	20
4	6	10
Total	**45**	**80**

There may be minor deviation in marks distribution.

INSTRUMENTATION I
EE 552

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
Comprehensive treatment of methods and instrument for a wide range of measurement problems.

1. Instrumentations Systems (2 Hours)
- 1.1 Functions of components of instrumentation system introduction, signal processing , Signal transmission ,output indication
- 1.2 Need for electrical, electronics, pneumatic and hydraulic working media systems and conversion devices
- 1.3 Analog and digital systems

2. Theory of measurement (10 Hours)
- 2.1 Static performance parameters - accuracy, precision, sensitivity, resolution and linearity
- 2.2 Dynamic performance parameters - response time, frequency response and bandwidth
- 2.3 Error in measurement
- 2.4 Statistical analysis of error in measurement
- 2.5 Measurement of voltage & current (moving coil & moving iron instruments)
- 2.6 Measurement of low, high & medium resistances
- 2.7 AC bridge & measurement of inductance and capacitance

3. Transducer (8 Hours)
- 3.1 Introduction
- 3.2 Classification
- 3.3 Application
  - 3.3.1 Measurement of mechanical variables, displacement, strain. velocity. acceleration and vibration
  - 3.3.2 Measurement of process variables - temperature pressure, level, fluid flow, chemical constituents in gases or liquids, pH and humidity.
  - 3.3.3 Measurement of bio-physical variables blood pressure and myoelectric potentials

4. Electrical Signal Processing and transmission (6 Hours)
- 4.1 Basic Op-amp characteristics
- 4.2 Instrumentation amplifier
- 4.3 Signal amplification, attenuation, integration, differentiation, network isolation, wave shaping
- 4.4 Effect of noise, analog filtering, digital filtering
- 4.5 Optical communication, fibre optics, electro-optic conversion devices

5. Analog - Digital and Digital - Analog Conversion (6 Hours)
- 5.1 Analog signal and digital signal
- 5.2 Digital to analog convertors - weighted resistor type, R-2R ladder type, DAC Errors
- 5.3 Analog to digital convertors - successive approximation type, ramp type, dual ramp type, flash type, ADC errors

6. Digital Instrumentation (5 Hours)
- 6.1 Sample data system, sample and hold circuit
- 6.2 Components of data acquisition system
- 6.3 Interfacing to the computer
- 6.4

7. Electrical equipments (8 Hours)
- 7.1 Wattmeter
  - 7.1.1 types
  - 7.1.2 working principles
- 7.2 Energy meter
  - 7.2.1 types
  - 7.2.2 working principles
- 7.3 Frequency meter
  - 7.3.1 types
  - 7.3.2 working principles
- 7.4 Power factor meter
- 7.5 Instrument transformers

Practical:
1. **Accuracy test in analog meters**
2. **Operational Amplifiers in Circuits**
   - Use of Op amp as a summer, inverter, integrator and differentiator

3. **Use resistive, inductive and capacitive transducers to measure displacement**
   - Use strain gauge transducers to measure force
4. **Study of Various transducers for measurement of Angular displacement, Angular Velocity, Pressure and Flow**
   - Use optical, Hall effect and inductive transducer to measure angular displacement
   - Use tacho - generator to measure angular velocity
   - Use RTD transducers to measure pressure and flow
5. **Digital to Analog Conversion**
   - Perform static testing of D/A converter
6. **Analog to Digital Conversion**
   - Perform static testing of A/D converter

References:

1. D.M Considine "Process Instruments and Controls Handbook" third edition McGraw Hill, 1985
2. S. Wolf and R.F.M. Smith "Students Reference Manual for Electronics Instrumentation Laboratories", Prentice Hall, 1990
3. E.O Deobelin "Measurement System, Application and Design" McGraw Hill, 1990
4. A.K Sawhney "A Course in Electronic Measurement and Instrumentation " Dhanpat Rai and Sons,1988
5. C.S. Rangan, G.R Sharma and V.S.V. Mani, "Instrumentation Devices and Systems" Tata McGraw Hill publishing Company Limited New Delhi,1992.
6. J.B. Gupta. "A Course in Electrical & Electronics Measurement & Instrumentation, thirteenth edition, 2008, Kataria & Sons.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	2	6
2	10	16
3	8	16
4	6	10
5	6	10
6	5	10
7	8	12
Total	**45**	**80**

* There could be a minor deviation in the marks distribution.

POWER SYSTEM ANALYSIS - I
EE 555

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:
The course aim to deliver the basic principle and fundamental analysis techniques for generation, transmission and distribution components of a power system as a first course in power system

1. General Background (6 hours)
- 1.1 Power System Evolution
- 1.2 Generation, Transmission and Distribution Components
- 1.3 Energy Sources; hydro, thermal, Nuclear etc.
- 1.4 Basic introduction to renewable energy; Photovoltaic, wind, geothermal etc
- 1.5 Major electrical components in power station; alternators, transformers, bus bars, voltage regulators, switch and isolators, metering and control panels
- 1.6 Infinite bus concept
- 1.7 Voltage levels, AC Vs DC Transmission
- 1.8 Single phase and three phase power delivery

2. Overhead & Underground Transmission (8 hours)
- 2.1 Line supports, spacing between conductors
- 2.2 Transmission line conductor materials
- 2.3 Stranded and bundled conductors
- 2.4 Overhead line insulators, its types
- 2.5 Voltage distribution along string of suspension insulators, string efficiency
- 2.6 Classification, construction of underground cables, insulation resistance
- 2.7 Dielectric stress in single core/multi core cables
- 2.8 Cable faults and location of faults

3. Computational Technique (8 hours)
- 3.1 Single phase representation of three phase system
- 3.2 Impedance and reactance diagram
- 3.3 Single line diagram
- 3.4 Complex powers
- 3.5 Direction of power flow
- 3.6 Per unit system; advantage and applications

4. Line parameter calculations (10 hours)
- 4.1 Inductance, resistance and capacitance of a line
- 4.2 Inductance of line due to internal & external flux linkages
- 4.3 Skin & proximity effect
- 4.4 Inductance of single phase two wire line, stranded & bundled conductor consideration, concept of G.M.R and G. M.D, inductance of 3 phase line; equilateral and unsymmetrical spacing
- 4.5 Transposition, inductance of double circuit 3 phase lines
- 4.6 Concept of G.M.R and G. M.D for capacitance calculations
- 4.7 Capacitance calculations of single phase two wire line, stranded & bundled conductor consideration, capacitance of 3 phase line; equilateral and unsymmetrical spacing, double circuit
- 4.8 Earth effect in capacitance of a line

5. Transmission line modeling (4 hours)
- 5.1 Classification of a lines based on short, medium and long lines
- 5.2 Representation of 'Tee' and 'Pi' of medium lines; calculation of ABCD parameters
- 5.3 Distributed Parameter model of Long lines; calculation of ABCD parameters
- 5.4 Equivalent 'Tee' and 'Pi' of long lines

6. Performance Analysis (8 hours)
- 6.1 Sending and receiving end quantities analysis
- 6.2 Voltage regulation & efficiency calculation of transmission lines
- 6.3 Transmission line as source and sink of reactive power
- 6.4 Real and reactive power flow through lines
- 6.5 Surge impedance loading
- 6.6 High capacitance effect of long lines
- 6.7 Reactive compensation of transmission lines

References:

1. Power System Analysis by W.D. Stevension, Tata McGraw Hill Publications
2. Modern Power system analysis by I.J Nagrath and D.P Kothari, Tata McGraw Hill Publications

3. A text book on Power System Engineering by Chakraborty, M.L. sony, P.V. Gupta et al., Dhanpat rai & Co.
4. Electric power Generation, Transmission & Distribution by S.N. Singh, Prentece Hall

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	6	10
2	8	12
3	8	16
4	10	16
5	4	10
6	8	16
Total	**44**	**80**

*There could be a minor deviation in Marks distribution

MICROPROCESSORS
EX 551

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3

Course Objective:
The objective of the course is to familiarize students with programming, hardware and application of microprocessor.

1. Introduction (4 hours)
- 1.1 Introduction and History of Microprocessors
- 1.2 Basic Block Diagram of a Computer
- 1.3 Organization of Microprocessor Based System
- 1.4 Bus Organization
- 1.5 Stored program Concept and Von Neumann Machine
- 1.6 Processing Cycle of a Stored Program Computer
- 1.7 Microinstructions and Hardwired/Micro programmed Control Unit
- 1.8 Introduction to Register Transfer Language

2. Programming with 8085 Microprocessor (10 hours)
- 2.1 Internal Architecture and Features of 8085 microprocessor
- 2.2 Instruction Format and Data Format
- 2.3 Addressing Modes of 8085
- 2.4 Intel 8085 Instruction Set
- 2.5 Various Programs in 8085
  - 2.5.1 Simple Programs with Arithmetic and Logical Operations
  - 2.5.2 Conditions and Loops
  - 2.5.3 Array and Table Processing
  - 2.5.4 Decimal BCD Conversion
  - 2.5.5 Multiplication and Division

3. Programming with 8086 Microprocessor (12 hours)
- 3.1 Internal Architecture and Features of 8086 Microprocessor
  - 3.1.1 BIU and Components
  - 3.1.2 EU and Components
  - 3.1.3 EU and BIU Operations
  - 3.1.4 Segment and Offset Address
- 3.2 Addressing Modes of 8086
- 3.3 Assembly Language Programming
- 3.4 High Level versus Low Level Programming
- 3.5 Assembly Language Syntax
  - 3.5.1 Comments
  - 3.5.2 Reserved words
  - 3.5.3 Identifiers
  - 3.5.4 Statements
  - 3.5.5 Directives
  - 3.5.6 Operators
  - 3.5.7 Instructions
- 3.6 EXE and COM programs
- 3.7 Assembling, Linking and Executing
- 3.8 One Pass and Two Pass Assemblers
- 3.9 Keyboard and Video Services
- 3.10 Various Programs in 8086
  - 3.10.1 Simple Programs for Arithmetic, Logical, String Input/Output
  - 3.10.2 Conditions and Loops
  - 3.10.3 Array and String Processing
  - 3.10.4 Read and Display ASCII and Decimal Numbers
  - 3.10.5 Displaying Numbers in Binary and Hexadecimal Formats

4. Microprocessor System (10 hours)
- 4.1 Pin Configuration of 8085 and 8086 Microprocessors
- 4.2 Bus Structure
  - 4.2.1 Synchronous Bus
  - 4.2.2 Asynchronous Bus
  - 4.2.3 Read and Write Bus Timing of 8085 and 8086 Microprocessors
- 4.3 Memory Device Classification and Hierarchy
- 4.4 Interfacing I/O and Memory
  - 4.4.1 Address Decoding
  - 4.4.2 Unique and Non Unique Address Decoding
  - 4.4.3 I/O Mapped I/O and Memory Mapped I/O
  - 4.4.4 Serial and Parallel Interfaces
  - 4.4.5 I/O Address Decoding with NAND and Block Decoders (8085, 8086)
  - 4.4.6 Memory Address Decoding with NAND, Block and PROM Decoders (8085, 8086)
- 4.5 Parallel Interface

4.5.1 Modes: Simple, Wait, Single Handshaking and Double Handshaking
4.5.2 Introduction to Programmable Peripheral Interface (PPI)

4.6 Serial Interface
4.6.1 Synchronous and Asynchronous Transmission
4.6.2 Serial Interface Standards: RS232, RS423, RS422, USB
4.6.3 Introduction to USART

4.7 Introduction to Direct Memory Access (DMA) and DMA Controllers

5. Interrupt Operations (5 hours)

5.1 Polling versus Interrupt
5.2 Interrupt Processing Sequence
5.3 Interrupt Service Routine
5.4 Interrupt Processing in 8085
5.4.1 Interrupt Pins and Priorities
5.4.2 Using Programmable Interrupt Controllers (PIC)
5.4.3 Interrupt Instructions
5.5 Interrupt Processing in 8086
5.5.1 Interrupt Pins
5.5.2 Interrupt Vector Table and its Organization
5.5.3 Software and Hardware Interrupts
5.5.4 Interrupt Priorities

6. Advanced Topics (4 hours)

6.1 Multiprocessing Systems
6.1.1 Real and Pseudo-Parallelism
6.1.2 Flynn's Classification
6.1.3 Instruction Level, Thread Level and Process Level Parallelism
6.1.4 Interprocess Communication, Resource Allocation and Deadlock
6.1.5 Features of Typical Operating System
6.2 Different Microprocessor Architectures
6.2.1 Register Based and Accumulator Based Architecture
6.2.2 RISC and CISC Architectures
6.2.3 Digital Signal Processors

Practical:

There will be about 12 lab exercises to program 8085 and 8086 microprocessors.

References:

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Application with 8085", 5th Edition 2002, Prentice Hall
2. Peter Abel, "IBM PC Assembly Language and Programming", 5th Edition 2001, Pearson Education Inc.
3. D. V. Hall, "Microprocessor and Interfacing, Programming and Hardware", 2nd Edition 1999, Tata McGraw Hill
4. John Uffenbeck, "Microcomputers and Microprocessors, The 8080, 8085 and Z-80 Programming, Interfacing and Troubleshooting" 3rd Edition 1999, Prentice Hall
5. Walter A. Triebel and Avtar Singh, "The 8088 and 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications", 4th Edition 2003, Prentice Hall
6. William Stalling, "Computer Organization and Architecture", 8th Edition 2009, Prentice Hall

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	4	8
2	10	16
3	12	16
4	10	16
5	5	8
6	4	8
1,2,3,4,5,6	-	8
Total	**45**	**80**

*There could be a minor deviation in Marks distribution

ELECTRIC MACHINES-II

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Lecture : 2 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:
To impart knowledge on constructional details, operating principle and performance of 3-phase Synchronous Machines and Fractional Kilowatt Motors.

1. Three Phase Synchronous Generator (8 hours)
- 1.1 Constructional Details, Armature Windings, Types of Rotor, Exciter
- 1.2 Working Principle, Rotating Magnetic Field
- 1.3 EMF equation, distribution factor, pitch factor
- 1.4 Armature Reaction and its effects
- 1.5 Alternator with load and its phasor diagram
- 1.6 Voltage Regulations
- 1.7 Parallel Operation and Synchronization
- 1.8 Operation on infinite bus

2. Three Phase Synchronous Motor (7 hours)
- 2.1 Principle of operation
- 2.2 Starting methods
- 2.3 No load and Load operation, Phasor Diagram
- 2.4 Effect of Excitation and power factor control, V and Inverted V Curves
- 2.5 Hunting
- 2.6 Power angle Characteristics of Cylindrical Rotor Machine
- 2.7 Two reaction Model of Salient pole machine
- 2.8 Power Angle Characteristics of Salient Pole Machine

3. Fractional Kilowatt Motors (12 hours)
- 3.1 Single phase Induction Motors: Construction and Characteristics
- 3.2 Double Field Revolving Theory
- 3.3 Split phase Induction Motor
  - 1.1.1 Capacitor start motor
  - 1.1.2 Capacitors start and run motor
  - 1.1.3 Shaded pole motor
  - 1.1.4 Reluctance start motor
- 3.4 Single phase Synchronous Motor
  - 1.1.5 Reluctance motor
  - 1.1.6 Hysteresis motor
- 3.5 Universal motors
- 3.6 Special Purpose Machines: Stepper motor, Schrage motor and Servo motor

References:

1 I.J. Nagrath&D.P.Kothari," Electrical Machines", Tata McGraw Hill
2 S. K. Bhattacharya, "Electrical Machines", Tata McGraw Hill
3 Husain Ashfaq ," Electrical Machines", DhanpatRai& Sons
4 A.E. Fitzgerald, C.KingsleyJr and Stephen D. Umans,"Electric Machinery", Tata McGraw Hill
5 P. S. Bhimbra, "Electrical Machines"' Khanna Publishers
6 Irving L.Kosow, "Electric Machine and Tranformers", Prentice Hall of India.
7 M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.
8 Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" OxfordUniversity Press, 2001.

Practical:
1. To study No-load characteristics of a 3-phase synchronous generator
2. To study load characteristics of synchronous generator with (a) resistive load (b) inductive load and (c) capacitive load
3. To study the effect of excitation on performance of a synchronous motor and to plot V- curve
4. To study the effect of a capacitor on the starting and running of a single-phaseinduction motor
5. To study the operating characteristics of universal motors

Evaluation Scheme
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicates in the table below.

Chapter	Hours	Marks Distribution*
1	8	14
2	7	12
3	12	14
Total	27	40

* There could be a minor deviation in the marks distribution.

COMMUNICATION ENGLISH
SH….

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 2

Course Objectives

- To make the students capable of producing professional writings such as research articles, technical proposals, reports and project work.
- To familiarize the students with the native speakers' pronunciation with the use of audio-visual aids.

