Tribhuvan University

Institute of Engineering

CURRICULUM

BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING

Revised Print
2009

Contents

1. INTRODUCTION

The Institute of Engineering (IOE) is offering this course with the objective of producing high level technical manpower capable of undertaking works in the Electrical Engineering field. The details of the course are as follows:

1.1 Title of the Course

Bachelor of Engineering in **Electrical Engineering**.

1.2 Duration of the Course

The total duration of the course is 4 years. Each year consists of two parts **I** and **II**, each part having duration of 90 working days (15 weeks).

2. COURSE STRUCTURE

The course is divided into 8 parts. The first year courses include fundamental common subjects. The second and third year generally include specific courses of the related discipline. The final year include professional and application type courses.

The course structure attached in the later section of this book provides information about lecture, tutorial and practical hours per week, full marks and pass marks for internal assessment and final examination, and the duration of final examination of each subject.

3. COURSE CODE

Each subject is specified by a unique code consisting of two letters followed by three digit number for core courses and five digit numbers for elective courses. The first two letters denote the department which offers the subject (SH: Science and Humanities, AE: Agricultural Engineering, AR: Architecture, CE: Civil Engineering, CT: Computer Engineering, EE: Electrical Engineering, EX: Electronics and Communication Engineering, GE: Geomatics Engineering, IE: Industrial Engineering, ME: Mechanical Engineering). The first digit of the number denotes the year on which the subject is offered (4 for first year, 5 for second year, 6 for third year and 7 for fourth year respectively for Bachelor' level course). The remaining two digits 01 to 49 are used for the core subjects offered in odd parts and 51 to 99 are used for the core subjects offered in even parts. Two extra digits from 01 to 99 are used for the elective courses.

Core Courses:

AB	DEF

AB: Offering Department (SH, AE, AR, CE, CT, EE, EX, GE or ME)
D: Year (4 for first year, 5 for second year, and so on).

EF: 01- 49 for courses offered in odd parts and 51 to 99 for courses offered in even parts

Elective Courses:

AB DEFGH

GH: 01 to 99 specific numbers to each elective course

For example, ME 751 is the code for the core course "Finite Element Method" which is offered in fourth year second part by Department of Mechanical Engineering.

4. INSTRUCTION METHODS

The method of teaching is lectured augmented by tutorials and/or practical, whichever is relevant. Tutorials are used to enlarge and develop the topic and concepts stated in the lecture. Practical classes in the form of laboratory works and design/drawing practices are used to verify the concepts and to develop necessary basic skills. Each course is specified with certain lecture, tutorial and practical hour(s) per week. The hours specified as 3/2 in practical means 3 laboratory hours in each two weeks.

The use of multimedia and interactive mode presentations is encouraged for conducting fourth year courses.

5. INTERNAL ASSESSMENT AND FINAL EXAMINATION

The students' achievement in each subject is evaluated by internal assessment and final examination.

5.1 Internal Assessment

20 % of the total marks is allocated for internal assessment for theory part of all subjects. Internal assessment mark should include class performance, timely submissions and correctness of assignments, class tests, quizzes, etc.

Evaluation of practical part of most of the subjects is done through continuous assessment. It includes lab performance, report submission, presentation, viva etc. However, for few courses final examinations are also conducted.

70 % attendance is mandatory to qualify for the final examination.

5.2 Final Examination

Final examinations of 3 hours for theoretical subjects with full mark of 80 and 1.5 hours for theoretical subjects with full mark of 40 are conducted as per academic calendar of IOE.

5.3 Pass Marks

Any student must obtain 40 % in both internal assessment and final examination of each subject to pass in the subject. Only students who have passed the internal assessment of a particular subject are allowed to appear in the final examination of that subject.

6. EVALUATION SYSTEM

Students who have passed all the components of all subjects in all parts are considered to have successfully completed the course. The overall achievement of each student is measured by a final aggregate percentage which is obtained by providing a weight to percentages scored by the students in each part as prescribed below:

First year (both I and Ii Parts):	20 %
Second year (both I and II Parts):	20 %
Third year (both I and II Parts):	30 %
Fourth years (both I and II Parts):	30 %

Depending upon the final weighted aggregate percentage scored by a student, a division is awarded as follows:

80 % and above:	Distinction
65 % or above and below 80 %:	First
50 % or above and below 65%:	Second
40 % or above and below 50%:	Pass

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Year : I

Part : I

S. N.	Course Code	Course Title	Teaching Schedule				Examination Scheme							Remark
							Theory			Practical				
								Final			Final			
			L	T	P	Total	Assesment Marks	Duaration hours	Marks	Assesment Marks	Duaration hours	Marks	Total	
1	SH 401	Engineering Mathematics I	3	2		5	20	3	80				100	
2	CI 401	Computer Programming	3		3	6	20	3	80	50			150	
3	ME 401	Engineering Drawing I	1		3	4				60	3	40	100	
4	SH 402	Engineering Physics	4	1	2	7	20	3	80	20	3	30	150	
5	CE 401	Applied Mechanics	3	2		5	20	3	80				100	
6	EE 401	Basic Electrical Engineering	3	1	1.5	5.5	20	3	80	25			125	
		Total	**17**	**6**	**9.5**	**32.5**	**100**	**15**	**400**	**155**	**6**	**70**	**725**	

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Year : I

Part : II

S. N.	Course Code	Course Title	Teaching Schedule				Examination Scheme						Total	Remark
							Theory			Practical				
							Assesment Marks	Final		Assesment Marks	Final			
			L	T	P	Total		Duaration hours	Marks		Duaration hours	Marks		
1	SH 451	Engineering Mathematics -II	3	2		5	20	3	80				100	
2	ME 451	Engineering Drawing II	1		3	4				60	3	40	100	
3	EX 451	Basic Electronics Engineering	3	1	1.5	5.5	20	3	80	25			125	
4	SH 453	Engineering Chemistry	3	1	3	7	20	3	80	20	3	30	150	
5	ME 452	Fundamentals of Thermodynamics and Heat Transfer	3	1	1.5	5.5	20	3	80	25			125	
6	ME 453	Workshop Technology	1		3	4	10			40			50	
		Total	**14**	**5**	**12**	**31**	**90**	**12**	**320**	**170**	**6**	**70**	**650**	

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Year : II

Part : I

S. N.	Course Code	Course Title	Teaching Schedule				Examination Scheme							Remark
							Theory			Practical			Total	
							Assesment Marks	Final		Assesment Marks	Final			
			L	T	P	Total		Duaration hours	Marks		Duaration hours	Marks		
1	SH 501	Engineering Mathematics III	3	2		5	20	3	80				100	
2	CT 501	Object Oriented Programming	3		3	6	20	3	80	50			150	
3	EE 501	Electric Circuit Theory	3	1	1.5	5.5	20	3	80	25			125	
4	EE 502	Electrical Engineering Material	3	1		4	20	3	80				100	
5	EX 501	Electronic Devices & Circuits	3	1	1.5	5.5	20	3	80	25			125	
6	EX 502	Digital Logic	3		3	6	20	3	80	50			150	
7	EX 503	Electromagnetics	3	1	1.5	5.5	20	3	80	125			125	
		Total	**21**	**6**	**10.5**	**37.5**	**140**	**21**	**560**	**275**			**875**	

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Year : II

Part : II

S. N.	Course Code	Course Title	Teaching Schedule L	T	P	Total	Examination Scheme: Theory Assesment Marks	Theory Final Duaration hours	Theory Final Marks	Practical Assesment Marks	Practical Final Duaration hours	Practical Final Marks	Total	Remark
1	SH 551	Applied Mathematics	3	1		4	20	3	80				100	
2	SH 553	Numerical Methods	3	1	3	7	20	3	80	50			150	
3	EE 551	Electric Machines I	3	1	1.5	5.5	20	3	80	25			125	
4	EE 552	Instrumentation I	3	1	1.5	5.5	20	3	80	25			125	
5	EE 555	Power System Analysis I	3	1		4	20	3	80				100	
6	EX 551	Microprocessor	3	1	3	7	20	3	80	50			150	
		Total	**18**	**6**	**9**	**33**	**120**	**18**	**480**	**150**			**750**	

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Year : III

Part : I

S. N.	Course Code	Course Title	Teaching Schedule				Examination Scheme						Total	Remark
							Theory			Practical				
							Assesment Marks	Final		Assesment Marks	Final			
			L	T	P	Total		Duaration hours	Marks		Duaration hours	Marks		
1	SH 601	Communication English	3	1	2	6	20	3	80	25			125	
2	SH 602	Probability and Statics	3	1		4	20	3	80				100	
3	EE 601	Electric Machines - II	2	1	1.5	4.5	10	1.5	40	25			75	
4	EE 602	Control System	3	1	1.5	5.5	20	3	80	25			125	
5	EE 603	Electric Machine Design	3		3	6	20	3	80	50			150	
6	EE 605	Power System analysis II	3	1		4	20	3	80				100	
7	EX 602	Instrumentation II	3	1	1.5	5.5	20	3	80	25			125	
		Total	**20**	**6**	**9.5**	**35.5**	**130**	**19.5**	**520**	**150**			**800**	

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Year : III

Part : II

S. N.	Course Code	Course Title	Teaching Schedule				Examination Scheme						Total	Remark
							Theory			Practical				
							Assesment Marks	Final		Assesment Marks	Final			
			L	T	P	Total		Duaration hours	Marks		Duaration hours	Marks		
1	CE 655	Engineering Economics	3	1		4	20	3	80				100	
2	CE 660	Hydro Power	3	1	1.5	5.5	20	3	80	25			125	
3	EE 651	Swichgear & Protection	4	1	1.5	6.5	20	3	80	25			125	
4	EE 652	Ditital Control system	3	1	1.5	5.5	20	3	80	25			125	
5	EE 653	Industrial Power Distribution & Illumination	4		2	6	20	3	80	25			125	
6	EX 651	Signal Analysis	3	1	1.5	5.5	20	3	80	25			125	
		Total	**20**	**5**	**8**	**33**	**120**	**18**	**480**	**125**			**725**	