Unit I: Reading (15 hours)

1. **Intensive Reading** 8 hours
   - 1.1. Comprehension
   - 1.2. Note-taking
   - 1.3. Summary writing
   - 1.4. Contextual questions based on facts and imagination
   - 1.5. Interpreting text

2. **Extensive Reading** **5** hours
   - 2.1. Title/Topic Speculation
   - 2.2. Finding theme
   - 2.3. Sketching character

3. **Contextual Grammar** **2** hours
   - 3.1. Sequence of tense
   - 3.2. Voice
   - 3.3. Subject-Verb agreement
   - 3.4. Conditional Sentences
   - 3.5. Preposition

Unit II: Writing **(30** hours**)**

1. **Introduction to technical writing process** **2** hours
   - 1.1. Composing and editing strategies
   - 1.2. MLA and APA comparison

2. **Writing notices with agenda and minutes** **2** hours
   - 2.1. Introduction
   - 2.2. Purpose
   - 2.3. Process

3. **Writing Proposal** **6** hours
   - 3.1. Introduction
   - 3.2. Parts of the proposal
     - 3.2.1. Title page
     - 3.2.2. Abstract/Summary
     - 3.2.3. Statement of Problem
     - 3.2.4. Rationale
     - 3.2.5. Objectives
     - 3.2.6. Procedure/Methodology
     - 3.2.7. Cost estimate or Budget
     - 3.2.8. Time management/Schedule
     - 3.2.9. Summary
     - 3.2.10. Conclusion
     - 3.2.11. Evaluation or follow-up
     - 3.2.12. Works cited

4. **Reports**
   - 4.1. Informal Reports 6 hours
     - 4.1.1. Memo Report
       - 4.1.1.1. Introduction
       - 4.1.1.2. Parts
     - 4.1.2. Letter Report
       - 4.1.2.1. Introduction
       - 4.1.2.2. Parts
   - 4.2. Project/Field Report 3 hours
     - 4.2.1. Introduction
     - 4.2.2. Parts
   - 4.3. Formal report 9 hours
     - 4.3.1. Introduction
     - 4.3.2. Types of Formal Reports
       - 4.3.2.1. Progress Report
       - 4.3.2.2. Feasibility Report
       - 4.3.2.3. Empirical/ Research Report
       - 4.3.2.4. Technical Report
     - 4.3.3. Parts and Components of Formal Report
       - 4.3.3.1. Preliminary section
         - 4.3.3.1.1. Cover page
         - 4.3.3.1.2. Letter of transmittal/Preface
         - 4.3.3.1.3. Title page

4.3.3.1.4. Acknowledgements
4.3.3.1.5. Table of Contents
4.3.3.1.6. List of figures and tables
4.3.3.1.7. Abstract/Executive summary

4.3.3.2. Main Section
4.3.3.2.1. Introduction
4.3.3.2.2. Discussion/Body
4.3.3.2.3. Summary/Conclusion
4.3.3.2.4. Recommendations

4.3.3.3. 4.3.3.3 Documentation
4.3.3.3.1. Notes (Contextual/foot notes)
4.3.3.3.2. Bibliography
4.3.3.3.3. Appendix

5. **Writing Research Articles** 2 hours
   5.1. Introduction
   5.2. Procedures

References

1. Adhikari, Usha : Yadv, Rajkumar : Shrestha, Rup Narayan ; (2000) Communicative Skills in english,Research Training Unit, IOE, Pulchowk Campus
2. Khanal, Ramnath, (2008) Need-based Language Teaching (Analysis in Relation to Teaching of English for Profession Oriented Learners) Kathmandu : D, Khanal.
3. Konar, Nira (2010), Communication Skills for Professional PHI Learning Private Limited, New Delhi.
4. Kumar, Ranjit (2006), Research Methodology, Pearson Education.
5. Laxminarayan, K.R (2001), English for Technical Communication. Chennai; Scitech publications (India) Pvt. Ltd.
6. Mishra, Sunita et. al. (2004), Communication Skills for Engineers, Pearson Education First Indian print.
7. Prasad, P. et. al (2007), The functional Aspects of Communication Skills S.K. Kataria & sons.
8. Rutherfoord, Andrea J. Ph.D (2001), Basic Communication Skills for Technology, Pearson Education Asia.
9. Rizvi, M. Ashraf (2008), Effective Technical Communication. Tata Mc Graw Hill.
10. Reinking A James et. al (1999), Strategies for Successful Writing: A rhetoric, research guide, reader and handbook, Prentice Hall Upper Saddle River, New Jersey.
11. Sharma R.C. et al. (2009), Business Correspondence and Report Writing: A Practical Approach to Business and Technical communication. Tata Mc Graw Hill.
12. Sharma, Sangeeta et. al (2010) Communication skills for Engineers and Scientists, PHI Learning Private Limited, New Delhi.
13. Taylor, Shirley et. al. (2009), Model Business letters, E-mails & other Business documents, Pearson Education.

Language lab		30 hours
Listening		12 hours
Activity I	General instruction on effective listening, factors influencing listening, and note-taking to ensure ttention. (Equipment Required: Laptop, multimedia, laser pointer, overhead projector, power point, DVD, video set, screen)	2 hours
Activity II :	Listening to recorded authentic instruction followed by exercises. (Equipment Required: Cassette player or laptop)	2 hours
Activity III	Listening to recorded authentic description followed by exercises. (Equipment Required: Cassette player or laptop)	4 hours
Activity IV	Listening to recorded authentic conversation followed by exercises (Equipment Required: Cassette player or laptop)	4 hours
Speaking		18 hours
Activity I	General instruction on effective speaking ensuring audience's attention, comprehension and efficient use of Audio-visual aids. (Equipment Required: Laptop, multimedia, laser pointer, DVD, video, overhead projector, power point, screen)	2 hours
Activity II	Making students express their individual views on the assigned topics (Equipment Required: Microphone, movie camera)	2 hours
Activity III	Getting students to participate in group discussion on the assigned topics	4 hours
Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector,	8 hours

	microphone, power point, laser pointer multimedia, video camera, screen)	
Activity V	Getting students to present their brief oral reports individually on the topics of their choice. (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	2 hours

Evaluation Scheme:

Unit	Testing Items	Number of Questions	Marks Distribution*
I	Reading Passages	3	15
	Novel	1	5
	Novel	1	5
	Grammar	10 or 5	5
II	Composing & Editing strategies	1	5
	MLA and APA Comparison	1	4
	Writing Research Articles	1	10
	Writing notice, Agenda and minutes	1	5
	Writing Proposal	1	8
	I Writing Reports (Formal Report)	1	10
	II Writing short reports or Project Report	1	8
		Total	80

- **There may be minor Variation in marks distribution**

Language Lab

Title	Testing Items	Number of Questions	Marks Distribution
Language Lab	**Listening** - Instruction - Description - Conversation	3	10
	Speaking - Expressing Individual views - Group/Round Table discussion - Talk delivery - Presenting brief oral report	3	15

PROBABILITY AND STATISTICS

.....

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 0

Course Objective:
To provide the students with particle knowledge of the principles and concept of probability and statistics and their application in engineering field.

1. Descriptive statistics and Basic probability (6 hours)
- 1.1. Introduction to statistics and its importance in engineering
- 1.2. Describing data with graphs (bar, pie, line diagram, box plot)
- 1.3. Describing data with numerical measure(Measuring center, Measuring variability)
- 1.4. Basic probability, additive Law, Multiplicative law, Baye's theorem.

2. Discrete Probability Distributions (6 hours)
- 2.1. Discrete random variable
- 2.2. Binomial Probability distribution
- 2.3. Negative Binomial distribution
- 2.4. Poison distribution
- 2.5. Hyper geometric distribution

3. Continuous Probability Distributions (6 hours)
- 3.1. Continuous random variable and probability densities
- 3.2. Normal distribution
- 3.3. Gama distribution
- 3.4. Chi square distribution

4. Sampling Distribution (5 hours)
- 4.1. Population and sample
- 4.2. Central limit theorem
- 4.3. Sampling distribution of sample mean
- 4.4. Sampling distribution of sampling proportion

5. Correlation and Regression (6 hours)
- 5.1. Least square method
- 5.2. An analysis of variance of Linear Regression model
- 5.3. Inference concerning Least square method
- 5.4. Multiple correlation and regression

6. Inference Concerning Mean (6 hours)
- 6.1. Point estimation and interval estimation
- 6.2. Test of Hypothesis
- 6.3. Hypothesis test concerning One mean
- 6.4. Hypothesis test concerning two mean
- 6.5. One way ANOVA

7. Inference concerning Proportion (6 hours)
- 7.1. Estimation of Proportions
- 7.2. Hypothesis concerning one proportion
- 7.3. Hypothesis concerning two proportion
- 7.4. Chi square test of Independence

9. Application of computer on statistical data computing (4 hours)
- 8.1 Application of computer in computing statistical problem. *eq* scientific calculator, EXCEL, SPSS , Matlab etc

References:

1. Richard A. Johnson, "Probability and Statistics for Engineers 7th edition", Miller and Freund's publication
2. Jay L. Devore, " Probability and Statistics for Engineering and the Sciences" ,Brooks/Cole publishing Company, Monterey, California,1982
3. Richard I. Levin, David S Rubin, " Statistics For Management", Prentice Hall publication
4. Mendenhall Beaver Beaver, " Introduction Probability and statistics 12th edition ", Thomson Brooks/Cole

Evaluation scheme:

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark distribution *
1	6	12
2	6	10
3	6	10
4	5	10
5	6	10
6	6	10
7	6	10
8	4	8
Total	**45**	**80**

*There may be minor deviation in marks distribution.

CONTROL SYSTEM
EG……

Theory: 3 **Year: III**
Tutorial: 1 **Part: I**
Practical: 3/2

Course Objectives:
To present the basic concepts on analysis and design of control system and to apply these concepts to typical physical processes.

1. Control System Background (2 hours)
- 1.1. History of control system and its importance
- 1.2. Control system: Characteristics and Basic features
- 1.3. Types of control system and their comparison

2. Component Modeling (6 hours)
- 2.1. Differential equation and transfer function notations
- 2.2. Modeling of Mechanical Components: Mass, spring and damper
- 2.3. Modeling of Electrical components: Inductance, Capacitance, Resistance, DC and AC motor, Transducers and operational amplifiers
- 2.4. Electric circuit analogies (force-voltage analogy and force- current analogy)
- 2.5. Linearized approximations of non-linear characteristics

3. System Transfer Function and Responses (6 hours)
- 3.1. Combinations of components to physical systems
- 3.2. Block diagram algebra and system reduction
- 3.3. Signal flow graphs
- 3.4. Time response analysis:
  - 3.4.1. Types of test signals (Impulse, step, ramp, parabolic)
  - 3.4.2. Time response analysis of first order system
  - 3.4.3. Time response analysis of second order system
  - 3.4.4. Transient response characteristics
- 3.5. Effect of feedback on steady state gain, bandwidth, error magnitude and system dynamics

4. Stability (4 hours)
- 4.1. Introduction of stability and causes of instability
- 4.2. Characteristic equation, root location and stability
- 4.3. Setting loop gain using Routh-Hurwitz criterion
- 4.4. R-H stability criterion
- 4.5. Relative stability from complex plane axis shifting

5. Root Locus Technique (6 hours)
- 5.1. Introduction of root locus
- 5.2. Relationship between root loci and time response of systems
- 5.3. Rules for manual calculation and construction of root locus
- 5.4. Analysis and design using root locus concept
- 5.5. Stability analysis using R-H criteria

6. Frequency Response Techniques (6 hours)
- 6.1. Frequency domain characterization of the system
- 6.2. Relationship between real and complex frequency response
- 6.3. Bode Plots: Magnitude and phase
- 6.4. Effects of gain and time constant on Bode diagram
- 6.5. Stability from Bode diagram (gain margin and phase margin)
- 6.6. Polar Plot and Nyquist Plot
- 6.7. Stability analysis from Polar and Nyquist plot

7. Performance Specifications and Compensation Design (10 hours)
- 7.1. Time domain specification
  - 7.1.1. Rise time, Peak time, Delay time, settling time and maximum overshoot
  - 7.1.2. Static error co-efficient
- 7.2. Frequency domain specification
  - 1.1.1 Gain margin and phase margin
- 7.3. Application of Root locus and frequency response on control system design
- 7.4. Lead, Lag cascade compensation design by Root locus method.
- 7.5. Lead, Lag cascade compensation design by Bode plot method.
- 7.6. PID controllers

8. State Space Analysis (4 hours)
- 8.1. Definition of state -space

8.2. State space representation of electrical and mechanical system
8.3. Conversion from state space to a transfer function.
8.4. Conversion from transfer function to state space.
8.5. State-transition matrix.

Practical:

1. To study open loop and closed mode for d.c motor and familiarization with different components in D.C motor control module.
2. To determine gain and transfer function of different control system components.
3. To study effects of feedback on gain and time constant for closed loop speed control system and position control system.
4. To determine frequency response of first order and second order system and to get transfer function.
5. Simulation of closed loop speed control system and position control system and verification

References:

1. Ogata, K., "Modern Control Engineering", Prentice Hall, Latest Edition
2. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, Latest Edition.
3. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition.
4. Nagrath & Gopal, "Modern Control Engineering", New Ages International, Latest Edition

Evaluation Scheme:

Chapter	Hours	Marks Distribution*
1	2	4
2	6	12
3	6	10
4	4	8
5	6	12
6	6	10
7	10	16
8	4	8
Total	44	80

* There could be minor deviation in the marks distribution.

INSTRUMENTATION II

EX

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

- Continuation of INSTRUMENTATION I with emphasis on advance system design and case studies.
- To introduce and apply the knowledge of microprocessor, A/D, D/A converter to design Instrumentation system.
- To provide the concept on interfacing with microprocessor based system and circuit design techniques.

1. Microprocessor Based Instrumentation System (4 hours)

1.1. Basic Features of Microprocessor Based System
1.2. Open Loop and Closed Loop Microprocessor Based System
1.3. Benefits of Microprocessor Based System
1.4. Microcomputer on Instrumentation Design
1.5. Interfacing With Microprocessor
  1.5.1. PC Interfacing Techniques
  1.5.2. Review of Address Decoding
  1.5.3. Memory Interfacing
  1.5.4. Programmed I/O, Interrupt Driven I/O and Direct Memory Access (DMA)

2. Parallel Interfacing With Microprocessor Based System (4 hours)

2.1. Methods of Parallel Data Transfer : Simple Input and Output, Strobe I/O, Single Handshake I/O, & Double Handshake I/O
2.2. 8255 as General Purpose Programmable I/O Device and its interfacing examples
2.3. Parallel Interfacing with ISA and PCI bus

3. Serial Interfacing With Microprocessor Based System (6 hours)

3.1. Advantages of Serial Data Transfer Over Parallel
3.2. Synchronous and Asynchronous Data Transfer
3.3. Errors in Serial Data Transfer
3.4. Simplex, Half Duplex and Full Duplex Data Communication
3.5. Parity and Baud Rates
3.6. Introduction Serial Standards RS232, RS423, RS422
3.7. Universal Serial Bus
  3.7.1. The Standards: - USB 1.1 and USB 2.0
  3.7.2. Signals, Throughput & Protocol
  3.7.3. Devices, Hosts And On-The-Go
  3.7.4. Interface Chips:- USB Device And USB Host

4. Interfacing A/D And D/A Converters (4 hours)

4.1. Introduction
4.2. General Terms Involved in A/D and D/A Converters
4.3. Examples of A/D and D/A Interfacing
4.4. Selection of A/D and D/A Converters Based on Design Requirements

5. Data Acquisition And Transmission (5 hours)

5.1. Analog and Digital Transmission
5.2. Transmission Schemes
  5.2.1. Fiber Optics
  5.2.2. Satellite
  5.2.3. Bluetooth Devices
5.3. Data Acquisition System
  5.3.1. Data Loggers
  5.3.2. Data Archiving and Storage

6. Grounding And Shielding (3 hours)

6.1. Outline for Grounding and Shielding
6.2. Noise, Noise Coupling Mechanism and Prevention
6.3. Single Point Grounding and Ground Loop
6.4. Filtering and Smoothing
6.5. Decoupling Capacitors and Ferrite Beads
6.6. Line Filters, Isolators and Transient Suppressors
6.7. Different Kinds of Shielding Mechanism
6.8. Protecting Against Electrostatic Discharge
6.9. General Rules For Design

7. Circuit Design (3 hours)

7.1. Converting Requirements into Design
7.2. Reliability and Fault Tolerance
7.3. High Speed Design
  7.3.1. Bandwidth, Decoupling, Ground Bounce, Crosstalk, Impedance Matching, and Timing
7.4. Low Power Design
7.5. Reset and Power Failure Detection and interface Unit

8. Circuit Layout (3 hours)

8.1. Circuits Boards and PCBs
8.2. Component Placement
8.3. Routing Signal Tracks
8.3.1. Trace Density, Common Impedance, Distribution of Signals and Return, Transmission Line Concerns, Trace Impedance and Matching, and Avoiding Crosstalk.
8.4. Ground ,Returns and Shields
8.5. Cables and Connectors
8.6. Testing and Maintenance

9. Software For Instrumentation And Control Applications (4 hours)

9.1. Types of Software, Selection and Purchase
9.2. Software Models and Their Limitations
9.3. Software Reliability
9.4. Fault Tolerance
9.5. Software Bugs and Testing
9.6. Good Programming Practice
9.7. User Interface
9.8. Embedded and Real Time Software

10. Case Study (9 hours)

Examples chosen from local industrial situations with particular attention paid to the basic measurement requirements, accuracy, and specific hardware employed environmental conditions under which the instruments must operate, signal processing and transmission, output devices:

a) Instrumentation for a power station including all electrical and non-electrical parameters.
b) Instrumentation for a wire and cable manufacturing and bottling plant.
c) Instrumentation for a beverage manufacturing and bottling plant.
d) Instrumentation for a complete textile plant; for example, a cotton mill from raw cotton through to finished dyed fabric.
e) Instrumentation for a process; for example, an oil seed processing plant from raw seeds through to packaged edible oil product.
f) Instruments required for a biomedical application such as a medical clinic or hospital.
g) Other industries can be selected with the consent of the Subject teacher.

Practical:

The laboratory exercises deal interfacing techniques using microprocessor or microcontrollers. There will be about six lab sessions which should cover at least following:

1. Simple and Handshake data transfer using PPI.
2. Basic I/O device interfacing like keyboard, seven segments, motors etc
3. Analog to Digital interfacing
4. Digital to Analog interfacing
5. Design exercise (small group project)

Study in detail the instrumentation requirements of a particular proposed or existing industrial plant and design an instrumentation and data collection system for that particular industrial plant. The final report should present the instrumentation requirements in terms of engineering specifications, the hardware solution suggested, a listing of the particular devices chosen to satisfy the requirements, appropriate system flow diagrams, wiring diagrams, etc. to show how the system would be connected and operated.

References:

- D. V. Hall, "*Microprocessor and Interfacing, Programming and Hardware*" Revised 2nd Edition 2006, Tata McGraw Hill
- K.R. Fowler, "*Electronic Instrument Design: Architecting for the Life Cycle*", Oxford University Press, Inc. 1996
- Ramesh S. Gaonkar, "*Microprocessor Architecture, Programming and Application with 8085*", 5th Edition 2002, Prentice Hall
- A.K. Ray & K.M. Bhurchandi, **"***Advanced Microprocessors And Peripherals*", 2nd Edition 2006, Tata McGraw Hill
- E.O. Duebelin, "*Measurement System Application And Design*",5th Edition, Tata McGraw Hills
- John Hyde, "*USB Design By Example*", Intel Press
- PCI bus, USB, 8255,Bluetooth datasheets
- D. M. Consodine, "*Process Instruments and Controls Handbook*", 3rd Edition, McGraw-Hill,New York, 1985.
- S. Wolf and R. F. Smith, "*Student Reference Manual for Electronic Instrumentation Laboratories*", Prentice Hall, Englewood Cliffs, New Jersey, 1990.
- S. E. Derenzo, "*Interfacing: A Laboratory Approach Using the Microcomputer for Instrumentation, Data Analysis, and Control*", Prentice Hall, Englewood Cliffs, New Jersey, 1990.

Evaluation Scheme:

The question will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hour	Marks Distribution*
1	4	6
2	4	6
3	6	12
4	4	8
5	5	8
6	3	6
7	3	6
8	3	4
9	4	8
10	9	16
Total	45	80

* There could be minor deviation in the marks distribution.

POWER SYSTEM ANALYSIS -II

.....

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**

Course Objective:
The course aim to deliver the advance analysis of the interconnected power system including load flow, short circuit studies and stability analysis.

1. Interconnected Power System [6 hours]
- 1.1. Introduction
- 1.2. Real power/ frequency balance
- 1.3. Reactive power/ voltage balance
- 1.4. Node equations
- 1.5. Bus admittance matrixes
- 1.6. Applications of Bus admittance matrixes in Network analysis
- 1.7. Basic concept of Bus impedance Matrixes

2. Load Flow Analysis [8 hours]
- 2.1. Basic complex power flow equations for a power system networks
- 2.2. Data for Load flow studies
- 2.3. Iterative approaches for solving power flow equations
  - 2.3.1. Gauss-Seidal method
  - 2.3.2. Newton- Rapshon methods
- 2.4. Introduction to advance techniques e.g. decoupled load flow
- 2.5. Voltage profile and var compensation

3. Power system fault calculation [4 hours]
- 3.1. Definition and purpose of fault calculation
- 3.2. Types of faults in power system
- 3.3. Symmetrical fault calculations
- 3.4. Calculation of short circuit MVA

4. Unbalance System Analysis [6 hours]
- 4.1. Symmetrical components
- 4.2. Sequence impedances
- 4.3. Sequence components of the voltages and currents
- 4.4. Expression for power in terms of symmetrical components
- 4.5. Transformer voltages and currents

5. Unsymmetrical faults on Power Systems [10 hours]
- 5.1. Sequence networks of synchronous generators
- 5.2. Fault calculations of a single synchronous generator
  - 5.2.1. Line to ground faults
  - 5.2.2. Line to line faults
  - 5.2.3. Double line to ground faults
- 5.3. Path for zero sequence currents in Transformers
- 5.4. Fault calculations on a power system networks
  - 5.4.1. Line to ground faults
  - 5.4.2. Line to line faults
  - 5.4.3. Double line to ground faults

6. Power System Stability [10 hours]
- 6.1. Operational power balance in a synchronous generator
- 6.2. Classification of power system stability
- 6.3. Swing equation & swing curve for a single machine infinite bus system
- 6.4. Rotor angle stability; steady state, dynamic & transient stability
- 6.5. Equal area criterion
- 6.6. Stability enhancement techniques
- 6.7. Step by step method for solving swing equations by computer methods
- 6.8. Basic concept of voltage stability

References:

1. Power System Analysis by W.D. Stevension, Tata McGraw Hill Publications
2. Power System Stability and Control by P. Kundur
3. Modern Power System Analysis by I.J Nagrath and D.P Kothari, Tata McGraw Hill Publications

Evaluation Scheme:

The question will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hour	Marks Distribution *
1	6	10
2	8	16
3	4	8
4	6	10
5	10	16
6	10	20
Total	42	80

*There could be a minor deviation in Marks distribution

ELECTRIC MACHINE DESIGN
……EE

Lecture : 3 **Year : III**
Tutorial : **Part : I**
Practical : 3

Course Objective:
To impart knowledge on the principle of design of electrical machines like transformers, induction machines and DC machine

1. **Materials used in electrical equipment** **(5 hours)**
   - 1.1. Review of electrical conducting materials
     - 1.1.1 Various characteristics and comparison between conducting materials
     - 1.1.2 Materials of high conductivity and high resistivity
   - 1.2 Magnetic materials
     - 1.2.1 Classification ,characteristics and application of magnetic materials
     - 1.2.2 Materials for steady flux (solid core materials), materials for pulsating fluxes (laminated core materials sheet)
     - 1.2.3 Special purpose alloys ,hot rolled and cold rolled steel sheets, sintered power core
     - 1.2.4 Magnetic materials used in transformers, dc machines and ac machines
   - 1.3 Insulating materials
     - 1.3.1 Classification ,characteristics ,application
     - 1.3.2 Insulating materials for transformers, dc machines and ac machines, ceramics

2. Heating and cooling of electric machine **(7 hours)**
- 2.1 Review of heat transfer: Conduction, convection and radiation
- 2.2 Internal temperature (hot spots and their calculations)
- 2.3 Temperature gradients in iron core
- 2.4 Temperature gradients in conductors placed in slots
- 2.5 Ventilation of electrical machine
  - 2.5.1 Types of enclosure, methods of cooling, schemes of ventilation
  - 2.5.2 Cooling of totally enclosed machines ,cooling circuits ,cooling systems
- 2.6 Temperature rise, heating time constant, final steady temperature rise, cooling time constant
- 2.7 Rating of electric machine based on temperature rise
- 2.8 Calculation of temperature rise in armature, field coils and commutators

3. Transformer Design **(13 hours)**
- 3.1 Review of transformer theory
- 3.2 Types of transformer : Power transformer, distribution transformer, core type and shell type
- 3.3 Design approach
  - 3.3.1 Output equations (single and three phase), Volt per turn
  - 3.3.2 Design of core(square core, stepped and cruciform core)
  - 3.3.3 Choice of flux density
  - 3.3.4 Design of winding and choice of current density
  - 3.3.5 Design of insulation
  - 3.3.6 Design of window and window space factor
  - 3.3.7 Design of yoke
- 3.4 Calculation of operating characteristics from design data
  - 3.4.1 Resistance of winding, leakage reactance of winding in core type transformer, iron loss, copper loss, efficiency, regulation.
- 3.5 Design of cooling system
  - 3.5.1 Temperature rise in plain walled tank, design of tank and tubes

4. Three phase induction motor design **(10 hours)**
- 4.1 Review of three phase induction motor theory
  - 4.1.1 Construction and principle of three phase induction motor
  - 4.1.2 Various types of three phase stator winding
- 4.2 Design approach:
  - 4.2.1 Output equation, choice of magnetic and electric loading
  - 4.2.2 Choice of stator winding. stator slots and insulation, stator teeth , stator teeth, stator core and stator stamping dimension
  - 4.2.3 Air gap length, rotor design (squirrel cage and slip ring type)
  - 4.2.4 Leakage inductance, evaluation of equivalent circuit parameters and operating characteristics from design data.

5. DC Machine Design **(9 hours)**
- 5.1 Armature Winding
  - 5.1.1 Lap and wave winding

5.2 Design Approach :

5.2.1 Output equation, choice of average gap density, choice of ampere conductors per meter

5.2.2 Choice of no of poles in DC machine, pole proportions

5.2.3 Selection of length of air gap

5.2.4 Choice of armature windings, no of armature conductors, no of coils, no of armature slots, armature conductor selection

5.2.5 Design of commutator , design of brushes, design of compensating winding

5.2.6 Evaluation of operating characteristics from design data

Practical

1. A detail design of core type power and distribution transformer
   - orthographic drawing of transformer including winding, tank and tubes
2. A detail design of three phase induction motor
   - Drawing of three phase stator winding (Mush winding, Lap winding and Wave winding)
3. A detail design of DC armature winding
   - Drawing of Lap and wave winding used in DC machine armature

References

1. A.K. Sawhney " A course in Electrical Machine Design"
2. M.G. Say " Performance and design of AC Machines"
3. M.G. Say "Performance and design of DC Machines"

Evaluation Scheme:

The questions will cover all the chapters in syllabus. The evaluation scheme will be as indicated in the table below.

Chapters	Hours	Marks distribution*
1	5	10
2	7	12
3	13	24
4	10	18
5	9	16
Total	44	80

* There could be minor deviation in marks distribution

ENGINEERING ECONOMICS
CE

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:
After completing this course, students will be able to conduct simple economic studies. They will also be able to make evaluation of engineering projects and make decisions related to investment.

1. Introduction [3 hours]
- 1.1. Origin of Engineering Economy
- 1.2. Principles of Engineering Economy
- 1.3. Role of Engineers in Decision Making
- 1.4. Cash Flow Diagram.

2. Interest and Time Value of Money [6 hours]
- 2.1. Introduction to Time Value of Money
- 2.2. Simple Interest
- 2.3. Compound Interest
  - 2.3.1. Nominal Interest rate
  - 2.3.2. Effective Interest rate
  - 2.3.3. Continuous Compounding
- 2.4. Economic Equivalence
- 2.5. Development of Interest Formulas
  - 2.5.1. The Five Types of Cash flows
  - 2.5.2. Single Cash flow Formulas
  - 2.5.3. Uneven Payment Series
  - 2.5.4. Equal Payment Series
  - 2.5.5. Linear Gradient Series.
  - 2.5.6. Geometric Gradient Series.

3. Basic Methodologies of Engineering Economic Analysis [8 hours]
- 3.1. Determining Minimum Attractive (Acceptable) Rate of Return (MARR).
- 3.2. Payback Period Method
- 3.3. Equivalent Worth Methods
  - 3.3.1. Present Worth Method
  - 3.3.2. Future Worth Method.
  - 3.3.3. Annual Worth Method.
- 3.4. Rate of Return Methods
  - 3.4.1. Internal Rate of Return Method.
  - 3.4.2. External/Modified Rate of Return Method.
- 3.5. Public Sector Economic Analysis (Benefit Cost Ratio Method).
- 3.6. Introduction to Lifecycle Costing
- 3.7. Introduction to Financial and Economic Analysis

4. Comparative Analysis of Alternatives [6 hours]
- 4.1. Comparing Mutually Exclusive Alternatives having Same useful life by
  - 4.1.1. Payback Period Method and Equivalent Worth Method
  - 4.1.2. Rate of Return Methods and Benefit Cost Ratio Method
- 4.2. Comparing Mutually Exclusive Alternatives having different useful lives by
  - 4.2.1. Repeatability Assumption
  - 4.2.2. Co-terminated Assumption
  - 4.2.3. Capitalized Worth Method
- 4.3. Comparing Mutually Exclusive, Contingent and Independent Projects in Combination.

5. Replacement Analysis: [6 hours]
- 5.1. Fundamentals of Replacement Analysis
  - 5.1.1. Basic Concepts and Terminology
  - 5.1.2. Approaches for Comparing Defender and Challenger
- 5.2. Economic Service Life of Challenger and Defender
- 5.3. Replacement Analysis When Required Service Life is Long.
  - 5.3.1. Required Assumptions and Decision Framework
  - 5.3.2. Replacement Analysis under the Infinite Planning Horizon
  - 5.3.3. Replacement Analysis under the Finite Planning Horizon

6. Risk Analysis [6 hours]
- 6.1. Origin/Sources of Project Risks.
- 6.2. Methods of Describing Project Risks.
  - 6.2.1. Sensitivity Analysis
  - 6.2.2. Breakeven Analysis
  - 6.2.3. Scenario Analysis
- 6.3. Probability Concept of Economic Analysis
- 6.4. Decision Tree and Sequential Investment Decisions

7. Depreciation and Corporate Income Taxes [6 hours]
- 7.1. Concept and Terminology of Depreciation
- 7.2. Basic Methods of Depreciation

7.2.1. Straight line method
7.2.2. Declining Balance Method
7.2.3. Sinking Fund Method,
7.2.4. Sum of the Year Digit Method
7.2.5. Modified Accelerated Cost Recovery System (MACRS)

7.3. Introduction to Corporate Income Tax.
7.4. After Tax Cash flow Estimate.
7.5. General Procedure for Making After Tax Economic Analysis.

8. Inflation and Its Impact on Project Cashflows. [4 hours]

8.1. Concept of Inflation.
8.2. Measuring Inflation
8.3. Equivalence Calculation Under Inflation
8.4. Impact of Inflation on Economic Evaluation

Tutorials:

1. Assignments,
2. Quizzes and 1 Case study.

References:

1. Chan S. Park, *Contemporary Engineering Economics,* Prentice Hall, Inc.
2. E. Paul De Garmo, William G. Sullivan and James A. Bonta delli, *Engineering Economy,* MC Milan Publishing Company.
3. James L. Riggs, David D. Bedworth and Sabah U. Randhawa, *Engineering Economics,* Tata MCGraw Hill Education Private Limited.

Evaluation Scheme:

The question will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution *
1	4	4
2	8	8
3	12	16
4	8	12
5	8	12
6	8	12
7	8	12
8	4	4
Total	60	80

*There may be minor variation in marks distribution.

DIGITAL CONTROL SYSTEM
EG……

Theory: 3 **Year: III**
Tutorial: 1 **Part: II**
Practical: 3/2

Course Objectives:
To present the basic concepts on analysis and design of sampled data control system and to apply these concepts to typical physical processes.

1. Introduction to discrete time control system [8 hours]
- 1.1. Principle features of discrete time control system
- 1.2. Signal sampling, quantizing and coding
- 1.3. Data acquisition, conversion and distribution system
- 1.4. Reconstruction of original signal from sampled signal

2. The Z-Transform [8 hours]
- 2.1. Fundamentals of Z-transform
- 2.2. Important properties and theorems of the Z-transform
- 2.3. Z-transform from the convolution integral
- 2.4. Inverse Z-transform
  - 2.4.1. Direct Division
  - 2.4.2. Partial Fraction
  - 2.4.3. Inversion Integral
- 2.5. Z-transform method for solving difference equation

3. Analysis of discrete time control system [10 hours]
- 3.1. S-plane to Z-plane mapping and Vice-versa.
- 3.2. Stability analysis of closed loop systems in the Z-plane
- 3.3. Discrete time equivalents of continuous time systems
- 3.4. Discrete time equivalents of analog controllers
- 3.5. Transient and steady state response analysis

4. Design and compensation of discrete time control system [10 hours]
- 4.1. Digital filters: structure, implementation, frequency response, applications
- 4.2. Control system controllers: structure, hardware/software features, responses to control signals, use of root locus and frequency domain concepts
- 4.3. Phase lead and phase lag compensator design for discrete time system
- 4.4. PID controller design and selection of parameters for discrete time system

5. Discrete time state equations [8 hours]
- 5.1. State space representation of discrete time systems
- 5.2. Discretization of the continuous time state space equation
- 5.3. Pulse transfer function matrix
- 5.4. Stability assessment from the discretized state space equations

Practical:
1. Study of relay type "ON-OFF" control system
   - To familiarize the student about the feedback control system with an ON/OFF control
2. Z - transform using MATLB
   - To learn the application of MATLAB to convert the s-domain transfer function into z-domain
   - To study the affects in transient response and frequency response of different methods and sampling time used in z- Transfer function.
3. Stability analysis of closed –loop system in z-plane
   - To learn the application of MATLAB to test the stability of a system in z-domain
4. Simulation study using simulink of MATLAB
   - To Familiarize with MATLAB Simulation
   - To study simulation of discrete time control system
5. Position control system through analog interfacing
   - To learn the use of analog interfacing technique to control the position of motor in the DC Motor module

References:

1. K. Ogata, “Discrete Time Control Systems”, Prentice Hall, Englewood Cliffs, New Jersey.
2. Charles L. Phillips, “Digital Control System: Analysis and Design”, Prentice Hall, Englewood Cliffs, New Jersey.

Evaluation Scheme:

The questions will cover all the chapters in syllabus. The evaluation scheme will be as indicated in the table below.

Chapter	Hours	Mark distribution*
1	8	12
2	8	16
3	10	20
4	10	20
5	8	12
Total	44	80

* There could be minor deviation in the marks distribution.

Signal Analysis

.....

Lecture : 3 **year : III**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
To provide understanding of basic concepts in signals and systems.

1. **Signal** **(4 hours)**
   Signal definition, continuous time signal, discrete time signal, basic signal types, energy signal, power signal, periodicity of continuous time signal, periodicity of discrete time signal, transformation of independent variable.

2. **Fourier series** **(9 hours)**
   Continuous time Fourier series representation, properties of continuous time Fourier series (linearity, time shift, frequency shift, time reversal, time scaling, conjugation conjugate symmetry, multiplication, convolution), Parsevals relation.Discrete time Fourier series representation, Properties of discrete time Fourier series (linearity, time shift, frequency shift, time reversal, conjugation and conjugate symmetry, multiplication, convolution), parseval's relation.

3. **Fourier transform** **(12 hours)**
   Continuous time Fourier transform representation, properties of continuous time Fourier transform (linearity, time shift, frequency shift, time reversal, time scaling, duality, conjugation and conjugate symmetry, multiplication, convolution), Parseval's relation, Fourier transform of square wave function, impulse function, unit step function, rectangular function, signum function, cosine function, periodic function etc, energy spectral density, power spectral density. Discrete time Fourier transform representation, properties of discrete time Fourier transform (linearity, time shift, frequency shift, time reversal, conjugation and conjugate symmetry, multiplication, convolution), Parseval's relation, Fourier transform of rectangular sequence, unit sample sequence, periodic sequence etc, discrete Fourier transform, properties of discrete Fourier transform.

4. **Sampling** **(2 hours)**
   Ideal sampling, practical considerations in sampling, reconstruction of signal from its samples, aliasing.

5. **Continuous time system** **(9 hours)**
   System definition, properties of system, Linear time invariant (LTI) system, convolution integral, properties of LTI system, frequency response of LTI system, bode plot, conditions for distortion less transmission, ideal low pass filter, impulse response and step response of ideal low pass filter, impulse response and frequency response of first order system and second order system.

6. **Discrete time system** **(9 hours)**
   System definition, properties of system, Linear time invariant (LTI) system, convolution sum, properties of LTI system, difference equation, transfer function, frequency response of LTI system, bode plot, conditions for distortion less transmission, impulse response and frequency response of first order system and second order system.

References

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid "Signals and Systems", Prentice Hall
2. B. P. Lathi, "Linear systems and signals", Oxford University Press.

Evaluation Scheme
Marks distribution for all the chapters in the syllabus is shown in the table below.