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Year : IV

Part : I

S. N.	Course Code	Course Title	Teaching Schedule L	T	P	Total	Examination Scheme: Theory Assesment Marks	Theory Final Duaration hours	Theory Final Marks	Practical Assesment Marks	Practical Final Duaration hours	Practical Final Marks	Total	Remark
1	CE 701	Project Engineering	3	1		4	20	3	80				100	
2	CE 708	Technology Environment and Society	2			2	10	1.5	40				50	
3	ME 708	Organization and Management	3	1		4	20	3	80				100	
4	EE 701	Power Electronics	3	1	1.5	5.5	20	3	80	25			125	
5	EE 702	Utilization of Electrical Energy	3	1	1.5	5.5	20	3	80	25			125	
6	EE 703	Power Plant Equipment	4		1.5	5.5	20	3	80	25			125	
7	EE 725	Elective I	3	1	1.5	5.5	20	3	80	25			125	
8	EE 707	Project (Part A)			3	3				50			50	
		Total	**21**	**5**	**9**	**35**	**130**	**19.5**	**520**	**150**			**800**	

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Year : IV

Part : II

S. N.	Course Code	Course Title	Teaching Schedule				Examination Scheme							
							Theory			Practical				
			L	T	P	Total	Assesment Marks	Final Duaration hours	Final Marks	Assesment Marks	Final Duaration hours	Final Marks	Total	Remark
1	CE 752	Engineering Professional Practice	2			2	10	1.5	40				50	
2	EE 751	High Voltage Engineering	3	1		4	20	3	80				100	
3	EE 753	Power Plant Design	3		2	5	20	3	80	50			150	
4	EE 754	Transmission and Distribution System Design	3		2	5	20	3	80	50			150	
5	EE 765	Elective II	3	1	1.5	5.5	20	3	80	25			125	
6	EE 785	Elective III	3	1	1.5	5.5	20	3	80	25			125	
7	EE 755	Project (Part B)			6	6				50		50	100	
		Total	**17**	**3**	**13**	**33**	**110**	**16.5**	**440**	**200**		**50**	**800**	

ENGINEERING MATHEMATICS I

SH 401

Lecture : 3
Tutorial : 2
Practical : 0

Year : I
Part : I

Course Objective:
To provide students a sound knowledge of calculus and analytic geometry to apply them in their relevant fields.

1. Derivatives and their Applications **(14 hours)**

1.1. Introduction
1.2. Higher order derivatives
1.3. Mean value theorem
  1.3.1. Rolle's Theorem
  1.3.2. Lagrange's mean value theorem
  1.3.3. Cauchy's mean value theorem
1.4. Power series of single valued function
  1.4.1. Taylor's series
  1.4.2. Maclaurin's series
1.5. Indeterminate forms; L'Hospital rule
1.6. Asymptotes to Cartesian and polar curves
1.7. Pedal equations to Cartesian and polar curves; curvature and radius of curvature

2. Integration and its Applications **(11 hours)**

2.1. Introduction
2.2. Definite integrals and their properties
2.3. Improper integrals
2.4. Differentiation under integral sign
2.5. Reduction formula; Beta Gama functions
2.6. Application of integrals for finding areas, arc length, surface and solid of revolution in the plane for Cartesian and polar curves

3. Plane Analytic Geometry **(8 hours)**

3.1. Transformation of coordinates: Translation and rotation
3.2. Ellipse and hyperbola; Standard forms, tangent, and normal
3.3. General equation of conics in Cartesian and polar forms

4. Ordinary Differential Equations and their Applications **(12 hours)**

4.1. First order and first degree differential equations
4.2. Homogenous differential equations
4.3. Linear differential equations
4.4. Equations reducible to linear differential equations; Bernoulli's equation

4.5. First order and higher degree differential equation; Clairaut's equation
4.6. Second order and first degree linear differential equations with constant coefficients.
4.7. Second order and first degree linear differential equations with variable coefficients; Cauchy's equations
4.8. Applications in engineering field

References:

1. Erwin Kreyszig, "Advance Engineering Mathematics" , John Wiley and Sons Inc
2. Thomas,Finney, "Calculus and Analytical Geometry" Addison- Wesley
3. M. B. Singh, B. C. Bajrachrya, "Differential Calculus", Sukunda Pustak Bhandar,Nepal
4. M. B. Singh, S. P. Shrestha, "Applied Mathematics", RTU, Department of Engineering Science and Humanities.
5. G.D. Pant, G. S. Shrestha, "Integral Calculus and Differential Equations", Sunila Prakashan, Nepal
6. M. R. Joshi, "Analytical Geometry", SukundaPustak Bhandar,Nepal
7. S. P. Shrestha, H. D. Chaudhary, P. R. Pokharel, "A Textbook of Engineering Mathematics - Vol I", Vidyarthi Pustak Bhandar.
8. Santosh Man Maskey, "Calculus", Ratna Pustak Bhandar, Nepal

COMPUTER PROGRAMMING

CT 401

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

Course Objective:
To familiarize the student with computer software and high level programming languages and to develop the programming skill using C language

1. Overview of Computer Software & Programming Languages **(3 hours)**

1.1. System software
1.2. Application software
1.3. General software features and recent trends
1.4. Generation of programming languages
1.5. Categorization of high level languages

2. Problem Solving Using Computer **(3 hours)**

2.1. Problem analysis
2.2. Algorithm development and Flowchart
2.3. Compilation and Execution
2.4. Debugging and Testing
2.5. Programming Documentation

3. Introduction to 'C' Programming **(4 hours)**

3.1. Character set, Keywords, and Data types
3.2. Preprocessor Directives
3.3. Constants and Variables
3.4. Operators and statements

4. Input and Output **(3 hours)**

4.1. Formatted input/output
4.2. Character input/output
4.3. Programs using input/output statements

5. Control Statements **(6 hours)**

5.1. Introduction
5.2. The goto, if, if ... ... else, switch statements
5.3. The while, do ... while, for statements

6. User-Defined Functions **(4 hours)**

6.1. Introduction
6.2. Function definition and return statement
6.3. Function Prototypes

6.4. Function invocation, call by value and call by reference, Recursive Functions

7. Arrays and Strings **(5 hours)**

7.1. Defining an Array
7.2. One-dimensional Arrays
7.3. Multi-dimensional Arrays
7.4. Strings and string manipulation
7.5. Passing Array and String to function

8. Structures **(4 hours)**

8.1. Introduction
8.2. Processing a Structure
8.3. Arrays of Structures
8.4. Arrays within Structures
8.5. Structures and Function

9. Pointers **(4 hours)**

9.1. Introduction
9.2. Pointer declaration
9.3. Pointer arithmetic
9.4. Pointer and Array
9.5. Passing Pointers to a Function
9.6. Pointers and Structures

10. Data Files **(5 hours)**

10.1. Defining opening and closing a file
10.2. Input/Output operations on Files
10.3. Error handling during input/output operations

11. Programming Languages: FORTRAN **(4 hours)**

11.1 Character set
11.2 Data types, Constants and variables
11.3 Arithmetic operations, Library Functions
11.4 Structure of Fortran program
11.5 Formatted and Unformatted Input/Output Statements
11.6 Control Structures: Goto, Logical IF, Arithmetic IF, Do loops
11.7 Arrays: one dimensional and two dimensional

Practical

- Minimum 6 sets of computer programs in C (from Unit 4 to Unit 10) and 2 sets in FORTRAN (from Unit 11) should be done individually. (30 marks out of 50 marks)
- Student (maximum 4 persons in a group) should submit a mini project at the end of course. (20 marks out of 50 marks)

References:

1. Kelly & Pohl, "A Book on C", Benjamin/Cumming
2. Brian W. Keringhan & Dennis M. Ritchie, "The 'C' Programming Language", PHI
3. Daya Sagar Baral, Diwakar Baral and Sharad Kumar Ghimire "The Secrets of C Programming Language", Bhundipuran Publication
4. Bryons S. Gotterfried, "Programming with C", TMH
5. Yashavant Kanetkar, "Let Us C", BPB
6. Alexis Leon, Mathews Leon, "Fundamentals of Information Technology", Leon Press and Vikas Publishing House

ENGINEERING DRAWING I

ME 401

Lectures : 1
Tutorial : 0
Practical : 3

Year : I
Part : I

Course Objective:
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 & Techniques (2 hours)

1.1. Equipment and materials
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. Lettering strokes, letter proportions, use of pencils and pens, uniformity and appearance of letters, freehand techniques, inclined and vertical letters and numerals, upper and lower cases, standard English lettering forms

2. Dimensioning (2 hours)

2.1. Fundamentals and techniques
2.2. Size and location dimensioning, SI conversions
2.3. Use of scales, measurement units, reducing and enlarging drawings
2.4. Placement of dimensions: aligned and unidirectional

3. Applied Geometry (6 hours)

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

4. Basic Descriptive Geometry (14 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 plane, Inclined to one of the principal plane and parallel to other, Inclined to both principal planes

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
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 **(18 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, broken revolved, removed (detail) sections, phantom of hidden section, Auxiliary sectional views, specifying cutting planes for sections, conventions for hidden lines, holes, ribs, spokes
5.3. Auxiliary views: Basic concept and use, drawing methods and types, symmetrical and unilateral auxiliary views. Projection of curved lines and boundaries, line of intersection between two planes, true size of dihedral angles, true size and shape of plane surfaces

6. Developments and Intersections **(18 hours)**

6.1. Introduction and Projection of Solids
6.2. Developments: general concepts and practical considerations, development of a right or oblique prism, cylinder, pyramid, and cone, development of truncated pyramid and cone, Triangulation method for approximately developed surfaces, transition pieces for connecting different shapes, development of a 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 -prisms and pyramids, cylinder and an oblique plane.