Chapters	Hours	Mark distribution*
1	4	8
2	9	14
3	12	22
4	2	6
5	9	15
6	9	15
Total	45	80

* There could be minor deviation in the marks distribution.

Switchgear and Protection
……EE

Lecture : 4 **Year : III**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objective:
To present fundamental knowledge on protection system and its associated components in power system

1. Principle of power system protection (3 hours)
- 1.1. Protection system components and its terminologies
- 1.2. Basic requirement of protection scheme
- 1.3. Need of protection scheme in power system
- 1.4. Back up protection, coordination , protection zone

2. Current and Potential Transformers (3 hours)
- 2.1. Potential transformer: Operation, standard ratios, errors, application
- 2.2. Current transformer : Wound and bar types, operation, standard ratios
- 2.3. Accuracy classification , typical knee point voltage , applications

3. Fuses (4 hours)
- 3.1. Types of fuses: Construction, operating characteristic and application
- 3.2. Fuse element, rated fuse current , minimum fusing factor, fusing factor, pre arcing and arcing time
- 3.3. Merits and demerits of various types of fuse

4. Isolators and Contactors (4 hours)
- 4.1. Isolators: Construction, operation and uses
- 4.2. Contactors: Construction and operation, normally open (NO) and Normally Close (NC), auxiliary contacts of contactors and application of contactors

5. System Earthing (6 hours)
- 5.1. Earthing: Definition, purpose, system earthing and body earthing, methods of earthing, substation earthing, measurement of soil resistivity
- 5.2. Causes of over voltages: Internal cause and external cause
- 5.3. Over voltage protection: Overhead earth wire, angle of protection, horn gap and rod gap lightning arrestor, surge absorbers
- 5.4. Isolated neutral, solid neutral, resistance earthing, reactance earthing, Peterson coil earthing

6. Circuit Breaker (12hours)
- 6.1. Circuit breaking process: Arc phenomena, arc extinction and its methods, pre-arcing and arcing time, restricting voltage and recovery voltage
- 6.2. Duties of circuit breaker
- 6.3. Classification of circuit breaker:
  - 6.3.1. Miniature circuit breaker: Construction, operating principle and application and various types of MCB such as ELCB
  - 6.3.2. Moulded Case circuit Breaker: Construction, operating principle and application
  - 6.3.3. Air circuit breaker: Construction, operating merits and demerits, arc extinction phenomena and application.
  - 6.3.4. Oil circuit breaker: Construction, operating merits and demerits, arc extinction phenomena and application
  - 6.3.5. Vacuum circuit breaker: Construction, operating merits and demerits, arc extinction phenomena and application.
  - 6.3.6. SF6 circuit breaker: Construction, operating merits and demerits, arc extinction phenomena and application
- 6.4. Circuit breaker rating: Rated voltage , rated current, rated frequency, operating duty, making capacity, short time rating
- 6.5. HVDC circuit breaker
- 6.6. Auto reclosure
- 6.7. Testing of circuit breaker

7. Protective relays (14 hours)
- 7.1. Introduction
- 7.2. Classification of relays
- 7.3. Method of earth fault detection
- 7.4. Restricted and unrestricted earth fault protection
- 7.5. Electromagnet attraction relays
- 7.6. Electro magnet induction relays
- 7.7. Buchholz relay
- 7.8. Over current relays
  - 7.8.1. Inverse definite minimum time (IDMT) relay, TDS,PSM
  - 7.8.2. Application of IDMT relay in sectionalized HV feeder, Time-Graded protection/Current Graded protection
- 7.9. Directional relay (induction type)
- 7.10. Over current and earth fault relay

7.11. Unit protection scheme/Differential protection
  7.11.1. Advantage of unit protection scheme over non unit protection
  7.11.2. Application of unit protection/differential protection scheme to HV feeders,
  7.11.3. Transformers and generators
  7.11.4. Biased or percentage relay and its application to transformers and generators
  7.11.5. Voltage balance relay
7.12. Universal relay torque equation
7.13. Distance protection
  7.13.1. Impedance, reactance and mho relay
  7.13.2. Application of distance protection relay in sectionalized feeder
7.14. Carrier current protection
7.15. Bus bar protection

8. Static and digital Relays (12 hours)

8.1. Need for static relays
8.2. Essential components of static relays
8.3. Comparison of static and electromagnet relays
8.4. Classification of static relays
8.5. A review of Electronic Circuit Commonly used in static relays: Auxiliary DC Voltage Supply,
8.6. Time Delay Circuit, Level Detectors, Multivibrator, logic circuit, use of operational amplifier in static relay,
8.7. Static Over current relays and over volatge/under voltage realy
8.8. Directional static over current relays
8.9. Static differential relays
8.10. Static differential protection scheme applied to transformer
8.11. Static distance relays such as impedance relay, reactance relay and mho relay
8.12. Static differential protection applied to the generator
8.13. Block diagram and Component of digital relay
8.14. Block diagram of microprocessor based protective scheme for protection of transformer, generator and transmission line
8.15. Block diagram of microprocessor based over voltage /under voltage relay

Practical

1. Draw magnetizing curve for a protective CT. Check Knee point voltage
2. Test over current device in an Air Circuit Breaker for operation using primary injection
3. Test an induction disc relay in over current in over current protection scheme for operating characteristics using secondary injection.
4. Test an induction disc relay in residual earth fault protection scheme for operating characteristics and setting using secondary injection.
5. Check connections on a biased differential protection scheme of transformer. Test the scheme for operation and setting values on internal faults using primary injection
6. Measurement of soil resistivity

References

1. Sunil S. Rao “Switchgear and protection” Khanna Publishers
2. G. Mason “The art and science of protective realying”
3. J.B Gupta “Switchgear and protection” Kataria and Sons

Evaluation Scheme:

The questions will cover all the chapters in syllabus. The evaluation scheme will be as indicated in the table below.

Chapters	Hours	Marks distribution*
1	3	4
2	3	4
3	4	6
4	4	6
5	6	8
6	12	16
7	14	20
8	12	16
Total	58	80

* There could be minor deviation in marks distribution

INDUSTRIAL POWER DISTRIBUTION AND ILLUMINATION
EE …..

Lecture : 4 **Year : III**
Tutorial : 0 **Part : II**
Practical : 2

Course Objective:
After completion of the course, the student will be able to:
- Have detailed knowledge in design electrical distribution and illumination system
- Understand relevant standards, rules and regulation system
- Apply appropriate measures to evaluate and improve energy efficiency

1. Introduction (6 hours)
- 1.1. Electric Load Estimate
- 1.2. Load Centre
- 1.3. Supply System for Industrial Plant
- 1.4. Classification of Electrical Installation
- 1.5. Reading and Interpretation of Building Drawing
- 1.6. Electrical Rules related to Electrical Installation & Testing.

2. Earthing (4 hours)
- 2.1. Introducton
- 2.2. System & Equipment Earthing
  - 2.2.1. Point to be Earthed
  - 2.2.2. Factors Influencing the earth resistance
  - 2.2.3. Method of reducing earth resistance
- 2.3. Methods of Earthing
- 2.4. Lightning Protection Earthing

3. Power Carrying Devices (6 hours)
- 3.1. Cables
  - 3.1.1. Cable Construction
  - 3.1.2. Types of cables
  - 3.1.3. Cable Ratings: voltage rating & Conductor size
  - 3.1.4. Installation of cable
  - 3.1.5. Locating cable faults
- 3.2. Connectors and Terminations
  - 3.2.1. Types of connectors and Applications
  - 3.2.2. Types of terminations and Methods
  - 3.2.3. Splicing Devices and Techniques :
- 3.3. Bus-way
  - 3.3.1. Bus-way Construction and Standards,
  - 3.3.2. Types of Bus-way
  - 3.3.3. Applications
  - 3.3.4. Installation

4. Distribution Substation of Industrial Plant (6 hours)
- 4.1. Introduction
- 4.2. Classification
- 4.3. Indoor Substations
- 4.4. Out-door Substations
- 4.5. Selection and Location of site
- 4.6. Schematic Diagram of Distribution Substation
- 4.7. Equipment and Measuring Accessories for Substations and Switch gear Installation

5. Electrification of Industrial Building (5 hours)
- 5.1. Concept of Industrial Installation
- 5.2. General rules guidelines for wiring of Industry
- 5.3. Installation and positioning of equipments.
- 5.4. Principles of circuit design in power circuits.
- 5.5. Energy and power requirement for Lift, Conveyor-belt and HVAC
- 5.6. Procedures for designing the circuits and deciding the number of circuits.
- 5.7. Method of drawing single line diagram.
- 5.8. Selection of type of wiring and rating of wires & cables.
- 5.9. Load calculations and selection of size of conductor.
- 5.10. Selection of rating of main Panel Board and distributions board,
- 5.11. Protective switchgear Fuse, MCCB , MCB and accessories.

6. System Components for Industrial Illumination (6 hours)
- 6.1. Light Sources
  - 6.1.1. Incandescent Filament Lamps
  - 6.1.2. Fluorescent Lamps
  - 6.1.3. High Intensity Discharge Lamps
  - 6.1.4. LED Lamps
  - 6.1.5. Types Luminaries
- 6.2. Types of Industrial Lighting Systems
  - 6.2.1. Factory Lighting for Visual Tasks
  - 6.2.2. Security Lighting

6.2.3. Emergency Lighting

7. Illuminating Design Principle (8 hours)

7.1. Basic Consideration for Illuminating Design
- 7.1.1. Space Function
- 7.1.2. Provision of Quality and Quantity of illumination
- 7.1.3. Selection of Lighting Systems, Sources, Luminaries, and Controls
- 7.1.4. Definitions of Terminology

7.2. Lumen Method of Lighting Computations
7.3. Point-to-point Lighting Computation
7.4. Design Procedures

8. Out-door Lighting Design (6 hours)

8.1. Introduction
8.2. Selection of Street Light Sources
8.3. Selection of Lumineries
8.4. Design Procedure of Street Lighting Scheme
8.5. Basic Floodlighting Effects
8.6. Selection of Floodlight Sources
8.7. Selection of Luminaries
8.8. Design Procedures
8.9. Application Guide: Buildings, color, Examples of flood lighting Installation.

9. Emergency and Back-up Supply System for Industrial Plant (6 hours)

9.1. Battery Supply System
- 9.1.1. Battery Installation
- 9.1.2. Charging and Maintenance

9.2. Emergency Supply System
9.3. Uninterrupted Supply for Critical Load

10. Electrical Energy Audit in Industry (6 hours)

10.1. Introduction
10.2. Energy Audit Technique
10.3. Electricity Conservation Program
10.4. Distribution system
10.5. Load Management
10.6. Energy efficient motors
10.7. Energy efficient lighting system
10.8. Energy Saving Opportunity

Practical:

1. Introduction to wiring accessories such as – switches, socket, distribution board etc , protective devices such as – fuse, MCB, MCCB etc their construction, function and application.
2. Preparing Electrical Lay-out and details for commercial Complex or Industrial Building
3. Conducting Market Study and Collecting, informative brochures and Specification on various product available about electrical lamp, appliances and equipments
4. Design electrical Installation scheme for commercial complex or Industry. Draw detail wiring diagrams. Prepare report and Drawing sheets (Light circuit Design, Power circuit Design and Detail Design of Distribution System)
5. Study of different types of sources of light and make connections, and to measure intensity of light with lux-meter:
   a. Fluorescent lamp
   b. HP mercury vapour lamp
   c. HP sodium vapour lamp
   d. Compact Fluorescent lamp (CFL)
6. Using Power Analyzer measure electric parameters for energy auditing propose

References:

1. J.B. Gupta " Electrical Installation Estimating and Costing" S.K. Kataria & Sons, New Delhi
2. G.L. Wadhwa " Generation, Distribution and Utilization of Electrical Energy", New Age International (P) Limited, India
3. H.Pratab " Art & Science of Utilisation of Electrical Energy" Dhanpat Rai & Sons, New Delhi

Evaluation Scheme:

The questions will cover all the chapters of syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	6	8
2	4	4
3	6	8
4	6	8
5	6	8
6	6	8
7	8	12
8	6	8
9	6	8
10	6	8
Total	60	80

*There may be minor deviation in marks distribution.

HYDROPOWER
EG……CE-

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective

- TO familiarize the basic concepts of Fluid flow and hydraulics and their application in the context of hydropower development.
- To make students acquainted with component of hydropower systems and their design principles

1. Introduction to Basic Fluid Mechanics and Hydraulics (14 hours)

1.1. Classification of Fluid Flows: Compressible versus incompressible flow, Laminar versus Turbulent flow, steady versus unsteady flow, One-, Two-, and Three-Dimensional flows

1.2. Properties of fluid: Concept of Continuum, density and specific gravity, vapor pressure and cavitation, energy and specific heats, compressibility, viscosity, surface tension and capillary effect.

1.3. Pressure and fluid statics: pressure at a point, variation of pressure with depth

1.4. Pressure measurement devices; barometer, manometer and other devices.

1.5. Hydrostatic forces on submerged plane surfaces and curved surfaces

1.6. Mass, Bernoulli and Energy Equations: Conservation of Mass, Mechanical Energy and Efficiency

1.7. The Bernoulli's Equation: Static, Dynamic and Stagnation Pressures; Limitation on the use of the Bernoulli's Equation; HGL and EGL, Applications of the Bernoulli's equation.

1.8. Pipe Hydraulics: Laminar flow in pipes(pressure drop and head loss), turbulent flow in pipes (shear stress, velocity profile , The Moody's chart), Types of fluid flow problems in pipes, Minor losses, Series and parallel pipes, piping systems with pumps and Turbines.

1.9. Unsteady flow in pipes: Water hammer and its effects, Hydraulic hammer and hydrodynamic pressure calculations

1.10. Open channel hydraulics: classification, Froude number, specific energy, uniform flow in channels, best hydraulic cross section.

2. Introduction to Hydrology (5 hours)

2.1. Descriptive Hydrology: Hydrological Cycle, Types of precipitation, Measurement of rainfall, Intensity duration curves

2.2. Stream gauging: selection of stream gauging site, river stage measurement, measurement of water depth, measurement of discharge , Area- velocity method, Current meter, Slope- area method, Salt concentration method, Stage discharge relationship

2.3. Estimation of peak flow: Empirical methods, Rational methods, Probability plotting method, gumbel's distribution

3. Planning of Hydropower projects (5 hours)

3.1. Introduction to Hydropower: Comparison of hydropower and thermal power, combined power system and grids, basic terms and definitions

3.2. Investigation and planning: Planning parameters, power market, hydrology, topography, geology, soils and materials, Environmental issues, project appraisal and socio-economic considerations

3.3. Hydropower Development cycle: Reconnaissance studies, Prefeasibility Studies and Feasibility Studies.

3.4. Assessment of available Hydropower, necessity of storage and pondage, essential stream flow data, flow duration and power duration curve and their uses, Firm power and secondary power, Environmental flow.

3.5. Types of Hydropower plants, General arrangement of a hydropower project (sketch also) ; intakes, conveyance systems, forebay, surge tanks, power house, tailrace,

4. Dam Engineering (5 hours)

4.1. Classification of dams, gravity, arch, earth or rock fill and buttress dams(with sketches), Relative advantages and disadvantages of one type of dam over another. Investigation of dam site, Engineering surveys

4.2. Gravity dam: Force acting on gravity dams(water pressure, uplift, wave pressure, silt pressure, wind pressure, earthquake forces), primary load combinations for the numerical problems(Water, uplift and self weight only)

4.3. Stability requirements: Failure due to overturning and sliding, Elementary profile of gravity dam, Middle- third rule.

5. Component of Hydropower System (6 hours)

5.1. Intake : Types, importance, location, Layout, Design Criteria only

5.2. Hydraulic Tunnels : Lay out, Design Criteria

5.3. Settling Basin : Lay out and Design Criteria

5.4. Forebay and surge tanks: Layout and Design criteria

5.5. Penstock Liners: Lay out and Design criteria
5.6. Valves: Types and suitability

6. Spillways (3 hours)

6.1. Design of spillways, definition, purpose, types
6.2. Gates: types and their location
6.3. Occurance of cavitation and cavitation erosion.

7. Hydro-Electric Machines (7 hours)

7.1. Hydro-Mechanical installations: turbines- Pelton, Francis, Kaplan and their performance characteristics, selection of Turbines and their specific speed, draft tube and its importance
7.2. Pumps: Centrifugal, Reciprocating and their performance characteristics, selection and starting speed
7.3. Electro-mechanical installations: generators and their types, purpose and working principle of governers
7.4. Power House: Classification and dimensions of Power House.

Praticals

1. Hydrostatics force on a submerged body
2. Verification of Bernoulli's equation
3. Head loss in a pipe
4. Performance characteristics of a pelton turbine
5. Performance characteristics of Francis turbine
6. Characteristics of a centrifugal pump.

References:

1 P.N.Modi and S. Seth " Fluid Mechanics and Hydraulics" Standard book house, 2009
2 Subramanya K. " Engineering Hydrology " Tata Mc graw hill publication
3 Dandekar M.M. and Sharma K.N. " Water power Engineering"
4 Hydraulic machines ,G. I Krivchenko, Mir publishers Moscow

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark distribution*
1	14	28
2	5	6
3	5	8
4	5	8
5	6	10
6	3	6
7	7	14
Total	45	80

* There may be minor variation in marks distribution

PROJECT ENGINEERING
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 0

Course Objective:

- To introduce the basic knowledge on project and project environment
- To make the students able to prepare feasibility study report and project proposal.
- To provide the sound knowledge of project planning, implementation and controlling.
- To provide knowledge on risk associated with the project
- To provide the knowledge of project finance and
- To provide the concept of modern trends and techniques of project management.

1. Introduction of Project and Project Management [6 hours]

1.1. Definition of Project, its characteristics, and example of project.
1.2. Classification of Project.
1.3. Project Objective and Goal.
1.4. Project Life Cycle Phases.
1.5. Project Environment.
1.6. Introduction to Project Management.