Constructing a development using auxiliary views, intersection of two cylinders, a cylinder & a cone

Practical:

1. Drawing Sheet Layout, Freehand Lettering, Sketching of parallel lines, circles, Dimensioning
2. Applied Geometry(Sketch and Instrumental Drawing)
3. Descriptive Geometry I: Projection of Point and Lines (4.1 to 4.3)(Sketch and Instrumental Drawing)
4. Descriptive Geometry II: Projection of Planes (4.4) (Sketch and Instrumental Drawing)
5. Descriptive Geometry III: Applications in Three dimensional Space (4.5 to 4.15) (Sketch and Instrumental Drawing)
6. Multiview Drawings (5.1) (Sketch and Instrumental Drawing)
7. Multiview, Sectional Drawings and Dimensioning I (5.2)(Sketch and Instrumental Drawing)
8. Multiview, Sectional Drawings and Dimensioning II (5.2) (Sketch and Instrumental Drawing)
9. Auxiliary View, Sectional Drawings and Dimensioning (5.3) (Sketch and Instrumental Drawing)
10. Projection of Regular Geometrical Solids (Sketch and Instrumental Drawing)
11. Development and Intersection I (6.1) (Sketch and Instrumental Drawing)
12. Development and Intersection II (6.2) (Sketch and Instrumental Drawing)
13. Development and Intersection III (6.3) (Sketch and Instrumental Drawing)

References:

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

ENGINEERING PHYSICS
SH 402

Lecture : 4
Tutorial : 1
Practical : 2

Year : I
Part : I

Course objectives:

To provide the concept and knowledge of physics with the emphasis of present day application.

1. Oscillation: **(7 hours)**

1.1 Mechanical Oscillation: Introduction
1.2 Free oscillation
1.3 Damped oscillation
1.4 forced mechanical oscillation
1.5 EM Oscillation: Free, damped and Forced electromagnetic oscillation

2. Wave motion **(2 hours)**

2.1 Waves and particles,
2.2 Progressive wave,
2.3 Energy, power and intensity of progressive wave

3. Acoustics **(3 hours)**

3.1 Reverberation,
3.2 Sabine' Law
3.3 ultrasound and its applications

4. Physical Optics **(12 hours)**

4.1 Interference,
- 4.1.1 Intensity in double slit interference,
- 4.1.2 Interference in thin films,
- 4.1.3 Newton's rings,
- 4.1.4 Hadinger fringes

4.2 Diffraction,
- 4.2.1 Fresnel and Fraunhoffer's diffraction,
- 4.2.2 Intensity due to a single slit;
- 4.2.3 Diffraction grating,
- 4.2.4 X-ray diffraction, x-ray for material test

4.3 Polarization,
- 4.3.1 Double refraction,
- 4.3.2 Nichol prism, wave plates,
- 4.3.3 optical activity, specific rotation

5. Geometrical Optics **(3 hours)**

5.1 Lenses, combination of lenses,

5.2 Cardinal points,
5.3 Chromatic aberration

6. Laser and Fiber Optics **(4 hours)**

6.1 Laser production,
  6.1.1 He-Ne laser,
  6.1.2 Uses of laser
6.2 Fiber Optics,
  6.2.1 Self-focusing,
  6.2.2 Applications of optical fiber

7. Electrostatics **(8 hours)**

7.1 Electric charge and force,
7.2 Electric field and potential,
7.3 Electrostatic potential energy,
7.4 Capacitors, capacitor with dielectric,
7.5 Charging and discharging of a capacitor

8. Electromagnetism **(11 hours)**

8.1 Direct current: Electric current,
  8.1.1 Ohm's law, resistance and resistivity,
  8.1.2 Semiconductor and superconductor
8.2 Magnetic fields:
  8.2.1 Magnetic force and Torque,
  8.2.2 Hall effect,
  8.2.3 Cyclotron, synchrotron,
  8.2.4 Biot-savart law,
  8.2.5 Ampere's circuit law; magnetic fields straight conductors,
  8.2.6 Faraday's laws, Induction and energy transformation, induced field,
  8.2.7 LR circuit, induced magnetic field,
  8.2.8 Displacement current

9. Electromagnetic waves **(5 hours)**

9.1 Maxwell's equations,
9.2 wave equations, speed,
9.3 E and B fields,
9.4 Continuity equation,
9.5 Energy transfer

10. Photon and matter waves **(5 hours)**

10.1 Quantization of energy;
10.2 Electrons and matter waves;
10.3 Schrodinger wave equation;
10.4 Probability distribution;
10.5 One dimensional potential well;

10.6 Uncertainty principle;
10.7 Barrier tunneling

Practical:

1. To determine the acceleration due to gravity and radius of gyration of the bar about an axis passing through its center of gravity.
2. To determine the value of modulus of elasticity of the materials given and moment of inertia of a circular disc using torsion pendulum.
3. To determine the angle of prism and dispersive power of materials of the prism using spectrometer.
4. To determine the wavelength of sodium light by Newton's rings.
5. To determine the wavelength of He-Ne laser light and use it to measure the thickness of a thin wire by diffraction of light.
6. To study the variation of angle of rotation of plane of polarization using concentration of the cane sugar solution
7. To determine the specific rotation of the cane sugar solution using polarimeter.
8. To determine the low resistance of a given wire by Carey Foster bridge and to determine the resistance per unit length of the wire of the bridge.
9. To determine the capacitance of a given capacitor by charging and discharging through resistor.
10. To plot a graph between current and frequency in an LRC series circuit and find the resonant frequency and quality factor.
11. To determine dielectric constant of a given substance and study its variation with frequency by resonance method.
12. To determine the susceptibility of a solution of given materials by Quinkes method.
13. To study the electric field mapping.

References:

1. Halliday, Resnick, Walker, "Fundamentals of Physics", John Wiley & Sons. Inc.
2. Sapkota, Pokharel, Bhattarai, "Fundamentals of Engineering Physics", Benchmark Publication.
3. Brij Lal and Subrahmanyam, "A text book of Optics", S. Chand Publisher.
4. A. S. Basudeva, "Modern Engineering Physics", S. Chand Publisher.
5. R. K. Gaur and S. L. Gupta, "Engineering Physics", Dhanpat Publisher.
6. Brij Lal and Subrahmanyam, "Waves and Oscillation", S. Chand Publisher.

APPLIED MECHANICS

CE 401

Lecture : 3
Tutorial : 2
Practical : 0

Year : I
Part : I

Course Objective:

To provide basic knowledge of engineering mechanics to the students of all branches of engineering so that it would be helpful for them to understand structural engineering stress analysis principles in later courses or to use basics of mechanics in their branch of engineering. Emphasis has been given to statics.

1. Introduction **(2 hours)**

1.1 Definitions and scope of Applied Mechanics
1.2 Concept of Rigid and Deformed Bodies
1.3 Fundamental concepts and principles of mechanics: Newtonian Mechanics

2. Basic Concept in Statics and Static Equilibrium **(4 hours)**

2.1 Concept of Particles and Free Body Diagram
2.2 Physical meaning of Equilibrium and its essence in structural application
2.3 Equation of Equilibrium in Two Dimension

3. Forces Acting on Particle and Rigid Body **(6 hours)**

3.1 Different types of Forces: Point, Surface Traction and Body Forces -Translational Force and Rotational Force: Relevant Examples
3.2 Resolution and Composition of Forces: Relevant Examples
3.3 Principle of Transmissibility and Equivalent Forces: Relevant Examples
3.4 Moments and couples: Relevant Examples
3.5 Resolution of a Force into Forces and a Couple: Relevant Examples
3.6 Resultant of Force and Moment for a System of Force: Examples

4. Center of Gravity, Centroid and Moment of Inertia **(6 hours)**

4.1 Concepts and Calculation of Centre of Gravity and Centroid: Examples
4.2 Calculation of Second Moment of Area / Moment of Inertia and Radius of Gyration: And Relevant usages
4.3 Use of Parallel axis Theorem: Relevant Examples

5. Friction **(2 hours)**

5.1 Laws of Friction, Static and Dynamic Coefficient of Friction, Angle of Friction: Engineering Examples of usage of friction

5.2 Calculations involving friction in structures: Example as High Tension Friction Grip bolts and its free body diagram

6. Analysis of Beams and Frames **(9 hours)**

6.1 Introduction to Structures: Discrete and Continuum

6.2 Concept of Load Estimating and Support Idealizations: Examples and Standard symbols

6.3 Use of beams/frames in engineering: Concept of rigid joints/distribute loads in beams/frames.

6.4 Concept of Statically/Kinematically Determinate and Indeterminate Beams and Frames: Relevant Examples

6.5 Calculation of Axial Force, Shear Force and Bending Moment for Determinate Beams and Frames

6.6 Axial Force, Shear Force and Bending Moment Diagrams and Examples for drawing it.

7. Analysis of Plane Trusses **(4 hours)**

7.1 Use of trusses in engineering: Concept of pin joints/joint loads in trusses.

7.2 Calculation of Member Forces of Truss by method of joints: Simple Examples

7.3 Calculation of Member Forces of Truss by method of sections: Simple Examples

8. Kinematics of Particles and Rigid Body **(7 hours)**

8.1 Rectilinear Kinematics: Continuous Motion

8.2 Position, Velocity and Acceleration of a Particle and Rigid Body

8.3 Determination of Motion of Particle and Rigid Body

8.4 Uniform Rectilinear Motion of Particles

8.5 Uniformly Accelerated Rectilinear Motion of Particles

8.6 Curvilinear Motion: Rectangular Components with Examples of Particles

9. Kinetics of Particles and Rigid Body: Force and Acceleration **(5 hours)**

9.1 Newton's Second Law of Motion and momentum

9.2 Equation of Motion and Dynamic Equilibrium: Relevant Examples

9.3 Angular Momentum and Rate of Change

9.4 Equation of Motion-Rectilinear and Curvilinear

9.5 Rectangular: Tangential and Normal Components and Polar Coordinates: Radial and Transverse Components

Tutorials:

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

1. **Introduction** **(1 hour)**
   A. Theory; definition and concept type questions.
2. **Basic Concept in Statics and Static Equilibrium** **(2 hours)**
   A. Theory; definition and concept type questions.
3. **Concept of Force acting on structures** **(3 hours)**
   A. Practical examples; numerical examples and derivation types of questions.
   B. There can be tutorials for each sub-section.
4. **Center of Gravity, Centroid and Moment of Inertia** **(4 hours)**
   A. Concept type; numerical examples and practical examples type questions.
5. **Friction** **(2 hours)**
   A. Definition type; Practical example type and numerical type questions.
6. **Analysis of Beam and Frame** **(5 hours)**
   A. Concept type; definition type; numerical examples type with diagrams questions.
   B. There can be tutorials for each sub-section.
7. **Analysis of Plane Trusses** **(5 hours)**
   A. Concept type; definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.
8. **Kinematics of Particles and Rigid Body** **(4 hours)**
   A. Definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.
9. **Kinetics of Particles and Rigid Body: Force and Acceleration** **(4 hours)**
   A. Concept type; definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.

References:

1. F.P. Beer and E.R.Johnston, Jr. ,"Mechanics of Engineers- Statics and Dynamics", Mc Graw-Hill.
2. R.C. Hibbeler, Ashok Gupta, "Engineering Mechanics-Statics and Dynamics", New Delhi, Pearson.

3. I.C. Jong and B.G. Rogers, "Engineering Mechanics- Statics and Dynamics",
4. D.K. Anand and P.F. Cunnif, "Engineering Mechanics- Statics and Dynamics",
5. R.S. Khurmi, "A Text Book of Engineering Mechanics",
6. R.S.Khurmi, "Applied Mechanics and Strength of Materials",
7. I.B.Prasad, "A Text Book of Applied Mechanics",
8. Shame, I.H., "Engineering Mechanics-Statics and Dynamics", Prentice Hall of India, New Delhi.

BASIC ELECTRICAL ENGINEERING

EE 401

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : I
Part : I

Course Objective:

To understand the fundamental concept of DC, AC & 3-phase electrical circuits.

1. General Electric System **(6 hours)**

1.1 Constituent parts of an electrical system (source, load, communication & control)
1.2 Current flow in a circuit
1.3 Electromotive force and potential difference
1.4 Electrical units
1.5 Ohm's law
1.6 Resistors, resistivity
1.7 Temperature rise & temperature coefficient of resistance
1.8 Voltage & current sources

2. DC circuits **(4 hours)**

2.1 Series circuits
2.2 Parallel networks
2.3 Krichhhof's laws
2.4 Power and energy

3. Network Theorems **(12 hours)**

3.1 Application of Krichhof's laws in network solution
  3.1.1 Nodal Analysis
  3.1.2 Mesh analysis
3.2 Star-delta & delta-star transformation
3.3 Superposition theorem
3.4 Thevninn's theorem
3.5 Nortan's theorem
3.6 Maximum power transfer theorem
3.7 Reciprocity theorem

4. Inductance & Capacitance in electric circuits **(4 hours)**

4.1 General concept of capacitance
  4.1.1 Charge & voltage
  4.1.2 Capacitors in series and parallel
4.2 General concept of inductance
  4.2.1 Inductive & non-inductive circuits
  4.2.2 Inductance in series & parallel

5. Alternating Quantities **(3 hours)**

5.1 AC systems
5.2 Wave form, terms & definitions
5.3 Average and rms values of current & voltage
5.4 Phasor representation

6. Single-phase AC Circuits **(6 hours)**

6.1 AC in resistive circuits
6.2 Current & voltage in an inductive circuits
6.3 Current and voltage in an capacitive circuits
6.4 Concept of complex impedance and admittance
6.5 AC series and parallel circuit
6.6 RL, RC and RLC circuit analysis & phasor representation

7. Power in AC Circuits **(4 hours)**

7.1 Power in resistive circuits
7.2 Power in inductive and capacitive circuits
7.3 Power in circuit with resistance and reactance
7.4 Active and reactive power
7.5 Power factor, its practical importance
7.6 Improvement of power factor
7.7 Measurement of power in a single-phase AC circuits

8. Three-Phase Circuit Analysis **(6 hours)**

8.1 Basic concept & advantage of Three-phase circuit
8.2 Phasor representation of star & delta connection
8.3 Phase and line quantities
8.4 Voltage & current computation in 3-phase balance & unbalance circuits
8.5 Real and reactive power computation
8.6 Measurements of power & power factor in 3-phase system

Practical:

1. Measurement of Voltage, current& power in DC circuit
   Verification of Ohm's Law
   Temperature effects in Resistance
2. Krichoff's Voltage & current Law
   Evaluate power from V & I
   Note loading effects of meter
3. Measurement amplitude, frequency and time with oscilloscope
   Calculate & verify average and rms value
   Examine phase relation in RL & RC circuit
4. Measurements of alternating quantities
   R, RL,RC circuits with AC excitation
   AC power, power factor, VARs, phasor diagrams

5. Three-phase AC circuits
   Measure currents and voltages in three-phase balanced AC circuits
   Prove Y-Δ transformation
   Exercise on phasor diagrams for three-phase circuits
6. Measurement of Voltage, current& power in a three-phase circuit
   Two-wattmeter method of power measurement in R, RL and RC three phase circuits
   Watts ratio curve

References:

1. J.R Cogdell, "Foundations of Electrical Engineering", Prentice Hall, Englewood Chiffs, New Jersy.
2. I.M Smith," Haughes Electrical Technology", Addison-Wesley, ISR Rprint.

ENGINEERING MATHEMATICS II

SH 451

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

Course Objective:
To develop the skill of solving differential equations and to provide knowledge of vector algebra and calculus. To make students familiar with calculus of several variables and infinite series.

1. Calculus of Two or More Variables **(6 hours)**
- 1.1. Introduction: limit and continuity
- 1.2. Partial derivatives
  - 1.2.1. Homogeneous function, Euler's theorem for the function of two and three variables
  - 1.2.2. Total derivatives
- 1.3. Extreme of functions of two and three variables; Lagrange's Multiplier

2. Multiple Integrals **(6 hours)**
- 2.1. Introduction
- 2.2. Double integrals in Cartesian and polar form; change of order of integration
- 2.3. Triple integrals in Cartesian, cylindrical and spherical coordinates;
- 2.4. Area and volume by double and triple integrals

3. Three Dimensional Solid Geometry **(11 hours)**
- 3.1. The straight line; Symmetric and general form
- 3.2. Coplanar lines
- 3.3. Shortest distance
- 3.4. Sphere
- 3.5. Plane Section of a sphere by planes
- 3.6. Tangent Planes and lines to the spheres
- 3.7. Right circular cone
- 3.8. Right circular cylinder

4. Solution of Differential Equations in Series and Special Functions (9 hours)
- 4.1. Solution of differential equation by power series method
- 4.2. Legendre's equation
- 4.3. Legendre polynomial function; Properties and applications.
- 4.4. Bessel's equation
- 4.5. Bessel's function of first and second kind. Properties and applications

5. Vector Algebra and Calculus **(8 hours)**
- 5.1. Introduction

5.2. Two and three dimensional vectors
5.3. Scalar products and vector products
5.4. Reciprocal System of vectors
5.5. Application of vectors: Lines and planes
5.6. Scalar and vector fields
5.7. Derivatives – Velocity and acceleration
5.8. Directional derivatives

6. Infinite Series **(5 hours)**

6.1. Introduction
6.2. Series with positives terms
6.3. convergence and divergence
6.4. Alternating series. Absolute convergence
6.5. Radius and interval of convergence

References:

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", John Wiley and Sons Inc.
2. Thomas, Finney, "Calculus and Analytical Geometry", Addison- Wesley
3. M. B. Singh, B. C. Bajrachrya, "Differential Calculus", Sukunda Pustak Bhandar,Nepal
4. M. B. Singh, B. C. Bajrachrya, "A Text Book of Vectors", Sukunda Pustak Bhandar,Nepal
5. M. B. Singh, S. P. Shrestha, "Applied Engineering Mathematics", RTU, Department of Engineering Science and Humanities.
6. G.D. Pant, G. S. Shrestha, "Integral Calculus and Differential Equations", Sunila Prakashan,Nepal
7. Y. R. Sthapit, B. C. Bajrachrya, "A Text Book of Three Dimensional Geometry", Sukunda Pustak Bhandar,Nepal
8. Santosh Man Maskey, "Calculus", Ratna Pustak Bhandar, Nepal

ENGINEERING DRAWING II

ME 451

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

Course Objective:

To make familiar with the conventional practices of sectional views. To develop basic concept and skill of pictorial drawing and working drawings. Also to make familiar with standard symbols of different engineering fields.