2. Project Appraisal and Project Formulation [8 hours]

2.1. Concept of Project Appraisal
2.2. Project Proposal (technical and financial)
2.3. Procedure for Developing Project Proposal
2.4. Techniques of Project Formulation
- Feasibility analysis,
- Cost Benefit analysis,
- Input analysis,
- Environmental analysis

3. Project Planning and Scheduling [12 hours]

3.1. Concept of Project Planning and its Importance.
3.2. Project Planning Process.
3.3. Work Breakdown Structure (WBS)
3.4. Project Scheduling with Bar Chart, CPM & PERT
3.5. Project Scheduling with Limited Resources (Resource Leveling and Smoothing).
3.6. Introduction to Planning Soft ware - MS Project

4. Project Implementation and Controlling. [7 hours]

4.1. Introduction to Monitoring, Evaluation and Controlling
4.2. Project Control.
4.3. Project Control Cycle
4.4. Elements of Project Control (time, cost and quality).
4.5. Project Schedule Control
4.6. Project Cost Control: Methods and procedure (Earned value analysis)
4.7. Project Quality Control
4.8. Introduction to Project Management Information System (PMIS)

5. Project Risk Analysis and Management [7 hours]

5.1. Introduction to Project Risk.
5.2. Types of Project Risk.
5.3. Analysis of Major Sources of Risk
5.4. Effective Management of Project Risk.
- Risk Management planning
- Risk Identification
- Qualitative and Quantitative Risk Analysis
- Risk Response Planning
- Risk Monitoring and Controlling

6. Introduction to Project Financing [5 hours]

6.1. Project finance
6.2. Capital Structure Planning
6.3. Capital Budgeting Decision.

Tutorials:

1.	Writing project Proposal	[2 hours]
2.	Scheduling Using Bar chart & CPM	[4 hours]
3.	Scheduling Using Planning Software	[4 hours]
4.	Project Control Method (EVA)	[1 hour]
5.	Capital Structure Planning Exercise	[2 hours]
6.	Capital Budgeting Exercise	[2 hours]

References:

1 Ishwar Adhikari and Santosh Kr. Shrestha, “A text of Project Engineering” 2011, Chandeshwori Publication, First Edition.

2 Dhurba P.Rizal, “Project Management” 2001, Ratna pustak bhandar, First Edition.

3 E.R. Yescombe, “Principles of Project Finance” 2002, Yescombe-Consulting Limited.

4 K. Nagarajan, “Project Management”, ISBN: 81-224-1340-4, New Age International (P) Limited, New Delhi, India, 2001.

5 Dr. Govinda Ram Agrawal, “Project Management in Nepal” Edition: 2006, M.K. Publishers and Distributors, Kathmandu, Nepal.

Evaluation Scheme:

The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Chapters	Hours	Marks Distribution*
1	6	10
2	8	12
3	12	24
4	7	12
5	7	12
6	5	10
Total	45	80

* There may be minor deviation in marks distribution.

ORGANIZATION AND MANAGEMENT
ME….

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 0

Course Objectives:

1. Acquire knowledge in the field of organizational management and internal organization of companies required for managing an enterprise
2. Acquire knowledge in the field of personnel management, motivation and leadership for developing managerial skills
3. Gain knowledge for starting a small scale unit independently
4. Gain knowledge on case study and management information system.

Course Outlines:

1. Introduction

1.1 Organization (2 hours)

1.1.1 System approach applied to Organization
1.1.2 Necessity of Organization
1.1.3 Principles of Organization
1.1.4 Formal and Informal Organizations

1.2 Management (4 hours)

1.2.1 Functions of Management
1.2.2 Levels of Management
1.2.3 Managerial Skills
1.2.4 Importance of Management
1.2.5 Models of Management

1.3 Theory of Management (6 hours)

1.3.1 Scientific Management Approach
1.3.2 Administrative Management Approach
1.3.3 Behavioral Management Approach
1.3.4 Modern Management Theories

1.4 Forms of Ownership (2hours)

1.4.1 Single Ownership – Advantages and limitations
1.4.2 Partnership – Types of Partners – Advantages and limitations
1.4.3 Joint Stock Company – Formation of Joint Stock Company – Advantages and limitations
1.4.4 Co – operative Societies – Types of Co – operatives – Advantages and limitations
1.4.5 Public Corporations – Advantages and limitations

1.5 Organizational Structure (2 hours)

1.5.1 Line Organization – Advantages and dis – advantages
1.5.2 Functional Organization – Advantages and dis – advantages
1.5.3 Line and Staff Organization – Advantages and dis – advantages
1.5.4 Committee Organization – Advantages and dis – advantages

1.6 Purchasing and Marketing Management (4 hours)

1.6.1 Purchasing – Introduction
1.6.2 Functions of Purchasing Department
1.6.3 Methods of Purchasing
1.6.4 Marketing – Introduction
1.6.5 Functions of Marketing
1.6.6 Advertising

2. Personal Management (8 hours)

2.1 Introduction
2.2 Functions of Personal Management
2.3 Development of Personal Policy
2.4 Manpower Planning
2.5 Recruitment and Selection of manpower – Scientific selection
2.6 Training and Development of manpower
2.7 Job Analysis, Job Evaluation and Merit Rating
2.8 Wages and Incentives

3. Motivation, Leadership and Entrepreneurship (6 hours)

3.1 Motivation

3.1.1 Human needs
3.1.2 Maslow's Hierarchy of needs
3.1.3 Motivation – Introduction

3.1.4 Types of Motivation

3.1.5 Attitude Motivation; Group Motivation; Executive Motivation

3.1.6 Techniques of Motivation

3.1.7 Motivation Theories

3.1.7.1 McGregor's Theory X - Y

3.1.7.2 Fear and Punishment Theory

3.1.7.3 Alderfer's ERG Theory

3.1.7.4 MacClelland's Theory of learned needs

3.1.7.5 Herzberg's Hygiene Maintenance Theory

3.1.7.6 Vroom's Expectancy/ Valency Theory

3.2 Leadership - Introduction (2hours)

3.1.1 Qualities of a good Leader

3.1.2 Leadership Style

3.1.3 Blakes and Mouton's Managerial Grid

3.1.4 Leadership Approach

3.1.5 Leadership Theories

3.3 Entrepreneurship – Introduction (2 hours)

3.1.6 Entrepreneurship Development

3.1.7 Entrepreneurial Characteristics

3.1.8 Need for Promotion of Entrepreneurship

3.1.9 Steps for establishing small scale unit

4. Case Studies (2 hours)

4.1 Introduction

4.2 Objectives of case study

4.3 Phases of case study

4.4 Steps of case study

4.5 Types of case studies

5. Management Information System (5 hours)

5.1 Data and Information

5.2 Need, function and Importance of MIS

5.3 Evolution of MIS

5.4 Organizational Structure and MIS

5.5 Computers and MIS

5.6 Classification of Information Systems

5.7 Information Support for functional areas of management

5.8 Organizing Information Systems

Note: Students have to submit a case study report after visiting an industrial organization outside or inside the Kathmandu valley.

Reference:

1. H. B. Maynard, "*Industrial Engineering Handbook*" , Editor – in – Chief, 4th Edition, McGraw Hill, 19xx

2. E. S. Buffa and R. K. Sarin "*Modern Production / Operations Management",* 8th Edition, Wiley, 1987

3. H. J. Arnold and D. C. Feldman "*Organizational Behavior" ,* McGraw – Hill, 1986

4. J. A. Senn, "*Information Systems in Management "* , 4th Edition, Wadsworth Inc., 1990

5. P. Hershey and K. H. Blanchard, "*Management of Organizational Behavior – Utilizing Human Resources "*, 4th Edition, Prentice – Hall Inc., 1982

6. M. Mahajan, "*Industrial Engineering and production Management*" ,Dhanpat Rai and Co. (P) Ltd. , Delhi, 2002

7. S. Sadagopan, "*Management Information System",* Prentice Hall of India Pvt Ltd, 1997

8. C. B. Mamoria "*Personnel Management*", Himalaya Publishing House – 1989

9. O. P. Khanna, "*Industrial Engineering and Management*" , Dhanpat Rai Publications (P) Ltd., 2007

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	**Hours**	**Marks distribution***
1& 1.2	6	8 or 16
1.3	6	8
1.4 & 1.5	4	8
1.6	4	8
2	8	16
3.1	6	8
3.2 & 3.3	4	8
4 & 5	7	8 or 16
Total	45	80

* There may be minor deviation in marks distribution.

TECHNOLOGY ENVIRONMENT AND SOCIETY

CE ..

Lecture : 2 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 0

Course Objectives:

The course has been devised to provide knowledge of environment, technology and its impact on society. It would be helpful to the students to understand the global, national and local environmental issues and challenges of the information society.

1. Technology (8hours)
- 1.1. Definition,
- 1.2. Impact of technology on environment & society,
- 1.3. Benefits of technology due to new inventions,
- 1.4. Conflict of technology, technology creates opportunity for society to change
- 1.5. Appropriate technology,
- 1.6. Intermediate technology, labor based and labor intensive technology,
- 1.7. Shifts in employment due to technological advancement,
- 1.8. Role of technology to unmask old social problems, society's control of technology,
- 1.9. Impact of technology on culture, tradition and social values,
- 1.10. Technology is irreversible,
- 1.11. Agricultural age, industrial age and information age,
- 1.12. Characteristics of information society,
- 1.13. Information as power and wealth

2. Development approach: (6 hours)
- 2.1. LEP (labor based, environment friendly and participatory),
- 2.2. Community management, engineers role as facilitator,
- 2.3. Key features of infrastructure development policies of Nepal,
- 2.4. Ethnographic approach to collect information ,
- 2.5. Participatory approach as community empowerment ,
- 2.6. Participatory tools, focus group discussions, key informants interview,
- 2.7. Participatory observation, structured questionnaire,
- 2.8. Resource mapping, wealth ranking, poverty definition

3. Brief history of human civilization (4 hours)
- 3.1. Early civilization,
- 3.2. Great renaissance of Europe,
- 3.3. Early part of industrial revolution,
- 3.4. Transformation of industrial society into information society,
- 3.5. Impact of world war 1 & 2, Population explosion,
- 3.6. Rise of environmental issues,
- 3.7. Climate change as a threat to human civilization

4. Environment (3 hours)
- 4.1. Definition,
- 4.2. Importance, ecology & ecosystem,
- 4.3. Conservation of environment,
- 4.4. Optimum utilization of natural resources,
- 4.5. Renewable and non renewable resources,
- 4.6. Conflict of resources,
- 4.7. Global environmental issues,
- 4.8. Environmental issues of Nepal

5. Water and air pollution (6 hours)
- 5.1. Fecal -oral infection transmission route
- 5.2. Preventive measures,
- 5.3. On site sanitation(including eco -sanitation),
- 5.4. Importance of health education,
- 5.5. Organic pollution,
- 5.6. Inorganic pollution(nitrate, fluoride, iron, manganese, calcium arsenic, heavy metals), water pollution due to insecticides and pesticides
- 5.7. Sources, causes & impacts of airpolution
- 5.8. Mitigation measures,
- 5.9. Indoor air pollution,
- 5.10. Severity of its problems in Nepal

6. Climate change (3 hours)
- 6.1. Definition, causes, impacts,
- 6.2. Mitigation measures,
- 6.3. International efforts to mitigate its problems,
- 6.4. Bio –gas, organic farming,
- 6.5. Deforestation and its consequences,
- 6.6. Importance of national parks, conservation areas and forestation programs in Nepal

References:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Environmental Engineering", Laxmi Publications (P) Ltd., New Delhi, 1998
2. H.G. Wells, "Brief History of Civilization"
3. J. Neharu, "Glimps of World History"

Examination scheme

The question will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	8	10
2	6	8
3	4	4
4	3	4
5	6	10
6	3	4
Total	30	40

* **There may be minor deviation in marks distribution.**

POWER ELECTRONICS
EE …

Theory : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objective:
To introduce various power electronics based circuits and their use in power system

1. Characteristics and specification of power electronics device (10 hours)
- 1.1. Power Diode: V-I characteristics, switching characteristics , types of diodes , application
- 1.2. Thyristor:
  - 1.2.1. V-I characteristics, Turn On and Off mechanism, switching characteristics, protection scheme,
  - 1.2.2. Types of thyristors, merits-demerits and application of thyristors,
  - 1.2.3. Firing Circuits : Microcontroller based firing scheme, Long pulse, short pulse and train pulse generation using pulse transformer
  - 1.2.4. Various commutation technique: Load Commutation and Line commutation
- 1.3. Power Transistor : V-I Characteristics, switching characteristics, merits-demerits and application of transistor
- 1.4. Power MOSFET – V-I Characteristics, Switching characteristics, merits-demerits and applications of MOSFET
- 1.5. Insulated Gate Bipolar transistor (IGBT): V-I characteristics, switching characteristics, merits-demerits and application of IGBT, comparison with MOSFET
- 1.6. Triac : V-I characteristics of Triac, operating modes of Triac, merits-demerits of Triac
- 1.7. Diac: V-I characteristics and its merits and demerits

2. Single phase ac to dc conversion (6 hours)
- 2.1. Half wave rectification with power diode using inductive and resistive load
- 2.2. Half wave rectification with thyristor using inductive and resistive load
- 2.3. Full wave rectification with diode and thyristor using resistive and inductive load
- 2.4. Wave form, ripple content .Fourier analysis and filtering scheme
- 2.5. Single phase semi-converter and full converter
- 2.6. Power factor improvement
  - 2.6.1. Extinction angle control
  - 2.6.2. Symmetrical angle control

3. Three phase AC to DC conversion (4 hours)
- 3.1. Three phase AC to DC conversion using diode and the Fourier analysis of waveforms
- 3.2. Three phase bridge rectification with diodes and the Fourier analysis of waveforms
- 3.3. Three phase full converter

4. DC chopper (6 hours)
- 4.1. Introduction
- 4.2. Step down chopper
- 4.3. Chopper with dc motor as load
- 4.4. Step up chopper
- 4.5. Chopper classification

5. Inverter (8 hours)
- 5.1. Introduction
- 5.2. Single phase inverter
- 5.3. Single phase inverter with ac motor load
- 5.4. Three phase inverter
- 5.5. Fourier analysis of three phase inverter
- 5.6. Pulse width modulated inverter
  - 5.6.1. Single pulse modulation
  - 5.6.2. Multiple pulse modulations
  - 5.6.3. Sinusoidal pulse width modulation

6. AC voltage controller (6 hours)
- 6.1. Single phase voltage controller with phase control using resistive and inductive load
- 6.2. Single phase voltage controller in electronic load controller (ELC)
- 6.3. Principle of operation of single phase cycloconverter
- 6.4. Step-up and step down single phase cycloconverter
- 6.5. Three phase to single phase cycloconverter

7. HVDC power transmission (5 hours)
- 7.1. HVDC station configuration (Filter, Converters, Inverters)
- 7.2. Comparison of HVDC and HVAC transmission
- 7.3. Reversible power flow and control in dc line

7.4. Series operation of converters
7.5. 12-pulse operation of converter

Practical:

1. Study of single phase rectification with diode and thyristor
2. Study of three phase rectification with diode and thyristor
3. Study of DC conversion using chopper circuit
4. Study of DC to AC conversion with resistive load
5. Study of AC voltage controller with resistive load

References:

1. Muhammad H. Rashid "Power Electronics" Dhanpat Rai and Sons
2. B.R Gupta and V.Singhal " Power Electronics" Kataria and Sons

Evaluation scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	10	16
2	6	8
3	4	8
4	6	8
5	8	16
6	6	16
7	5	8
Total	44	80

* There may be minor deviation in marks distribution.

UTILIZATION OF ELECTRICAL ENERGY
EE …

Theory : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:
To present the basic concepts on utilization of electrical energy on various applications

1. Introduction [4 hours]
- 1.1. Common uses of electrical energy: Domestic, commercial, industrial
- 1.2. Classification of electrical consumers and their demand
- 1.3. Roles and advantages of electrical energy over other forms of energy on different applications

2. Electric Drive System [8 hours]
- 2.1. Advantages of electric drive
- 2.2. Types of electric drives- Individual, group and multi-motor and comparison among them
- 2.3. Methods of power transfer- Direct coupling/using belt drive, gears, pulleys
- 2.4. Selection of motors- Factors to be considered, electrical and mechanical characteristics matching.
- 2.5. Service Type (Continuous, Intermittent), Rating and Sizing of motor
- 2.6. Motors and their characteristics for particular service- domestic, industrial and commercial

3. Control of Electric Drive [12 hours]
- 3.1. DC Drive Control
  - 3.1.1. Background of AC Drive System
  - 3.1.2. Ward Leonard type variable speed drives
  - 3.1.3. Static Variable DC voltage drives using diodes and/or controlled rectifier
  - 3.1.4. 4-quadrant reversible voltage and power flow drive
  - 3.1.5. PID speed and torque controlled drives
- 3.2. AC Drive Control
  - 3.2.1. Background of AC Drive System
  - 3.2.2. Soft start variable ac voltage starter
  - 3.2.3. Variable frequency supplies for ac drive
  - 3.2.4. Slip power recovery system for slip ring induction motor

4. Electric Traction [8 hours]
- 4.1. Types of electric traction- self contained unit system, traction system fed from a separate distribution line, DC and AC supply system
- 4.2. Advantages of electric traction system
- 4.3. Tramways, trolley, and electric train: description and comparison
- 4.4. Types of motors used for electric traction
- 4.5. Starting, Braking and Speed control of traction motors
- 4.6. Speed-time curve for a traction system: Scheduled and Average speed and factors affecting these speeds

5. Electric Heating [6 hours]
- 5.1. Introduction of Electrical Heating
- 5.2. Advantages of electric heating
- 5.3. Building design consideration for electric heating
- 5.4. Methods of electric heating: Resistance heating, Induction heating, Electric arc heating, Dielectric heating, Infrared heating, and Micro-wave heating

6. Demand Side Management [8 hours]
- 6.1. Introduction and advantages of Demand Side Management
- 6.2. Consumer Classification and their demand characteristics
- 6.3. Effective Demand Side Management techniques
- 6.4. Causes and disadvantages of Low Power Factor and different techniques to improve Power Factor
- 6.5. Types of tariff: Simple tariff, Flat-rate tariff, Block-rate tariff, Two part tariff, Maximum demand tariff
- 6.6. Tariff System in Nepal

Laboratory:
1. Speed Control of DC shunt motor by controlled rectifier
2. Speed Control of Induction motor by rotor rheostat method
3. Speed Control of Induction motor by frequency control method
4. Study of PWM controller for an ac machine

Reference:

1. A course in Utilization of Electrical Energy, *G. Garg*
2. A course in Electrical Drives, *S. K. Pillai*
3. Utilization of electrical energy, *Taylor*

Evaluation scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1.	4	8
2.	8	16
3.	12	16
4.	8	16
5.	6	8
6.	8	16
Total	46	80

* **There may be minor deviation in marks distribution.**

POWER PLANT EQUIPMENT
EE …

Lecture : 4 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 1.5

Course Objective:
To present information on the equipment used in power generating plant including electrical as well as mechanical

Part – A (Electrical)

1. Hydro Power Plant (6 hours)
- 1.1. Energy Conversion from hydraulic to electrical terminologies
- 1.2. Steady State operation of hydro power plant
- 1.3. Water hammer and surge tank in hydro power plant
- 1.4. Control of water delivery to turbine
- 1.5. Transient in turbine –generator system
- 1.6. Pump storage plant
- 1.7. Generator for hydro power plants

2. Power/frequency control in hydro generator system (10 hours)
- 2.1. f and Q-V control loop of hydro generating system
- 2.2. Modeling of turbine
- 2.3. Special characteristics of hydraulic turbine
- 2.4. Modeling of governor
  - 2.4.1. Fundamentals of speed governing
  - 2.4.2. Generator response to load change
  - 2.4.3. Isochronous Governor
  - 2.4.4. Governor with droop characteristics
  - 2.4.5. Load sharing by parallel unit
  - 2.4.6. Requirement of transient droop

3. Var/Voltage control in hydrogenerating systems (6 hours)
- 3.1. Types of excitation systems-
  - 3.1.1. DC excitation system
  - 3.1.2. AC excitation system
  - 3.1.3. Static excitation system
- 3.2. Modeling of excitation systems

4. Substation equipments (8 hours)
- 4.1. Power transformer and its various components
- 4.2. Concept of unit transformer
- 4.3. Potential transformer and current transformer used in substation
- 4.4. Reactor used in generating station and substation
- 4.5. Fire fighting system in power station
- 4.6. Power Line Carrier Communication (PLCC)
- 4.7. PLC Application
- 4.8. Supervisory Control and Data Acquisition (SCADA) System and communication with load dispatch center

Part – B (Mechanical)

5. Diesel Power Plant (10 hours)
- 5.1. Diesel Cycle
- 5.2. Diesel Engine Operation, Starting, Fuel Storage and Supply System, Cooling System, Noise Abatement and Governing
- 5.3. Performance of Diesel Power Plant
- 5.4. Applications of Diesel Power Plant
- 5.5. Advantages and Disadvantages of Diesel Power Plant

6. Gas Turbine Power Plant (7 hours)
- 6.1. Gas Turbine Cycle; Open and Closed Cycles
- 6.2. Performance Improvement of Gas Turbine Power Plants; Intercooling, Regeneration and Reheating
- 6.3. Starting, Fuel Storage and Supply System, Cooling System, Noise Abatement and Governing
- 6.4. Advantages and Disadvantages of Gas Turbine Power Plant

7. Thermal (Steam) Power Plant (7 hours)
- 7.1. Rankine cycle
- 7.2. Performance Analysis, superheating reheating and regeneration
- 7.3. Steam Turbine: Classifications, Compounding, Governing and Lubrication systems for Steam Turbines
- 7.4. Advantages and Disadvantages Thermal Power Plants

8. Combined Power Plant (6 hours)
- 8.1. Gas and Steam Turbine Combined Cycle
- 8.2. Advantages of Combined Cycle
- 8.3. Performance and Economics of Combined Cycle

Practical:

1. Mini hydro Unit Control (Isolated Load)
   - Study the start –up and control of speed and generated voltage on the mini hydro unit, operating the generator on isolated load (not synchronized to the lab bus)
2. Mini hydro Unit Control (Synchronized)
   - Start up and synchronized to system bus
   - Study power and var control of the unit while synchronized and delivering energy to the system
3. Diesel Unit Control (Isolated Load)
   - As per lab #1
4. Diesel Unit Control (Synchronized)
   - As per lab #2

5. Load sharing between parallel units
   - Operate mini hydro and diesel generating units in parallel to supply a common load.
   - Examine control problems associated with load and var sharing

6. Field trip to generating plant (3 days trip)
   - visit a full size operating generating plant
   - study the specific component and its operating mechanism of the visited power plant
   - Prepare a formal report on power plant installation describing specific major component

Reference:

1. P.Kundur “Power System Stability and Control” Mc Graw Hill Inc
2. D.P. Kothari “Power System Engineering”
3. Hadi Sadat “Power System ”
4. S.C. Arora, S. Domkundwar “ A course in power plant Engineering”
5. P.C. Sharma “Power Plant Engineering”

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	6	8
2	10	16
3	6	8
4	8	8
5	10	16
6	7	8
7	7	8
8	6	8
Total	60	80

* There may be minor deviation in marks distribution.

PROJECT - I

Lecturer : 0 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
To plan a electrical engineering project under the supervision of an instructor. During the project students have to design functional project.

Tasks: In the development of the project each group of students will be expected to:

1. Students will form a small group (maximum of four students per group) projects
2. Project concept development (field selection, hardware/software, scope etc.) , attention will be paid to the suitability of the project topics for the technical level of the students and the practical applicability of the subject topics to the local situation. Wherever possible, projects will include aspect of computer applications in electrical engineering will be encouraged.
3. Perform literature review and prepare a specific written project proposal including a clear statement of objective and purpose of the project along with preliminary methodology, expected outcome, time plan and resources estimate.
4. Initiate and maintain contact through regular progress meetings with the initiator of the project or the immediate faculty supervisor
5. At the end of this semester students will come up with a report with a complete literature review and final methodology to be adopted with sample analysis.
6. End semester defense

Elective I

ELECTRICAL ENERGY SYSTEM MANAGEMENT
Elective-I

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:
To study planning and management aspects of electrical energy supply and to gain some familiarity with demand characteristics and load forecasting.

1. Power utilities and power sector development (9 hours)

1.1. Functional block model
1.2. Classifications: Centralized government owned, Locally owned, private/public, foreign investor owned
1.3. Power sector development in Nepal: History, growth of government and private utilities, achievements, various utilities in existence and their organization
1.4. Nepalese Power industry Regulatory framework: Company act, Industrial enterprises act, Hydropower development policy, Water resource act and regulation, Electricity act and regulation, Foreign investment and technology transfer act, Factory act
1.5. Power sector restructuring : Goals, constraints, pre-requisites and different models.

2. Financial Analysis and project funding (9 hours)

2.1. Basic accounting principles: Cash basis and Accrual basis of accounting,
2.2. Depreciation: straight line method, declining balance method and sum of years digit method, inflation and depression
2.3. Investment decisions: Interest and discount rates, inflation and depression, Present worth, Future worth, NPV, B/C ratio, IRR, Payback period , decision criteria
2.4. Electric utility funding requirements: capital requirement, operating requirement, Cash flow
2.5. Sources of project funding: Public finance, corporate finance and project finance

3. Electrical load forecasting (9 hours)

3.1. Load curves and load factor, demand factor, diversity factor, coincidence factor
3.1.1. - Load and their characteristics : Domestic, industrial, commercial, non commercial, transport, irrigation etc.
3.2. Objectives and classification of load forecasting
3.3. Tools and approaches
3.4. Errors and uncertainties
3.5. A accuracy and error analysis based on time series approach
3.6. Forecasting methods: mean and single moving average method, mathematical models: Linear , Parabolic and Exponential method of extrapolation and the method of survey, SIMCRED equation

4. Power system security and reliability (9 hours)

4.1. Security definitions
4.2. Security measures
4.3. Maintaining reserves: spinning reserve, scheduled or offline reserve, static reserve, Sources of reserves
4.4. Physical constrains to system security
4.5. Effects of system diversity, system interconnection, import/export.
4.6. Approaches to reliability, Reliability and quality, Repairable and non repairable components, The bathtub curve , Reliability function, Properties of reliability, Reliability indices: Mean Time to Failure, Mean Time Between Failures, Availability/Unavailability, Forced outage rate, Loss of Load Probability, Loss of Load Expectation
4.7. System reliability models: Series system, parallel system, Series parallel system, Parallel series system, Non series parallel system
4.8. Cost of reliability and unreliability.

5. Unit Commitment and Economic load dispatch of generating units (9 hours)

5.1. Understanding Unit commitment problem, solution approaches, Priority list scheme, Unit commitment schedule for a particular load curve.
5.2. Elements of a constrained optimization problem, LaGrange theorem as a tool to solve optimization problem
5.3. Characteristics of generating units (thermal and hydro): , Incremental fuel cost, incremental cost of production
5.4. Economic dispatch problem of thermal units excluding and including transmission losses, Graphical solution, Penalty factor and its physical insight, Use of penalty factor in power transaction
5.5. Economic dispatch of energy and VARs as an operational problems: Problems in new loading conditions, effect of power factor, VAR compensation techniques

Practical:

1 Presentation on Nepalese power utilities and regulatory environments
2 Solving economic dispatch problem of hydro units for loss minimization
3 Exploring demand supply situation of certain sector of the Nepalese power system and forecast the power and energy demand
4 Reliability evaluation (calculating LOLP) of a certain load center fed by different hydro units in Nepalese system
5 Exploring the security situation of a typical power system through N-1 contingency criteria
6 Preparing unit commitment schedule for a particular load centre fed by different hydro unit in Nepalese system

References

1. Robert N Anthony and James S Reece: Management Accounting Principles
2. Allen J Wood and Bruce W Woolenberg: Power Generation Operation and Control
3. C. L. Wadhwa: Electrical Power Systems, Willey Eastern Limited
4. V. N. A. Naikan: Reliability Engineering and Life Testing, Printice Hall of India Ltd.
5. S. Makridakis, S.C. Wheelwright, V.E. Mc Gee: Forecasting Methods and Applications
6. I.G. Nagarath and D.P. Kothari: Power System Engineering, Tata Mc Grawhill Publishing Company

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distributions*
1	9	16
2	9	16
3	9	16
4	9	16
5	9	16
Total	45	80

* There may be minor deviation in marks distribution.

RELIABILITY ENGINEERING
ELECTIVE I

Lecture : 3
Tutorial : 1
Practical : 1.5

Course objective:
To strengthen the knowledge of probability theory by introducing the concept of reliability engineering applicable to the physical systems especially at different level of electric power systems.

1. Review of probability theory (4 hours)
- 1.1. Probability concepts, permutation and combination, practical engineering concepts, Venn diagrams
- 1.2. Rules for combining probabilities, independent, mutually exclusive, complimentary, conditional events, application of conditional probability
- 1.3. Probability distributions: random variables, density distribution functions, mathematical expectation, variance and standard deviation.

2. Binomial distribution and its Applications (4 hours)
- 2.1. Binomial distribution: concepts, properties, general characteristics, binomial coefficients, expected value and standard deviation
- 2.2. Applications in engineering system evaluation, economic implications, identical and non-identical units, COPT

3. Network modeling and analysis of simple systems (4 hours)
- 3.1. Modeling concepts for reliability evaluations
- 3.2. Series, parallel and series-parallel systems
- 3.3. Redundancy: standby redundancy, impact of redundancy, perfect and imperfect switching

4. Modeling and analysis of complex systems (8 hours)
- 4.1. Modeling and evaluation concepts for complex systems
- 4.2. Conditional probability approach, cut set and tie set methods, connection matrix techniques, event tree and fault tree methods

5. Probability distribution in reliability evaluation (4 hours)
- 5.1. Distribution concepts, terminology, general reliability functions, evaluation techniques, shapes
- 5.2. Poisson distribution, relationship with binomial distribution
- 5.3. Normal and exponential distributions, probability density functions, a priori and a posterior probability, normal distribution and probability density function, mean value and mean time to failure.
- 5.4. Other distributions: Weibull, Gamma, Rayleigh and Log Normal distribution and their application in electric power change.

6. System reliability evaluation using probability distribution (4 hours)
- 6.1. Series, parallel and partially redundant systems, mean time to failure
- 6.2. Standby systems: perfect and imperfect switching, effect of spare components, failure in standby mode

7. Discrete Markov chains (4 hours)
- 7.1. General modeling concept, STPM, time dependent probability evaluation
- 7.2. Limiting state probability, absorbing states, applications of discrete Markov techniques in system reliability evaluation

8. Continuous Markov processes (4 hours)
- 8.1. General modeling concepts, transition rates, time dependent and limiting state probabilities, STTP
- 8.2. State space diagram: single, two and three components repairable systems, mission oriented systems
- 8.3. Evaluation of time dependent state probabilities by differential equations method and matrix multiplication methods
- 8.4. Reliability evaluation of repairable systems, MTTF, application in complex system

9. Frequency and duration techniques for reliability evaluation (8 hours)
- 9.1. Basic concepts of F&D techniques, application in multi-state problems, frequency of encountering individual states, mean duration of individual states, frequency of encountering cumulated states, frequency balance approach
- 9.2. Approximate reliability evaluation: series and parallel systems, network reduction techniques, minimum cut set method

Practical:
1. Evaluate the reliability of simple and complex systems using various techniques like series/parallel, cut set and tie set methods
2. Application of discrete Markov chain and continuous Markov process, F&D techniques, approximate reliability evaluation for complex engineering system

References:

1. Roy Billinton and Ronald Allan, "Reliability Evaluation of Engineering Systems: Concepts and Techniques", Plenum Publishers, New York, 1992.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distributions*
1	4	16
2	4	
3	4	
4	8	16
5	4	16
6	4	
7	4	16
8	4	
9	8	16
Total	44	80

* There may be minor deviation in marks distribution.

RURAL ELECTRIFICATION
ELECTIVE I

Lecture : 3
Tutorial : 1
Practical : 3/2

Course Objectives:
To present a summary of rural livelihood and to present the basic concepts of rural electrification and its impact upon the development of rural communities

1. Rural livelihood and Social, cultural and human factors in development (4 hours)
- 1.1. Components of rural livelihood and livelihood indicators
- 1.2. Social, cultural and human factors in development
- 1.3. Industrialization and urbanization

2. Electricity and rural development (4 hours)
- 2.1. Rural electrification – National objectives, targets and key players (National Water Plan)
- 2.2. Impact of electrification on rural and village life
- 2.3. End use of electricity

3. Rural electrification technologies – Nepalese context (8 hours)
- 3.1. Grid based rural electrification
  - 3.1.1. Utility operated: Voltage levels, Investment modality, Construction and operation modality, Consumer services, tariffs
  - 3.1.2. Community operated (CBRE, CBOM etc): Voltage levels, Investment modality, Construction and operation modality, Consumer services, tariffs
- 3.2. Electrification through Isolated hydropower stations
  - 3.2.1. Micro Hydro components (Civil, Mechanical and Electrical components including T&D network)
- 3.3. Electrification through alternative energy sources
  - 3.3.1. Solar (Components of Solar Home system)
  - 3.3.2. Wind (Components of Wind Power)

4. Environmental concerns, safety considerations and reliability indices in RE (8 hours)
- 4.1. Environmental concerns in rural electrification
- 4.2. Equipment and human safety in construction and operation of Rural electrification network as per Electricity regulation Nepal
- 4.3. Plant factor of Micro Hydro Schemes, load factor, load curve and reliability indices in Rural Electrification, SAIFI, SAIDI, CAIDI, ASAI

5. Design of Rural Electrification network (10 hours)
- 5.1. Load points fixation in contour map and load calculation
- 5.2. Transformer installation point and Line route fixation
- 5.3. Selection criteria of distribution system – single or three phase
- 5.4. **Hardware in RE Networks:** Poles and supporting accessories, Conductors and Fixtures (Cross arm, clamps etc), Insulators, Transformers, HT Metering units, Energy Meters, Current limiters, Service wire, Power cables, Isolators, Load break switches
- 5.5. Protection system of RE Networks :
  - 5.5.1. **11/33 kV Feeder protection:** Lightning arrestors, Circuit breakers with tripping provision on Over current, Short circuit, Earth Fault
  - 5.5.2. **LV feeder protection:** ACBs, MCCBs, HRC/Kitkat fuses
  - 5.5.3. **Transformer (33/0.4 and 11/0.4 kV) protection:** Lightning arrestors, Drop out fuses, MCCBs/ HRC fuses
- 5.6. **Load flow diagram preparation and Voltage drop calculation:** kVA-km conductor loading / Voltage drop calculation
- 5.7. **Economic analysis of RE**

6. RE Network operation (10 hours)
- 6.1. Load management: Load switching, Load shedding, Peak load tariff
- 6.2. Energy loss measurement and monitoring
  - 6.2.1. Load curve, Load factor, loss factor and Energy Loss calculation
  - 6.2.2. Metering and measurement
  - 6.2.3. Condition monitoring of RE network components: Poles, Jumpers, Insulators, Transformers, Distribution boxes, Clearances, Feeder loading
- 6.3. Types of faults frequently occur in RE Network
- 6.4. Correction, Corrective action and preventive actions
- 6.5. Metering, Billing and revenue collection
- 6.6. Inventory management

Practical

1. Case studies in rural electrification
- Technical Aspects
  - Energy loss of the network
  - Quality of the service provided – Voltage, frequency and interruption frequency and duration
  - Condition monitoring and Repair and maintenance of RE network

- Economic Aspects
  - Revenue generation
  - Operating expenses
  - Capital Investment
  - Profitability of the scheme
- Social Aspects
  - Energy based Enterprise development
  - Energy based Income Generation activities introduced
  - Impact on social life – Health, education, security, communication

A report to be produced by each student on case study

References:

1. AS Pabla Electric Power Distribution TATA McGRAW HILL
2. Bhjendra Aryal Cultural and human factors in Rural development Dikshant Prakashan
3. AEPC/ESAP Guideline for detailed feasibility study for projects from 100 kW to 1000 kW
4. Electricity regulation 2050, Nepal
5. National water Plan, Nepal
6. Samudayik Bidyut bitran niyamawali 2060, NEA
7. ISO 9001 standard
8. AEPC status/progress reports on renewable energy

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distributions*
1	4	8
2	4	8
3	8	16
4	8	16
5	10	16
6	10	16
Total	44	80

* There may be minor deviation in marks distribution.

ENGINEERING PROFESSIONAL PRACTICE
CE ……

Lecture : 2 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 0

Course Objective:
To familiarize the students with their roles in the society, ethical and legal environment in which engineering is practiced, contract administration, regulatory environment and contemporary issues in Engineering.