1. Conventional Practices for Orthographic and Sectional Views (12 hours)

1.1 Conventional Practices in Orthographic views: Half Views and Partial Views, Treatment of Unimportant Intersections, Aligned Views, Treatment for Radially Arranged Features, Representation of Fillets and Rounds

1.2 Conventional Practices in Sectional views: Conventions for Ribs, Webs and Spokes in Sectional View, Broken Section, Removed Section, Revolved Section, Offset Section, Phantom Section and Auxiliary Sectional Views

1.3 Simplified Representations of Standard Machine Elements

2. Pictorial Drawings (20 hours)

2.1 Classifications: Advantages and Disadvantages

2.2 Axonometric Projection: Isometric Projection and Isometric Drawing
- 2.2.1 Procedure for making an isometric drawing
- 2.2.2 Isometric and Non-isometric Lines; Isometric and Non-isometric Surfaces
- 2.2.3 Angles in Isometric Drawing
- 2.2.4 Circles and Circular Arcs in Isometric Drawing
- 2.2.5 Irregular Curves in Isometric Drawing
- 2.2.6 Isometric sectional Views

2.3 Oblique Projection and Oblique Drawing
- 2.3.1 Procedure for making an Oblique drawing
- 2.3.2 Rules for Placing Objects in Oblique drawing
- 2.3.3 Angles, Circles and Circular Arcs in Oblique drawing

2.4 Perspective Projection
- 2.4.1 Terms used in Perspective Projection
- 2.4.2 Parallel and Angular Perspective
- 2.4.3 Selection of Station Point

3. Familiarization with Different Components and Conventions (8 hours)

3.1 Limit Dimensioning and Machining Symbols
- 3.1.1 Limit, Fit and Tolerances
- 3.1.2 Machining Symbols and Surface Finish

3.2 Threads, Bolts and Nuts
- 3.2.1 Thread Terms and Nomenclature, Forms of Screw Threads
- 3.2.2 Detailed and Simplified Representation of Internal and External Threads
- 3.2.3 Thread Dimensioning
- 3.2.4 Standard Bolts and Nuts: Hexagonal Head and Square Head
- 3.2.5 Conventional Symbols for Bolts and Nuts

3.3 Welding and Riveting
- 3.3.1 Types of Welded Joints and Types of Welds, Welding Symbols
- 3.3.2 Forms and Proportions for Rivet Heads, Rivet Symbols, Types of Riveted Joints: Lap Joint, Butt Joint

3.4 Familiarization with Graphical Symbols and Conventions in Different Engineering Fields
- 3.4.1 Standard Symbols for Civil, Structural and Agricultural Components
- 3.4.2 Standard Symbols for Electrical, Mechanical and Industrial Components
- 3.4.3 Standard Symbols for Electronics, Communication and Computer Components
- 3.4.4 Topographical Symbols

3.5 Standard Piping Symbols and Piping Drawing

4. Detail and Assembly Drawings **(20 hours)**

4.1 Introduction to Working Drawing
4.2 Components of Working Drawing: Drawing Layout, Bill of Materials, Drawing Numbers
4.3 Detail Drawing
4.4 Assembly Drawing
4.5 Practices of Detail and Assembly Drawing: V-block Clamp, Centering Cone, Couplings, Bearings, Antivibration Mounts, Stuffing Boxes, Screw Jacks, etc

Practical:

1. Conventional Practices for Orthographic and Sectional Views (Full and Half Section)
2. Conventional Practices for Orthographic and Sectional Views (Other Type Sections)
3. Isometric Drawing
4. Isometric Drawing (Consisting of Curved Surfaces and Sections)
5. Oblique Drawing
6. Perspective Projection
7. Familiarization with Graphical Symbols (Limit, Fit, Tolerances and Surface Roughness Symbols)

8. Familiarization with Graphical Symbols (Symbols for Different Engineering Fields)
9. Detail Drawing
10. Assembly Drawing I
11. Assembly Drawing II
12. Building Drawing

References:

1. W. J. Luzadder, " Fundamentals of Engineering Drawing", Prentice Hall.
2. T. E. French, C. J. Vierck, and R. J. Foster, "Engineering Drawing and Graphic Technology", Mc Graw Hill Publshing Co.
3. F. E. Giescke, A . Mitchell, H. C. Spencer and J. T. Dygdone, "Technical Drawing", Macmillan Publshing Co.
4. N. D. Bhatt, "Machine Drawing", Charotar Publshing House, India.
5. P. S. Gill, "Machine Drawing", S. K. Kataria and Sons, India.
6. R. K. Dhawan "Machine Drawing", S. Chand and Company Limited, India.

BASIC ELECTRONICS ENGINEERING

EX 451

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

Course Objective:
To understand the language of electronics, elements and their functionality. To understand analog and digital systems and their applications.

1. Basic Circuits Concepts **(4 hours)**

1.1 Passive components: Resistance, Inductance, Capacitance; series, parallel combinations; Kirchhoff's law: voltage, current; linearity
1.2 Signal sources: voltage and current sources; nonideal sources; representation under assumption of linearity; controlled sources: VCVS, CCVS, VCCS, CCCS; concept of gain, transconductance, transimpedance.
1.3 Superposition theorem; Thevenin's theorem; Norton's theorem
1.4 Introduction to filter

2. Diodes **(6 hours)**

2.1 Semiconductor diode characteristics
2.2 Modeling the semiconductor diode
2.3 Diode circuits: clipper; clamper circuits
2.4 Zener diode, LED, Photodiode, varacters diode, Tunnel diodes
2.5 DC power supply: rectifier-half wave, full wave (center tapped, bridge), Zener regulated power supply

3. Transistor **(8 hours)**

3.1 BJT configuration and biasing, small and large signal model
3.2 T and μ model
3.3 Concept of differential amplifier using BJT
3.4 BJT switch and logic circuits
3.5 Construction and working principle of MOSFET and CMOS
3.6 MOSFET as logic circuits

4. The Operational Amplifier and Oscillator **(7 hours)**

4.1 Basic model; virtual ground concept; inverting amplifier; non-inverting amplifier; integrator; differentiator, summing amplifier and their applications
4.2 Basic feedback theory; positive and negative feedback; concept of stability; oscillator
4.3 Waveform generator using op-amp for Square wave, Triangular wave Wien bridge oscillator for sinusoidal waveform

5. Communication System **(4 hours)**

5.1 Introduction
5.2 Wired and wireless communication system

5.3 EMW and propagation, antenna, broadcasting and communication
5.4 Internet / intranet
5.5 Optical fiber

6. Digital Electronics **(11 hours)**

6.1 Number systems, Binary arithmetic
6.2 Logic gates: OR, NOT, AND NOR, NAND, XOR, XNOR gate; Truth tables
6.3 Multiplexers; Demux, Encoder, Decoder
6.4 Logic function representation
6.5 Combinational circuits: SOP, POS form; K-map;
6.6 Latch, flip-flop: S-R flip-flop; JK master slave flip-flop; D-flip flop
6.7 Sequential circuits: Generic block diagram; shift registers; counters

7. Application of Electronic System **(5 hours)**

7.1 Instrumentation system: Transducer, strain gauge, DMM, Oscilloscope
7.2 Regulated power supply
7.3 Remote control, character display, clock, counter, measurements, date logging, audio video system

Practical:

1. Familiarization with passive components, function generator and oscilloscope
2. Diode characteristics, rectifiers, Zener diodes
3. Bipolar junction transistor characteristics and single stage amplifier
4. Voltage amplifiers using op-amp, Comparators, Schmitt
5. Wave generators using op-amp
6. Combinational and sequential circuits

References:

1. Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" PHI
2. Thomas L. Floyd, "Electronic Devices" Pearson Education, Inc.
3. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", Oxford University Press.

ENGINEERING CHEMISTRY

SH 453

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

Course Objective:

To develop the basic concepts of Physical Chemistry, Inorganic Chemistry and Organic Chemistry relevant to problems in engineering.

1. Electro-chemistry and Buffer **(6 hours)**

1.1 Electro-chemical cells
1.2 Electrode Potential and Standard Electrode Potential
1.3 Measurement of Electrode Potential
1.4 Nernst equation
1.5 EMF of Cell
1.6 Application of Electrochemical and Electrolytic cells
1.7 Electrochemical Series and its Application
1.8 Buffer: its type and mechanism
1.9 Henderson's equation for pH of buffer and related problems
1.10 Corrosion and its type
1.11 Factors influencing corrosion
1.12 Prevention of corrosion

2. Catalyst **(4 hours)**

2.1 Introduction
2.2 Action of Catalyst (Catalytic Promoters and Catalytic Poisons)
2.3 Characteristics of Catalyst
2.4 Types of Catalyst
2.5 Theories of Catalysis
2.6 Industrial Applications of Catalysts

3. Environmental Chemistry **(5 hours)**

3.1 Air Pollution
3.2 Air Pollutants i) gases $SO_x, NO_x, CO, CO_2, O_3$ and hydrocarbons ii)particulates dust, smoke and fly ash
3.3 Effects of Air Pollutants on human beings and their possible remedies
3.4 Ozone depletion and its photochemistry
3.5 Water Pollution (Ref of surface water and pound water)
3.6 Water Pollutants (Ref of surface water) their adverse effect and remedies
3.7 Soil pollution
3.8 Pollutants of soil their adverse effects and possible remedies

4. Engineering Polymers **(6 hours)**

4.1 Inorganic polymers
4.2 General properties of inorganic polymers
4.3 Polyphosphazines
4.4 Sulpher Based Polymers
4.5 Chalcogenide Glasses
4.6 Silicones
4.7 Organic Polymers
4.8 Types of Organic Polymers
4.9 Preparation and application of
i) Polyurethane ii) Polystyrene iii) Polyvinylchloride iv) Teflon
v) Nylon 6,6 and vi) Bakelite vii) Epoxy Resin viii) Fiber Reinforced Polymer
4.10 Concept of bio-degradable, non-biodegradable and conducting polymers