1. **History of Engineering Practices** [3 **hours]**
   - 1.1. Man and Society
   - 1.2. Technology and Society
   - 1.3. History of Engineering Practice in Eastern Society
   - 1.4. History of Engineering Practice in Western society
   - 1.5. Engineering Practices in Nepal

2. **Profession and Ethics** **[6 hours]**
   - 2.1. Profession: Definition and Characteristics
   - 2.2. Professional Institutions
   - 2.3. Relation of an Engineer with Client, Contractor and Fellow Engineers
   - 2.4. Ethics, Code of Ethics and Engineering Ethics
   - 2.5. Moral Dilemma and Ethical Decision Making
   - 2.6. Detailed Duties of an Engineer and Architect
   - 2.7. Liability and Negligence

3. **Professional Practices in Nepal** **[3 hours]**
   - 3.1. Public Sector practices
   - 3.2. Private Sector Practices
   - 3.3. General Job Descriptions of Fresh Graduates in both Public and Private Sector

4. **Contract Management** **[6 hours]**
   - 4.1. Methods of work execution/contracting
   - 4.2. Types of Contracts
   - 4.3. Tendering Procedure
   - 4.4. Contract agreement

5. **Regulatory Environment** **[5 hours]**
   - 5.1. Nepal Engineering Council Act
   - 5.2. Labor Law
   - 5.3. Intellectual Property Right
   - 5.4. Building Codes and Bylaws
   - 5.5. Company Registration

6. **Contemporary Issues in Engineering** **[3 hours]**
   - 6.1. Globalization and Cross Cultural Issues
   - 6.2. Public Private Partnership
   - 6.3. Safety, Risk and Benefit Analysis
   - 6.4. Development and Environment
   - 6.5. Conflict and Dispute Management

7. **Case Studies based on Engineering Practices** **[4 hours]**

References:

1. Carson Morrison and Philip Hughes “Professional engineering Practice – Ethical Aspects”, McGraw-Hill Ryerson Ltd.’ Toronto 1982
2. Dr Rajendra Adhikari, “Engineering Professional Practice – Nepalese and international Perspectives” Pashupati Publishing House, Kathmandu Nepal 2010
3. M. Govindarajan; S Natarajan and V.S. Senthikumar., “ Engineering Ethics” – PHI Learning Pvt. Ltd. New Delhi 2009
4. Nepal Engineering Council Act
5. Contract Act
6. Labor Act
7. Company Act
8. Copyright Act
9. Public Procurement Act
10. Building By-Laws

Evaluation Scheme:

The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Chapter	Hours	Marks distribution*
1	3	4
2	6	8
3	3	4
4	6	8
5	5	6
6	3	4
7	4	6
Total	30	40

* There may be minor deviation in marks distribution.

HIGH VOLTAGE ENGINEERING

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Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:
After the completion of this course the student will get through knowledge for

- different causes and types of over voltages
- breakdown mechanisms for gaseous, liquid and solid dielectrics
- HVAC/HVDC and impulse testing of In sulation
- safety against high voltage

1. Evolution of power system [6]
- 1.1. Classification of High voltages
- 1.2. Emerging Trends in Power Systems
- 1.3. High voltage AC and HVDC systems
- 1.4. basic introduction to FACTS devices
- 1.5. High voltage power cables AC and DC

2. Electric shocks [6]
- 2.1. Physiological effects of electric shock, ventricular fibrillation
- 2.2. First aid for electric shock
- 2.3. Safety precautions and regulations
- 2.4. Earthing and shielding techniques for personnel and equipment protection
- 2.5. Measurements of earth resistivity and earth resistance

3. Over voltages in power system [8]
- 3.1. Classification of over voltages; temporary and transient over voltages, internal and external over voltages
- 3.2. Temporary Over Voltage ; Unsymmetrical faults in the system, High capacitance of long EHV lines, Ferro-resonance, Load rejection, effective grounding, shunt compensations
- 3.3. Switching over voltages; switching surge ratio, Energizing an unloaded transmission line, De-energizing the transmission line, Interruption of capacitive current by circuit breaker, Current chopping by Circuit breaker, Ferro Resonance, countermeasure to reduce switching over voltages
- 3.4. Lightning over voltages; lightning phenomena, direct and indirect lightning strokes, effect of ground wire and tower footing resistance in lightning over voltages
- 3.5. Protection principle against lightning, lightning and surge arrestors, earth wire, grounding mast

4. Insulation coordination: [4]
- 4.1. Basic Insulation level and basic switching level
- 4.2. insulation coordination to different equipments; transformers, bus structures, bushings, transmission lines;
- 4.3. insulation protection level for temporary, switching and lightning over voltages
- 4.4. surge protection: lighting and switching surge characteristics, horn gaps, grading rings, lighting arrestors

5. High stress electric fields [8]
- 5.1. review of electromagnetic field theory : electrostatic potential difference, potential gradient, conducting and dielectric materials in electric fields, polarization, leakage conductance of dielectrics
- 5.2. electromagnetic fields near transmission lines; electromagnetic induction in neighboring facilities such as communication circuits, pipelines or railway tracks
- 5.3. evaluation of electric field distributions, manual and computer flux mapping and field calculations
- 5.4. corona and radio interference

6. Dielectric breakdowns [8]
- 6.1. electrical breakdown in gases: ionization and decay processes, high field cathodic emission, secondary ionization and breakdown, quenching, partial breakdown, the corona effect, polarity effects, surge effects
- 6.2. electrical breakdown in insulating liquids: chemical breakdown of liquids, presence of impurities, polar molecules and dielectric heating in ac field
- 6.3. electrical breakdown in solid materials: surface tracking and carbonization, air voids in solid insulating materials, effects of electrical stress concentration, polarization, energy losses and dielectric heating in ac fields

7. Introduction to high voltage testing: [4]
- 7.1. breakdown testing using high voltage ac and dc voltages and impulse voltages,
- 7.2. measurement of high AC, DC and Impulse voltages, standardization of testing procedures
- 7.3. non-destructive testing of insulations: leakage current, dielectric loss evaluation, partial discharge radio frequency sensing, impurity

monitoring of liquid and gaseous insulating materials, insulations testing as routine maintenance procedures

References:

1. High voltage engineering, KamaRaju & Naidu
2. Extra High voltage AC Transmission, Rakosh Das Begmudre
3. Power System Analysis by W.D. Stevension, Tata McGraw Hill Publications
4. Power System Stability and Control by P. Kundur

Evaluation Scheme:

The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Chapter	Hours	Marks Distribution*
1	6	8
2	6	8
3	8	16
4	4	8
5	8	16
6	8	16
7	4	8

*There could be a minor deviation in Marks distribution

POWER PLANT DESIGN
EE …

Theory : 3 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 3

Course Objectives:
To study technical requirements and economic principles related to design of power plant, electrical systems, switchyards and plant design guidelines

1. Energy Sources and electric power generation (8 hours)
- 1.1. Renewable and non-renewable energy sources – Technology of geothermal, tidal, wind, solar thermal, solar photovoltaic, thermal, combustion, biothermal, combined cycle, gas turbine and hydro
- 1.2. Operational characteristics of each of the technologies in power system on the basis of reliability, forced and scheduled outages, availability, on-grid and off-grid operation, operating range, maintainability
- 1.3. Environmental aspects of each of the technologies, scope and feasibility in Nepalese context
- 1.4. Co-generation, captive generation, distributed generation

2. Integrated System Planning in design approach (4 hours)
- 2.1. Load forecast, system expansion planning, load uncertainties, system security, balancing load, reserve capacity, spinning reserve,
- 2.2. Different technologies for stable system operation, benefits of interconnection of regional utilities

3. Hydro Power plant design (8 hours)
- 3.1. Power Plant sitting, hydro-power plant selection, hydro-power plant design guidelines, civil structures and mechanical equipment, location and selection of civil structures
- 3.2. Run of river (ROR), Pondage run of river (PROR), Reservoir and Pumping station –components , operation and characteristics
- 3.3. Discharge exceedance (Q), Plant size and unit size, turbine selection, minimum river discharge and environmental mitigation measures of hydro-projects,

4. Electric system design of a power plant (24 hours)
- 4.1. Electrical Single Line diagram, device symbols and numbers, generator and transformer schemes, scheme selection
- 4.2. Generator and transformer specification, operation and maintenance viewpoint
- 4.3. Governor and Excitation system, mode of operation, brushless and static excitation
- 4.4. Protection systems for generator and transformer in different types of plants, generator neutral grounding, protection standards
- 4.5. LV switchgear and station service, battery characteristics and battery charger operation, fire-fighting
- 4.6. HV and MV Switchgear in power plants, HV switchyard, Switchyard scheme, bus layout, auxiliary and ancillary systems
- 4.7. Fault level calculation
- 4.8. Earthing system design of power station and sub-station
- 4.9. Protection system design of generator
- 4.10. Switchyard and synchronizing scheme
- 4.11. Power evacuation & transmission line selection

Power Plant Design Laboratory
1. Design of a hydro power plant – civil and mechanical components
   - 1.1. Analysis of hydrological data, topology, determination of discharge and head, site selection
   - 1.2. Selection of plant and unit size, selection and layout of hydraulic structures and approximate sizing
   - 1.3. Turbine selection
2. Design of a hydro power plant – electrical system design
   - 2.1. Generator and transformer selection, specification for procurement
   - 2.2. Fault level calculation for switchgear
   - 2.3. Earthing system – grid size and conductor size calculation, earth resistance calculation
   - 2.4. Protection system – connection diagram of generator protection, settings of generator over-current, differential, reverse power, loss of excitation, stator and rotor earth-fault relays
   - 2.5. Switchyard scheme design and layout design
   - 2.6. Auxillary and Ancillary System

References:

1. Engineering and Design of Hydro electric Power Plants – US Army Corps of Engineers
2. Technical Manual – Electrical Power Plant Design – Department of the US Army.
3. Guide for Control of Hydroelectric Power plants – IEEE No. 1010-1987

4. Guide for safety in AC substation grounding – IEEE No. 80-2000.
5. Wilenbrock and Thomas 'Planning Engineering and Construction of electric Power Generating Facilities" John Wiley and Sons
6. Marsh 'Economics of Electric Utility power Generation "Clarendon Press
7. Dr.P.C. Sharma "Power Plant Engineering" S.K. kataria and Sons
8. Generation and Economic Considerations – J.B. Gupta
9. Power Plant Engineering – AK Raja, Amit Prakash Srivastava, Manish Dwivedi

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	8	16
2	4	8
3	8	16
4	24	40
Total	44	80

* There may be minor deviation in marks distribution.

TRANSMISSION AND DISTRIBUTION DESIGN
EE

Lecturer : 3 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 3

Course Objectives:
To address general matters of electrical power and energy demand load characteristics, technical requirements and economic principles related to design of transmission lines and distribution systems.

1. Introduction [4 hours]
- 1.1. Advantages of grid systems
- 1.2. Transmission line design & planning
- 1.3. Technical and economic comparison of ac and dc transmission
- 1.4. Physical structures of transmission lines: ampacities, towers, sire choices, insulation and protection against lightning, shielding, grounding, sagging and clearances
- 1.5. Right-of-way and other design and construction problems, terrain and weather implications
- **1.6.** Transmission system design for Nepal

2. Transmission voltage level and number of circuit selection [4 hours]
- 2.1. Effect of voltage level in power and energy loss, conductor and insulator economy
- 2.2. Technical aspects of alternating current overhead lines: power and VAR transmission capability as functions of line length, line impedance and voltage level,
- 2.3. choice of voltage level for transmission for single and multiple circuit

3. Overhead line insulator design [8 hours]
- 3.1. Factors affecting insulator design
- 3.2. Air clearance computations, shield wires and tower grounding
- 3.3. Overhead line insulator material, types of overhead line insulators
- 3.4. Advantages of string insulators, string efficiency, string insulator configurations
- 3.5. Selection of overhead line insulators considering continuous operating voltage and over voltages

4. Conductor & support selections [10 hours]
- 4.1. Electrical, mechanical and economical requirements
- 4.2. Conductor material and preliminary size selection
- 4.3. Meeting electrical requirements; voltage regulation, efficiency, corona etc.
- 4.4. conductor choices, wire types and size, bundled conductors
- 4.5. economical size determination
- 4.6. Route selection for transmission lines
- 4.7. Surveying requirements for transmission line design and construction
- 4.8. mechanical aspects; tensioning and sagging, stringing chart, supports at unequal level
- 4.9. tower design: span selection, ground clearance, moments acting on tower and tower strength computation

5. Electric power Distribution [4 hours]
- 5.1. Underground and overhead lines systems
- 5.2. Radial and networked systems.
- 5.3. Distribution equipment: overhead lines, single phase and there phase cables, distribution transformers, switcher
- 5.4. Voltage levels, regulation, compensation
- 5.5. Urban and rural distribution system
- 5.6. Right-of-way, effects of terrain and weather and other construction problems
- 5.7. Distribution practices in rural and urban Nepal

6. Electrical loads Characteristics & Load forecast [7 hours]
- 6.1. Characterization of loads: domestic, commercial, industrial
- 6.2. Time dependence of electrical loads: load duration curves, load factor, daily variation, seasonal and annual variation, long and short term prediction of load, effects of conservation, effects of rates, diversity, load uncertainty
- 6.3. Characteristics of electric loads in Nepal
- 6.4. Load forecasting techniques, small area load forecast

7. Distribution system design [5 hours]
- 7.1. Load center selection
- 7.2. Selection of distribution transformer locations, their sizes and primary voltage level
- 7.3. selection of distribution line layout, distribution transformers, overhead lines and/or cables protection
- 7.4. evaluation of capital and operation costs

Practical:

A . Design of an overhead transmission line (25 hour)

1. Evaluation Of Electrical Requirements
2. Choice Of Ac Or Dc, Voltage Level, Conductors, Insulators
3. Route Selection Form Maps
4. Civil And Mechanical Engineering Aspects: Right-Of-Way, Tower Design, Tensioning, Sagging, Construction Aspects
5. Electrical performance: regulation, stability compensation, protecton

B. Design of a distribution system (15 hour)

1. Evaluation Of Loads: Growth, Geographical Distribution
2. Selection Of Distribution Line Layout, Distribution Transformers, Overhead Lines And/Or Cables Protection
3. Evaluation Of Capital And Operation Costs

References:

1. Elgerd, "Electric Energy Systems Theory," McGrow Hill
2. Stevnsion, "Elements of Power System Analysis," McGrow Hill
3. Deshpande, "Elements of Electrical Power system Design," Pitman and Sons
4. Marsh, Economics of Electric Utility Power Generation," Clarendon Press

Evaluation Scheme:

Chapter	Hours	Marks Distributions*
1	4	8
2	4	8
3	8	16
4	10	16
5	4	8
6	7	16
7	5	8

*There could be a minor deviation in Marks distribution

Project-II

Lecturer : 0
Tutorial : 0
Practical : 6

Year : IV
Part : II

Course Objective:
To complete an electrical engineering project Planned in Project – I under the supervision of an instructor. During the project students have to come up with final output.

Tasks: In the development of the project each group of students will be expected to:

1. This will be the continuation of project-I, start with fulfillment comment(s) in project-I
2. Initiate and maintain contact through regular progress meetings with the immediate faculty supervisor
3. prepare periodic progress reports for the project supervisor
4. carry out such laboratory or field tests as are appropriate for the project, It is important to that industry be involved in this area as much as possible to enhance contacts and provide a mechanism for interaction between university and industry, and to encourage direct relevance of the projects to real world situations
5. prepare a formal written report in good engineering style at the conclusion of the project
6. present an oral report to faculty and peers on the results of the project exercise

Elective II

ADVANCED POWER SYSTEM ANALYSIS

EE …….

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:

1. Review of transmission Line (5 hours)
- 1.1. Basic relationship in transmission line
- 1.2. Uncompensated line
- 1.3. Load compensation and System compensation
- 1.4. Symmetrical line and mid point voltage of Symmetrical line

2. Conventional method of transmission line compensation (8 hours)
- 2.1. Shunt compensation
- 2.2. Series compensation
- 2.3. Phase angle control
- 2.4. Effects f compensations on voltage regulation, transient stability and voltage stability.

3. Compensation Using Power electronic Devices (20 hours)
- 3.1. Thyristor Controlled Reactor (TCR)
- 3.2. Thyristor Switched Capacity (TSC)
- 3.3. fixed Capacitor Thyristor Controlled Reactor
- 3.4. Switfhing Converter type Var generator (STATCOM)
- 3.5. GTO Controlled Series Capacitor (GCSC)
- 3.6. Static Synchronous Series Capacitor (SSSC)
- 3.7. Unified Power Flow Controller (UPFC)
- 3.8. Static voltage and phase angle controller

4. Computer Simulation Study (12 hours)
- 4.1. Study on TCR, Fixed Capacitor Thyristor Controlled Reactor, STATCOM
- 4.2. Modeling of synchronous machine in d-g-0 frame
- 4.3. Use of Mat-Lab Simulink in power system analysis
- 4.4. Load flow analysis – Gauss Siedal method, Newton-Raphson method and Fast-Decoupled method.
- 4.5. Rotor Angle Stability
- 4.6. Voltage Stability

Practical: Exercised on computer simulation

References

1. Jhon J. Grainger and William D. Stevenson Jr., "Power system Analysis", Mc Graw Hill int.
2. Narain G. Higorani and Laszlo Gyugai, Understanding FACTS", IEEE Press
3. Hadi Saadat, "Power System analysis", TATA Mc Graw Hill.
4. R.H. Miller, "Reactive power compensation in power system", Mc. Graw Hill
5. P.s. Kundur, "Power System Stability and control", Mc. Graw Hill. Inc.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distributions*
1	5	8
2	8	16
3	20	32
4	12	24
Total	45	80

* There may be minor deviation in marks distribution.

Biomedical Instrumentation

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:

To provide specific engineering and instrumentation methods and principles to the task of obtaining basic knowledge of design, application and maintenance of different biomedical instruments.