5. 3-d Transition elements and their applications **(5 hours)**

5.1 Introduction
5.2 Electronic Configuration
5.3 Variable oxidation states
5.4 Complex formation tendency
5.5 Color formation
5.6 Magnetic properties
5.7 Alloy formation
5.8 Applications of 3-d transition elements

6. Coordination Complexes **(5 hours)**

6.1 Introduction
6.2 Terms used in Coordination Complexes
6.3 Werner's Theory Coordination Complexes
6.4 Sidgwick's model and Sidgwick's effective atomic number rule
6.5 Nomenclature of coordination compounds (Neutral type, simple cation and complex anion and complex cation and simple anion type)
6.6 Valence Bond Theory of Complexes
6.7 Application of valence bond theory in the formation of
i) Tetrahedral Complexes
ii) Square planar Complexes and iii) Octahedral Complexes
6.8 Limitations of Valence Bond Theory
6.9 Applications of Coordination Complexes

7. Explosives **(3 hours)**

7.1 Introduction
7.2 Types of explosives: Primary, Low and High explosives
7.3 Preparation and application of TNT, TNG, Nitrocellulose and Plastic explosives

8. Lubricants and Paints **(3 hours)**

8.1 Introduction
8.2 Function of Lubricants
8.3 Classification of Lubricants (Oils, Greases and Solid)
8.4 Paints
8.5 Types of Paint
8.6 Application of Paints

9. Stereochemistry **(4 hours)**

9.1 Introduction
9.2 Geometrical Isomerism (Cis Trans Isomerism) Z and E concept of Geometrical Isomerism
9.3 Optical Isomerism with reference to two asymmetrical carbon center molecules
9.4 Terms Optical activity, Enantiomers, Diastereomers, Meso structures, Racemic mixture and Resolution

10. Reaction Mechanism in Organic reactions **(4 hours)**

10.1 Substitution reaction
10.2 Types of substitution reaction SN^1 and SN^2
10.3 Elimination reaction
10.4 Types of elimination reaction El and E2
10.5 Factors governing SN^1, SN^2, El and E2 reaction mechanism path

References:

1. Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing Co.
2. Shashi Chawala, "A Text Book of Engineering Chemistry", Dhanpat Rai Publishing Co.
3. J. D. Lee, "A New Concise Inorganic Chemistry", Wiley India Pvt. Limited.
4. Marron and Prutton, "Principles of Physical Chemistry", S. Macmillan and Co. Ltd.
5. Bahl and Tuli, "Essential of Physical Chemistry", S. Chand and Co. Ltd.
6. Satya Prakash and Tuli, "Advanced Inorganic Chemistry Vol 1 and 2", S. Chand and Co. Ltd
7. Morrison and Boyd, "Organic chemistry".
8. Moti Kaji Sthapit, "Selected Topics in Physical Chemistry", Taleju Prakashan, Kathmandu.
9. Peavy, Rowe and Tchobanoglous, "Environmental Engineering", McGraw-Hill, New York.
10. R. K. Sharma, B. Panthi and Y. Gotame, "Textbook of Engineering Chemistry", Athrai Publication.

Practical:

1. Compare the alkalinity of different water samples by double indicator method 6 Periods
2. Determine the temporary and permanent hardness of water by EDTA Complexo-metric method 3 Periods
3. Determine residual and combined chlorine present in the chlorinated sample of water by Iodometric method 6 Periods
4. Prepare organic polymer nylon 6,6/ Bakelite in the laboratory 3 Periods
5. Determine the pH of different sample of buffer solution by universal indicator method 6 Periods
6. Prepare inorganic complex in the laboratory 3 Periods
7. Determine surface tension of the given detergent solution and compare its cleansing power with other detergent solutions 6 Periods
8. Construct an electrochemical cell in the laboratory and measure the electrode potential of it 3 Periods
9. Estimate the amount of iron present in the supplied sample of ferrous salt using standard potassium permanganate solution (redox titration) 6 Periods

FUNDAMENTALS OF THERMODYNAMICS AND HEAT TRANSFER

ME 452

Lectures : 3
Tutorial : 1
Practical : 3/2

Year : I
Part : II

Course Objective:

To develop basic concepts, laws of thermodynamics and heat transfer and their applications.

1. Introduction **(3 hours)**

- 1.1 Definition and Scope of Engineering Thermodynamics
- 1.2 Value of energy to society
- 1.3 Microscopic versus Macroscopic Viewpoint
- 1.4 Concepts and Definitions
  - 1.4.1 System, Surroundings, Boundary and Universe; Closed Systems, Open Systems, and Isolated Systems
  - 1.4.2 Thermodynamic Properties: Intensive, Extensive and Specific Properties
  - 1.4.3 Thermodynamic Equilibrium
  - 1.4.4 Thermodynamic State
  - 1.4.5 Thermodynamic Process, Cyclic Process, Quasi-equilibrium Process, Reversible and Irreversible Process
- 1.5 Common Properties: Pressure, Specific Volume, Temperature
- 1.6 Zeroth Law of Thermodynamics, Equality of Temperature

2. Energy and Energy Transfer **(3 hours)**

- 2.1 Energy and its Meaning
- 2.2 Stored Energy and Transient Energy; Total Energy
- 2.3 Energy Transfer
  - 2.3.1 Heat Transfer
  - 2.3.2 Work Transfer
- 2.4 Expressions for displacement work transfer
- 2.5 Power

3. Properties of Common Substances **(6 hours)**

- 3.1 Pure Substance and State Postulate
- 3.2 Ideal Gas and Ideal Gas Relations
- 3.3 Two Phase (Liquid and Vapor) Systems: Phase Change; Subcooled Liquid, Saturated Liquid, Wet Mixture, Critical Point, Quality, Moisture Content, Saturated Vapor and Superheated Vapor
- 3.4 Properties of Two Phase Mixtures

3.5 Other Thermodynamic Properties: Internal Energy, Enthalpy, and Specific Heats
3.6 Development of Property Data: Graphical Data Presentation and Tabular Data Presentation

4. First Law of Thermodynamics **(9 hours)**

4.1 First Law of Thermodynamics for Control Mass; First Law of Thermodynamics for Control Mass Undergoing Cyclic Process
4.2 First Law of Thermodynamics for Control Volume
4.3 Control Volume Analysis: Steady State Analysis and Unsteady State Analysis
4.4 Control Volume Application: Steady and Unsteady Work Applications and Steady and Unsteady Flow Applications
4.5 Other Statements of the First Law

5. Second Law of Thermodynamics **(9 hours)**

5.1 Necessity of Formulation of Second Law
5.2 Entropy and Second Law of Thermodynamics for an Isolated System
5.3 Reversible and Irreversible Processes
5.4 Entropy and Process Relation for an Ideal Gases and Incompressible Substances
5.5 Control Mass Formulation of Second Law
5.6 Control Volume Formulation of Second Law
5.7 Isentropic Process for an Ideal Gas and for an Incompressible Substances
5.8 Carnot Cycle, Heat Engine, Heat Pump and Refrigerator
5.9 Kelvin-Planck and Clausius Statements of the Second Law of Thermodynamics and their Equivalence

6. Thermodynamic Cycles **(9 hours)**

6.1 Classification of Cycles
6.2 Air Standard Brayton Cycle
6.3 Rankine Cycle
6.4 Internal Combustion Cycles
  6.4.1 Air standard Analysis
  6.4.2 Air Standard Otto Cycle
  6.4.3 Air Standard Diesel Cycle
6.5 Vapor Compression Refrigeration Cycle

7. Introduction to Heat Transfer **(6 hours)**

7.1 Basic Concepts and Modes of Heat Transfer
7.2 One dimensional steady state heat conduction through a plane wall
7.3 Radial steady state heat conduction through a hollow cylinder
7.4 Heat flow through composite structures
  7.4.1 Composite Plane Wall
  7.4.2 Multilayer tubes

7.5 Electrical Analogy for thermal resistance
7.6 Combined Heat Transfer and Overall Heat Transfer Coefficient for Plane Wall and Tube
7.7 Nature of Convection; Free and Forced Convection
7.8 Heat Radiation, Stefan's Law, Absorptivity, Reflectivity and Transmissivity; Black Body, White Body and Gray Body

Practical:

1. Temperature Measurements
2. Experiment related to first law
3. Heat Pump
4. Heat Conduction
5. Heat Radiation

References:

1. M. C. Luintel, "Fundamentals of Thermodynamics and Heat Transfer", Athrai Publication (P) Limited.
2. R. Gurung, A. Kunwar & T. R. Bajracharya, "Fundamentals of Engineering Thermodynamics and Heat Transfer", Asmita Books Publishers and Distributors (P) Limited.
3. J. R. Howell & R. O. Buckius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Publishers
4. V. Wylen, Sonntag & Borgnakke, "Fundamentals of Thermodynamics", John Wiley & Sons, Inc.
5. M. J. Moran & H. N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley & Sons, Inc.
6. Y. A. Cengel & M.A. Boles, "Thermodynamics: An Engineering Approach", McGraw-Hill.
7. J. P. Holman, "Heat Transfer", McGraw-Hill
8. Y. A. Cengel, "Heat Transfer: A Practical Approach", McGraw-Hill.

WORKSHOP TECHNOLOGY

ME 453

Lecture : 1
Tutorial : 0
Practical : 3

Year : I
Part : II

Course Objective:

To impart knowledge and skill components in the field of basic workshop technology. To be familiar with different hand and machine tools required for manufacturing simple metal components and articles.

1. General Safety Considerations (2 hours)

1.1. Bench Tools
1.2. Machinist's Hammers
1.3. Screw Drivers
1.4. Punches
1.5. Chisels
1.6. Scrapers
1.7. Scribers
1.8. Files
1.9. Pliers and Cutters
1.10. Wrenches
1.11. Hacksaw
1.12. Bench Vise
1.13. Hand drill
1.14. Taps and Dies
1.15. Hand Shears
1.16. Rules, Tapes and Squares
1.17. Soldering Iron
1.18. Rivets

2. Hand Working Operations (1 hours)

2.1. Sawing
2.2. Filing
2.3. Threading
2.4. Scribing
2.5. Shearing
2.6. Soldering
2.7. Riveting

3. Measuring and Gauging (1 hours)

3.1. Introduction
3.2. Semi – Precision Tools – Calipers, depth Gauge, Feeler Gauge
3.3 Precision Tools – Micrometers, Vernier Calipers, Vernier Height Gauge,

Telescopic Gauge, Hole Gauge, Bevel Protractor, Dial Indicator, Gauge Blocks and Surface Plate

4. Drills and Drilling Processes **(1 hours)**

4.1 Introduction
4.2 Types of Drill Presses
4.3 Work Holding Devices and Accessories
4.4 Cutting Tools
4.5 Geometry of Drill Bits
4.6 Grinding of Drill Bits
4.7 Operations – Drilling, Counter - boring, Counter - sinking, Reaming, Honning, Lapping
4.8 Cutting Speeds
4.9 Drilling Safety

5. Machine Tools **(4 hours)**

5.1. General Safety Considerations
5.2. Engine Lathes
  5.2.1 Introduction
  5.2.2 Physical Construction
  5.2.3 Types of Lathe
  5.2.4 Lathe Operations – Facing, Turning, Threading
5.3 Shapers
  5.3.1 Introduction
  5.3.2 Types of Shapers
  5.3.3 Physical Construction
  5.3.4 General Applications
5.4 Milling Machines
  5.4.1 Introduction
  5.4.2 Types of Milling Machines
  5.4.3 Physical Construction
  5.4.4 Milling Cutters – Plain, Side, Angle, End, Form
  5.4.5 Milling Operations – Plain, Side, Angular, Gang, End, Form, Keyway
  5.4.6 Work Holding Devices
  5.4.7 Cutter Holding Devices
5.5 Grinding Machines
  5.5.1 Abrasives, Bonds, Grinding Wheels
  5.5.2 Rough Grinders – Portable Grinders, Bench Grinders, Swing Frame Grinders, Abrasive Belt Grinders
  5.5.3 Precision Grinders – Cylindrical Grinders, Surface Grinders

6. Material Properties **(1 hours)**

6.1. Tool materials – Low, medium and high carbon steels; Hot and cold rolled steels; Alloy steels; Carbide and Ceramic materials

6.2. Heat treating methods for steels – Annealing, Tempering, Normalizing, Hardening and Quenching
6.3. Non – ferrous metals – Brass, Bronze, Aluminum – Comparative Properties

7. Sheet Metal Works **(1 hours)**

7.1. Introduction
7.2. Sheet Metal Tools
7.3. Marking and Layout
7.4. Operations – Bending, Cutting, Rolling

8. Foundry Practice **(1 hours)**

8.1. Introduction
8.2. Pattern Making
8.3. Foundry Tools
8.4. Core Making
8.5. Melting Furnace – Cupola
8.6. Sand Casting Process

9. Forging Practice **(1 hours)**

9.1. Introduction
9.2. Forging Tools
9.3. Operations – Upsetting, Drawing, Cutting, Bending, Punching
9.4. Forging Presses and Hammers
9.5. Advantages and Limitations

10. Metal Joining **(2 hours)**

10.1 Safety Considerations
10.2 Introduction
10.3 Soldering
10.4 Brazing
10.5 Welding – Gas Welding, Arc Welding, Resistance Welding, Tungsten Inert Gas Welding (TIG), Metal Inert Gas Welding (MIG)

Practical:

1. Bench Tools and hand operations: Measuring, Marking, Layout, Cutting, Filling, Drilling, Tapping, Assembly
2. Bench Tools and hand operations: (Contd.)
3. Drilling machines
4. Measuring and Gauging Instruments
5. Engine lathe: Basic operations such as Plain turning, facing, cutting off, knurling.
6. Engine lathe: Taper turning, drilling and boring
7. Basic Shaper Operations
8. Milling Machines

9. Grinding Machines
10. Sheet Metal works
11. Foundry Practice
12. Forging Practice
13. Electric Arc Welding
14. Gas Welding

References:

1. Anderson and E. E. Tatro, "Shop Theory", JMcGraw – Hill.
2. O. D. Lascoe, C. A. Nelson and H. W. Porter, "Machine shop operations and setups", American Technical society.
3. "Machine shop Practice – Vol. I" , Industrial Press, New York.
4. "Machine shop Practice – Vol. I" , Industrial Press, New York.
5. Ryerson, " Technology of Machine Tools", Mc Graw Hill.
6. Oberg, Jones and Horton, "Machinery's Handbook", Industrial Press, New York.
7. S. K. Hajra Choudhury and A. K. Hajra Choudhury, "Elements of Workshop Technology - Vol. I (Manufacturing Processes)", Media Promoters and Publishers Pvt. Ltd. , Bombay, INDIA.
8. S. K. Hajra Choudhury, S. K. Bose and A. K. Hajra Choudhury , "Elements of Workshop Technology - Vol. II: (Machine Tools)" , Media Promoters and Publishers Pvt. Ltd. , Bombay, INDIA.
9. Prof. B. S. Raghuwanshi, "A Course in Workshop Technology - Vol. I" , Dhanpat Rai and Co. (P) Ltd, Delhi, INDIA.
10. Prof. B. S. Raghuwanshi, "A Course in Workshop Technology - Vol. II" , Dhanpat Rai and Co. (P) Ltd, Delhi, INDIA.
11. H. S. Bawa, "Workshop Technology - Vol. I", Tata Mc – Graw Hill publishing company Limited, New Delhi, INDIA,
12. H. S. Bawa, "Workshop Technology - Vol. II" , Tata Mc – Graw Hill publishing company Limited, New Delhi, INDIA,
13. R. S. Khurmi and J. K. Gupta, "A text book of Workshop Technology", S. Chand and Company Ltd, New Delhi. INDIA

ENGINEERING MATHEMATICS III

SH 501

Lecture : 3
Tutorial : 2
Practical : 0

Year : II
Part : I

Course Objective:
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 "$\leq$"
5.5. The Dual: Maximization with Problem Constraints of the form "$\geq$"
5.6. Maximization and Minimization with mixed Constraints. The two-phase method
(An alternative to the Big M Method)

References:

1. S. K. Mishra, G. B. Joshi, V. Parajuli, "Advance Engineering Mathematics", Athrai Publication.
2. E. Kreszig, "Advance Engineering Mathematics", Willey, New York.
3. M.M Gutterman and Z.N.Nitecki, "Differential Equation, a First Course", Saunders, New York.

OBJECT ORIENTED PROGRAMMING

CT 501

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

Course Objective:

To familiarize students with the C++ programming language and use the language to develop 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++", Sams Publication
2. Daya Sagar Baral and Diwakar Baral, "The Secrets of Object Oriented Programming in C++", Bhundipuran Prakasan
3. Harvey M. Deitel and Paul J. Deitel, "C++ How to Program", Pearson Education Inc.
4. D. S. Malik, "C++ Programming", Thomson Course Technology
5. Herbert Schildt, "C++: The Complete Reference", Tata McGraw Hill

ELECTRIC CIRCUIT THEORY

EE 501

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : II
Part : I

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", Prentice Hall.
2. William H. Hyat. Jr. & Jack E. Kemmerly, "Engineering Circuits Analysis", McGraw Hill International Editions, Electrical Engineering Series.
3. Michel D. Cilletti, "Introduction to Circuit Analysis and Design", Holt, Hot Rinehart and Winston International Edition, New York.

ELECTRICAL ENGINEERING MATERIAL

EE 502

Lecture : 3
Tutorial : 1
Practical : 0

Year : II
Part : I

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.
2. R.C. Jaeger,"Introduction to Microelectronic Fabrication- Volume IV", Addison Wesley publishing Company,Inc.
3. Kasap.S.O, Principles of electrical engineering materials and devices, McGraw Hill, NewYork.
4. R.A.Colcaser and S.Diehl-Nagle,"Materials and Devices for Electrical Engineers and Physicists,McGraw-Hill, New York.

ELECTRONIC DEVICES AND CIRCUITS

EX 501

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : II
Part : I

Course Objectives:

To introduce the fundamentals of analysis of electronic circuits and 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

3. Field-Effect Transistor **(9 hours)**

3.1 Structure and Physical Operation of Enhancement-Type MOSFET
3.2 Current-Voltage Characteristics of Enhancement-Type MOSFET
3.3 The Depletion-Type MOSFET
3.4 MOSFET Circuits at DC
3.5 MOSFET as an Amplifier
3.6 Biasing in MOS Amplifier Circuits
3.7 Junction Field-Effect Transistor

4. Output Stages and Power Amplifiers **(9 hours)**

4.1 Classification of Output Stages
4.2 Class A Output Stage
4.3 Class B Output Stage
4.4 Class AB Output Stage
4.5 Biasing the Class AB Stage
4.6 Power BJTs
4.7 Transformer-Coupled Push-Pull Stages
4.8 Tuned Amplifiers

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

5.1 Basic Principles of Sinusoidal Oscillator
5.2 Op Amp-RC Oscillator Circuits
5.3 LC and Crystal Oscillators
5.4 Generation of Square and Triangular Waveforms Using Astable Multivibrators
5.5 Integrated Circuit Timers
5.6 Precision Rectifier Circuits

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

6.1 Unregulated Power Supply
6.2 Bandgap Voltage Reference, a Constant Current Diodes
6.3 Transistor Series Regulators
6.4 Improving Regulator Performance
6.5 Current Limiting
6.6 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", Oxford University Press, 2006
2. David A. Bell, " Electronics Device and Circuits ", PHI