1. Fundamental of Medical Instrumentation: (4 hours)
- 1.1. Biomedical Engineering and Areas of Engineering Contribution
- 1.2. Biometrics and Design Consideration Factors for Medical Instruments
- 1.3. Man Instrument System and their Objectives
- 1.4. Components of Man Instrument System

2. Bioelectric Signals and Electrodes: (4 hours)
- 2.1. Body System and Bioelectric Phenomenon
- 2.2. Sources of Bioelectric Signals
- 2.3. Resting and Action Potentials
- 2.4. Electrode Theory and their Equivalent Circuits
- 2.5. Types of Biopotential Electrodes
- 2.6. Application of electrodes in medical instrumentation

3. Physiological Transducers: (4 hours)
- 3.1. Classification of Transducers
- 3.2. Performance Characteristics of Transducers
- 3.3. Active Transducers and their Application in Medical Instruments
- 3.4. Passive Transducers and their Types used in Medical Instruments

4. Bioelectric Signals Measurement and Recording System (10 hours)
- 4.1. Aspects of Bioelectric Signals
- 4.2. Electrocardiography (ECG)
  - 4.2.1. Normal Characteristics of Electrocardiogram
  - 4.2.2. ECG Lead Configuration and Recording Techniques
  - 4.2.3. Computer –Aided Electrocardiograph Analysis
- 4.3. Electroencephalography (EEG)
  - 4.3.1. Electroencephalogram and Evoked Potential
  - 4.3.2. EEG Pre amplifier Design
  - 4.3.3. EEG Electrode Configuration and Recording Techniques
  - 4.3.4. Practical Details of EEG
- 4.4. Electromyography (EMG)
  - 4.4.1. Electromyography Recording Technique
  - 4.4.2. Applications of EMG

5. Non- Invasive Diagnostic Instruments (12 hours)
- 5.1. Blood Flow Measurement
  - 5.1.1. Magnetic Blood Flow meter
  - 5.1.2. Ultrasonic Blood Flow meter
  - 5.1.3. Blood Flow Measurement by Thermal Convection
  - 5.1.4. Blood Flow Measurement by Radiographic Method
- 5.2. Diagnostic Medical Imaging System
  - 5.2.1. Radiographic Imaging System
    - 5.2.1.1. Principle of generation of X-rays and its medical properties
    - 5.2.1.2. Functional X-ray Machine
    - 5.2.1.3. Biological Effects of X-rays
  - 5.2.2. Ultrasonography Imaging System
  - 5.2.3. Computer Tomography (CT-Scan) System
  - 5.2.4. Magnetic Resonance Imaging System (MRI)
  - 5.2.5. Nuclear Medicine Machine

6. Therapeutic Instruments (4 hours)
- **6.1.** Function of Kidneys
- **6.2.** Principle of Artificial Kidneys
- **6.3.** Heamodialysis Machine
- **6.4.** Types of Dialyzers
- **6.5.** Lithotripsy and its principle
- **6.6.** Lithotripter Machine
- **6.7.** Defibrillator Machine

7. Biomedical Telemetry and Telemedicine (3 hours)
- **7.1.** Wireless Telemetry
- **7.2.** Single Channel Telemetry System
- **7.3.** Multi channel Telemetry
- 7.4. Telemedicine Using Mobile Communication Equipments

8. Electrical Safety of Medical Equipment (4 hours)
- **8.1.** Physiological Effects of Electricity
- **8.2.** Leakage Currents and Methods of Accident Prevention
- **8.3.** Micro shocks and Macro shocks Hazards
- **8.4.** Electrical Safety Codes and Standards
- **8.5.** Special Safety Measures for Electrical Susceptible Patients

8.6. Power Distribution and Protection System of the Hospital

Practicals:

Three practical exercises based on availability of the portable medical instruments, clinical based equipment and Field Visit to Medical Institution and related Field Visit Report and Viva Voce.

References:

1. Biomedical Instrumentation and Measurements - Leslie Cromwell, et Al, Prentice Hall, India

2. A Hand Book of Biomedical Instrumentation, R S Khandpur, Tata Mc Graw Hill

Evaluation Scheme

chapters	hours	Marks distribution*
1	4	6
2	4	8
3	4	10
4	10	16
5	12	24
6	4	8
7	3	4
8	4	4
Total	45	80

Applied Photovoltaic Engineering

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:

1. The sun and the solar spectrum **(4 hours)**
- 1.1. Electromagnetic spectrum
- 1.2. Effects of Earth atmosphere, orbit and rotation on insolation
- 1.3. Estimation and measurement of solar radiation
- 1.4. Calculation of energy available in a place; radiation on inclined and horizontal plane, yearly energy available in place
- 1.5. Models and Software for assessing the solar energy

2. Semiconductors for photovoltaics **(4 hours)**
- 2.1. p-n junction for solar cell, fundamental concept; I-V and P-V characteristics
- 2.2. Model of PV cells; short circuit current, open circuit voltage, four parameter model, equivalent circuit, effect of temperature
- 2.3. Fill factor, efficiency series
- 2.4. Cell to panel, effect of shading and mitigation
- 2.5. Testing of PV panel
- 2.6. Model and simulation

3. Modern PV cell technology **(4 hours)**
- 3.1. Thin film technology
- 3.2. Polycrystalline silicon
- 3.3. Thin film solar cell
- 3.4. Epitaxial films including GaAs modern cell
- 3.5. Solar panel standards

4. Power electronics and control of photovoltaic system **(8 hours)**
- 4.1. Dc-Dc converter (buck, boost, isolating converters)
- 4.2. Inverter topology
- 4.3. Single stage and two stage power electronics configuration
  - 4.3.1. Control of dc-dc converters :Maximum power point tracking techniques
- 4.4. Control of Inverters
  - 4.4.1. Isolated operation
  - 4.4.2. Grid connected operation

5. Isolated PV systems **(6 hours)**
- 5.1. Storage devices: different type of batteries
- 5.2. Charge controller; principle and circuit diagram
- 5.3. UPS system with PV: back to back converter topology, charging scheme of UPS by PV and grid, setting priority
- 5.4. Water pumping

6. Grid Connected PV system **(8 hours)**
- 6.1. Phase, frequency and voltage matching
  - 6.1.1.Grounding
  - 6.1.2.Protection
  - 6.1.3.Transient response
  - 6.1.4.Power Flow analysis with PV units;
  - 6.1.5.Short Circuit analysis with PV units;
  - 6.1.6.Voltage profile
  - 6.1.7.Guideline for PV integration; penetration level
- 6.2. Interconnection standards, codes and practices
  - 6.2.1.IEEE
  - 6.2.2.IEC
  - 6.2.3.UL
  - 6.2.4.Voltage ride through requirements
  - 6.2.5.others

7. Design of PV system **(4 hours)**
- 7.1. Isolated PV system for residence
- 7.2. Grid connected PV system
- 7.3. Solar water pump

8. Socio-economic aspects **(4 hours)**
- 8.1. Economic assessment of PV power system (Payback period, Total Ownership cost -TOC, Present worth factor-PWF)
- 8.2. Environmental Impact analysis (EIA) and safety of PV system
- 8.3. Production, recycling and disposal of PV system (PV panel and batteries)
- 8.4. Large scale integration of PV into power grid

Practical Works (Experiment and Simulation)

1. Study of characteristics of PV cell and module
   - Plotting of I-V, P-V curve on different insolation
   - Determination of parameters of PV panel: short circuit current, open circuit voltage, series and shunt resistance
2. Design and simulation of stand-alone photovoltaic system: use suitable numerical tools (such as Maltlab Simulink, PSCAD)
3. Design and simulation of grid connected PV system: use suitable numerical tools (such as Maltlab Simulink, PSCAD)
4. Case study: Study of large scale PV system (one from *world and Nepal* each)
5. Field visit

Reference

1. Photovoltaic system analysis and design, AK Mukharji, PHI 2011.
2. Kalogirou, S. A. Solar Energy Engineering: Processes and Systems, Academic Press, 2009, ISBN-10: 0123745012
3. Renewable and Efficient Electric Power Systems, G Masters, Wiley Publication 2004.
4. Messenger, R. A., Ventre, J., Photovoltaic Systems Engineering, 2nd ed., CRC Press, 2003, ISBN-10: 0849317932
5. Foster, R.; Ghassemi, M.; Cota, A.; Solar Energy: Renewable Energy and the Environment, CRC Press, 2009, ISBN-10: 1420075667

Evaluation Scheme

SN	Chapter	Hours	Marks
1	1	4	8
2	2	6	8
3	3	4	8
4	4	8	16
5	5	6	8
6	6	8	16
7	7	4	8
8	8	4	8

* There may be minor deviation in marks distribution.

Elective III

MICRO-HYDRO POWER
EE

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
To introduce operation, maintenance and design aspect of Micro Hydro power plant including basic hydrology and geology.

1. Micro hydro basics and status in Nepal (2 hours)

1.1. Necessity of micro hydro power, Power from water, typical layout, isolated /mini grid or grid connected scheme, Micro hydro design approach, Status of micro hydro power development in Nepal and agencies involved .

2. Hydrological and demand survey (7hours)

2.1. Plant factor and load factor, Hydrograph and flow duration curve, Hydrological cycle, Matching power supply with demand, Capability and demand survey, Methods of finding ADF (annual average daily flow), Methods of head measurements, Methods of flow measurements, load demand curves of various loads, Peak demand forecasting, Optimum generating installed capacity, Geological consideration.

3. Turbines, drive system and governors: (9 hours)

3.1. Turbine types for micro hydro, their constructional features and operational characteristics, Effect on efficiency during part flow conditions, Nomogram and turbine selection, Comparison of costs of the turbines

3.2. Introduction to drive system, Various drive arrangements and their features, Drive problem, Design parameters for a drive system

3.3. purpose of speed governing, Various governing mechanisms, Electrical load controller as a governor in micro hydro, Ballast load, water cooled and air cooled ballasts, Effect of ballast on generator sizing, Ballast sizing.

4. Generators and voltage regulators (9 hours)

4.1. Choice between AC and DC, Synchronous generator specifications, Brushless synchronous generator and its operational features, voltage regulation, Automatic voltage regulator(AVR), Practical consideration for AVR, Induction generator specifications and its operation, Induction generator controller, Induction generator sizing, Sizing of excitation capacitance, comparison of induction generator with other systems, Mechanical consideration to be given to the induction generators.

5. Switchgear, protection and measurement: (4 hours)

5.1. Isolators, fuses, main switches, Moulded case circuit breakers(MCCB), Oil and air CB, earth leakage CB, contactors, Under voltage trips, Over voltage trips, Over current trips, temperature trips, lightening protection, Earthing system, metering equipment, voltmeter, ammeter-AC and DC, Energy meter, speed meter, pressure gauge, frequency meter, appropriate choice of switchgear, protection and measurement.

6. Testing , Commissioning, Operation and Maintenance: (5 hours)

6.1. Head works, Electro-mechanical equipment, Alternator, Loading machine on main load, Taking readings, Setting up trips.

6.2. Types of manuals-operation manual, component manual, installer manual, preventive maintenance schedule, log sheet, repair manual, training manual, responsibility of designers, installer and users as regards to O and M.

7. Financial Evaluation, Tariff design and Issues in Micro hydro: (9 hours)

7.1. Cost elements, The time value of money, compounding and discounting, Future and present values, Cash flows , Benefit cost ratio, Net present value, Internal rate of return, Comparison with alternatives

7.2. Tariff category, Principals of tariff design, Unit energy cost, Flat power tariff VS energy tariff.

7.3. Issues: Reliability, funding requirement, Subsidy policy and mechanism, Cost per KW, Sustainability, Operation and maintenance, Local people's participation, End use of electricity for project viability.

Practical:

1 Flow and head measurement in actual site, load demand survey in actual site.
2 Calculating and forecasting the peak demand and its matching by water supply.
3 Turbine and generator sizing and selection-various alternatives.
4 Approximate design of unit or wattage subscription category(primary tariff)
5 Designing the basic hydraulic structures such as diversion weir, intakes, desiliting basins, canal tunnel, penstock pipe, reservoir etc.

6 To find out the total capital cost investment and calculate the cost per KW.
7 To find out total annual costs (annual fixed costs and annual operating costs).
8 To design tariff category and fix the charges for each categories.

References:

1. Adam Harvey with Andy Brown, Priyantha Hettiarachi and Allen Inversin: Micro Hydro Design Manual, A Guide to Small Scale Water Power Schemes (ITDG Publication).
2. D.P. Kothari, K.C. Singal and Rakesh Ranjan: Renewable Energy Sources and Emerging Technologies, Printice Hall of India Ltd.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distributions*
1	2	16
2	7	
3	9	16
4	9	16
5	4	16
6	5	
7	9	16
Total	45	80

* There may be minor deviation in marks distribution.

ARTIFICIAL NEURAL NETWORK

EE….

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
To introduce the concept of artificial network as an alternative options for solving engineering problems.

1. **Working with data: Data types; data, information and knowledge; concept of data mining; Dimension reduction of data matrix: Principal component analysis. (4 hours)**

2. **Introducton of Artifical Neural Network (ANN): Biological Analogy, Historical development; ANN terminology; network structure; basis functions; activation functions; advantages of ANN; application areas of ANN. (6 hours)**

3. **Learning process & optimization techniques (10 hours)**
   - 3.1. supervised learning: Error correction learning, memory based learning
   - 3.2. unsupervised learning: Hebian learning, competitive learning
   - 3.3. learning with critic
   - 3.4. gradient descent and least mean square
   - 3.5. Derivative free optimization techniques: advantages of derivative free techniques; genetic algorithm: fundamental of GA and biological background.; GA operators & GA operation.
   - 3.6. Simulated annealing: theoretical background and algorithm.

4. **Supervised network (8 hours)**
   - 4.1. McCullotch and Pitt Neuron; LTUs, simple perceptron and perceptorn learning. Limitation of simple percepron.
   - 4.2. ADDALINE network and delta rule
   - 4.3. Multilayer perceptron: Needs of multilayer network, generalized delta rule (error-backpropagation), effect of momentum term and learning rate
   - 4.4. Error.back propagation learning of sigmoidal units; drawbacks of error-backpropagatin

5. **Unsupervised network (4 hours)**
   - 5.1. competitive network: network structure & working;
   - 5.2. dissimilarity measures;
   - 5.3. Self Organizing Map and Kohonen learning;
   - 5.4. applications

6. **Special networks: (4 hours)**
   - 6.1. Radial basis function network: structure and working procedure, advantages
   - 6.2. LVQ network: structure and learning approach
   - 6.3. Hopefield network
   - 6.4. Autoassociative memory network: general structure and Purpose, Autocorrelator; Heterocorrelator

7. **Application of ANN in Electrical Engineering (8 hours)**
   - 7.1. Fault diagnosis
   - 7.2. Control application
   - 7.3. Network planning
   - 7.4. Forecasting task.
   - 7.5. State estimation
   - 7.6. Unit commitment

Practical:
1. Computer simulation of PCA.
2. Computer simulation of perceptron network
3. computer simulation of back propagation network
4. A Short term case study demonstrating ANN application for a specific purpose.

References::
1. Simon Hykin, "Neural networks A Comprehensive Foundation", second edition; Pearson Education.

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distributions*
1	4	8
2	6	8
3	10	16
4	8	16
5	4	8
6	4	8
7	8	16
Total	44	80

WIND ENERGY CONVERSION SYSTEM
EE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
To introduce the technology, grid integration and energy assessment for the wind power system to the final year BE student.

1. Wing Power Basics (8 hours)
- 1.1. Historical evolution of wind power system
- 1.2. Change in size and output
- 1.3. Wind energy conversion system: turbine, generator, power electronics, grid
- 1.4. Wind power plant and wind mill
- 1.5. Economics
- 1.6. Economics
  - 1.6.1. Wind fluctuations
  - 1.6.2. Capacity credits
  - 1.6.3. Embedded generation benefits
  - 1.6.4. Storage
- 1.7. Future trend: Cost, capacity, integration issues.

2. Wind energy assessment (10 hours)
- 2.1. Power in the Wind : temperature, altitude correction, impact of Tower Height
- 2.2. Maximum Rotor Efficiency
- 2.3. Average Power in the Wind
  - 2.3.1. Discrete Wind Histogram
  - 2.3.2. wind Power Probability Density Functions
  - 2.3.3. Weibull and Rayleigh Statistics
  - 2.3.4. Average Power in the Wind with Rayleigh Statistics
  - 2.3.5. Wind Power Classification
- 2.4. simple Estimates of Wind Turbine Energy
- 2.5. Annual Energy using Average Wind Turbine Efficiency
- 2.6. Wind Farms
- 2.7. Specific wind Burtine Performance Calcualtions: aerodynamics, power curve and Weibull statistics
- 2.8. Wind Turbine Economics 371
  - 2.8.1.Capital Costs and
  - 2.8.2.Annual Costa 371
  - 2.8.3.Annualized ost of Electricity from Wind Turbines

3. Technology of wind energy conversion system (8 hours)
- 3.1. Wind Turbines
- 3.2. Generators
- 3.3. Power Electronics Interfaces
- 3.4. Classification of WECS
  - 3.4.1.Fixed speed based wind turbines
  - 3.4.2.Partially rated Converter-based (FRC) Wind Turbines
  - 3.4.3.Fully Rated converter-based (FRC) Wind Turbines

4. Integration of WECS (8 hours)
- 4.1. Interconnection issues
- 4.2. Operation of off-grid mode:hybrid system
- 4.3. Operation in grid connected mode
- 4.4. Fault ride through

5. Wind power and electricity markets (8 hours)
- 5.1. Introduction
- 5.2. The electrical energy market
- 5.3. Balancing, capacity and ancillary services
- 5.4. Support mechanisms
- 5.5. Costs
- 5.6. Investment and risk
- 5.7. The future

Practical Works
1. Wind Energy assessment of the partid\cular location
2. Analysis of different wind turbine generation systems
3. Case Study on technology and issues related grid integration of WECS
4. Market Analysis of WECS

Reference:

1. Wind Power in Power Systems, edited by Thomas Ackermann, Wiley publication, 2nd edition, 2004
2. Renewable and efficient power system
3. Wind Energy: Fundamentals, Resource analysis and Economics, Mathew Sathyajith, 2006
4. Wind Energy Explained: theory, Design and Application, James F. Manwell, Jon G. McGowan, Anthony L. Rogers, 2010.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	8	16
2	8	16
3	10	16
4	8	16
5	8	16
Total	40	80

* There may be minor deviation in marks distribution.