3. Robert Boylestad and Louis Nashelsky, " Electronic Device and Circuit Theory", PHI
4. Thomas L. Floyd, "Electronic Devices", Pearson Education Inc., 2007
5. Mark N. Horenstein, "Microelectronic Circuits and Devices", PHI
6. Paul Horowitz and Winfield Fill, "The Art of Electornics", Cambridge Publication
7. Jacob Millman and Christos C. Halkias,andSatyabrataJit "Millman's Electronic Device and Circuits", Tata McGraw- Hill

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

3. Combinational Logic Circuits **(5 hours)**

3.1 Boolean Laws and Theorems
3.2 Sum-of-Products Method
3.3 Truth Table to Karnaugh Map
3.4 Pairs, Quads, and Octets
3.5 Karnaugh Simplifications
3.6 Don't Care Conditions
3.7 Product-of-Sums Method
3.8 Product-of-Sums Simplification
3.9 Hazards and Hazard Covers
3.10 HDL Implementation Models

4. Data Processing Circuits **(5 hours)**

4.1 Multiplexer
4.2 DeMultiplexer
4.3 Decoder
4.4 BCD-to-Decimal Decoders
4.5 Seven-Segment Decoders
4.6 Encoder
4.7 Exclusive-OR Gates
4.8 Parity Generators and Checkers
4.9 Magnitude Comparator
4.10 Read-Only Memory
4.11 Programmable Array Logic
4.12 Programmable Logic Arrays
4.13 Troubleshooting with a Logic Probe
4.14 HDL Implementation of Data Processing Circuits

5. Arithmetic Circuits **(5 hours)**

5.1 Binary Addition
5.2 Binary Subtraction
5.3 Unsigned Binary Numbers
5.4 Sign-Magnitude Numbers
5.5 2's Complement Representation
5.6 2's Complement Arithmetic
5.7 Arithmetic Building Blocks
5.8 The Adder-Subtracter
5.9 Fast Adder
5.10 Arithmetic Logic Unit
5.11 Binary Multiplication and Division
5.12 Arithmetic Circuits Using HDL

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

6.1 RS Flip-Flops
6.2 Gated Flip-Flops
6.3 Edge-Triggered RS Flip-Flops
6.4 Egde Triggered D Flip-Flops
6.5 Egde Triggered J K Flip-Flops
6.6 Flip-Flop Timing
6.7 J K Mater- Slave Flip-Flops
6.8 Switch Contacts Bounds Circuits
6.9 Varius Representation of Flip-Flops
6.10 Analysis of Sequencial Circuits

7. Registers **(2 hours)**

7.1 Types of Registers
7.2 Serial In – Serial Out
7.3 Serial In – Parallel Out

7.4 Parallel In – Serial Out
7.5 Parallel In – Parallel Out
7.6 Applications of Shift Registers

8. Counters **(5 hours)**

8.1 Asynchronous Counters
8.2 Decoding Gates
8.3 Synchronous Counters
8.4 Changing the Counter Modulus
8.5 Decade Counters
8.6 Presettable Counters
8.7 Counter Design as a Synthesis Problem
8.8 A Digital Clock

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

9.1 Synchronous machines
  9.1.1 Clock driven models and state diagrams
  9.1.2 Transition tables, Redundant states
  9.1.3 Binary assignment
  9.1.4 Use of flip-flops in realizing the models
9.2 Asynchronous machines
  9.2.1 Hazards in asynchronous system and use of redundant branch
  9.2.2 Allowable transitions
  9.2.3 Flow tables and merger diagrams
  9.2.4 Excitation maps and realization of the models

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

10.1 Switching Circuits
10.2 7400 TTL
10.3 TTL parameters
10.4 TTL Overvew
10.5 Open Collecter Gates
10.6 Three-state TTL Devices
10.7 External Drive for TTL Loads
10.8 TTL Driving External Loads
10.9 74C00 CMOS
10.10 CMOS Characteristics
10.11 TTL- to –CMOS Interface
10.12 CMOS- to- TTL Interface

11. Applications **(2 hours)**

11.1 Multiplexing Displays
11.2 Frequency Counters
11.3 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 GoutamSaha, " Digital Principles and Applications", Tata McGraw-Hill.
2. David J Comer "Digital Logic And State Machine Design" Oxfored University Press.
3. William I. Fletcher "An Engineering Approach to Digital Design" Printice Hall of India, New Delhi.
4. William H. Gothmann, "Digital Electronics, An Introduction to Theory and Practice"

ELECTROMAGNETICS

EX 503

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : II
Part : I

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 **(12 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 **(13 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 incidence.

5. Transmission lines **(5 hours)**

5.1 Transmission line equations.
5.2 Input impedance, reflection coefficient, standing wave ratio.
5.3 Impadance matching, quarter wave transformer, single stub matching, double stub matching.

6. Wave guides **(2 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.

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. S. K. Mishra, G. B. Joshi, S. Ghimire, V. Parajuli, " A text book of Applied Mathematics", Dibya Deurali Prakashan.
2. E. Kreyszig, "Advance Engineering Mathematics", Fifth Edition, Wiley, New York.
3. A. V. Oppenheim, "Discrete-Time Signal Processing", Prentice Hall.
4. K. Ogata, "Discrete-Time Control System", Prentice Hall, Englewood Cliffs, New Jersey.

NUMERICAL METHODS

SH 553

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

Course objective:

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 agrange 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 1st 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.
2. Robert J schilling, Sandra l harries, " Applied Numerical Methods for Engineers using MATLAB and C.", Thomson Brooks/cole.
3. Richard L. Burden, J.Douglas Faires, "Numerical Analysis", Thomson / Brooks/cole

4. John. H. Mathews, Kurtis Fink, "Numerical Methods Using MATLAB", Prentice Hall publication
5. JAAN KIUSALAAS , "Numerical Methods in Engineering with MATLAB" , Cambridge Publication

ELECTRICAL MACHINES I

EE 501

Lecture : 3 **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. 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. 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. DC Generator **(9 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. DC Motor **(7 hours)**

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

5. Three-Phase Induction Machines **(13 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

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", 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

INSTRUMENTATION I

EE 552

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

Course Objectives:

To provide 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

7. Electrical equipment **(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" McGraw Hill.
2. S. Wolf and R.F.M. Smith "Students Reference Manual for Electronics Instrumentation Laboratories", Prentice Hall.
3. E.O Deobelin "Measurement System, Application and Design" McGraw Hill.
4. A.K Sawhney "A Course in Electronic Measurement and Instrumentation " DhanpatRai and Sons.
5. C.S. Rangan, G.R Sharma and V.S.V. Mani, "Instrumentation Devices and Systems" Tata McGraw Hill publishing Company Limited New Delhi.
6. J.B. Gupta. "A Course in Electrical & Electronics Measurement & Instrumentation, Kataria& Sons.

POWER SYSTEM ANALYSIS - I

EE 555

Lecture : 3
Tutorial : 1
Practical : 0

Year : II
Part : II

Course Objective:

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 **(9 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

MICROPROCESSORS

EX 551

Lecture : 3
Tutorial : 1
Practical : 3

Year : II
Part : II

Course Objective:

To familiarize students with architecture, 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/Microprogrammed 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", Prentice Hall
2. Peter Abel, "IBM PC Assembly Language and Programming", Pearson Education Inc.

3. D. V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata McGraw Hill
4. John Uffenbeck, "Microcomputers and Microprocessors, The 8080, 8085 and Z-80 Programming, Interfacing and Troubleshooting", Prentice Hall
5. Walter A. Triebel and Avtar Singh, "The 8088 and 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications", Prentice Hall
6. William Stalling, "Computer Organization and Architecture", Prentice Hall

COMMUNICATION ENGLISH
SH 601

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

Course Introduction

This course is designed for the students of engineering with the objective of developing all four skills of communication applicable in professional field.

Course Objectives

After completion of this course students will be able to:

a. comprehend reading materials both technical and semi-technical in nature
b. develop grammatical competence
c. write notice, agenda, minutes
d. write proposals
e. write reports
f. write research articles
g. listen and follow instruction, description and conversation in native speakers' accent
h. do discussion in group, deliver talk and present brief oral reports

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: Introduction to technical writing process and meeting **(4 hours)**

1. Editing, MLA/APA **(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

Unit III: Writing Proposal **(6 hours)**

1. Introduction

1.1 Parts of the proposal
- 1.1.1 Title page
- 1.1.2 Abstract/Summary
- 1.1.3 Statement of Problem
- 1.1.4 Rationale
- 1.1.5 Objectives
- 1.1.6 Procedure/Methodology
- 1.1.7 Cost estimate or Budget
- 1.1.8 Time management/Schedule
- 1.1.9 Summary
- 1.1.10 Conclusion
- 1.1.11 Evaluation or follow-up
- 1.1.12 Works cited

Unit IV: Reports **(18hours)**

1. Informal Reports **(6 hours)**

1.1 Memo Report
- 1.1.1 Introduction
- 1.1.2 Parts

1.2 Letter Report
- 1.2.1 Introduction
- 1.2.2 Parts

1.3 Project/Field Report (3 hours)
- 1.3.1 Introduction
- 1.3.2 Parts

1.4 Formal report (9 hours)
- 1.4.1 Introduction
- 1.4.2 Types of Formal Reports
  - 1.4.2.1 Progress Report
  - 1.4.2.2 Feasibility Report
  - 1.4.2.3 Empirical/ Research Report
  - 1.4.2.4 Technical Report

1.4.3 Parts and Components of Formal Report
- 1.4.3.1 Preliminary section
  - 1.4.3.1.1 Cover page
  - 1.4.3.1.2 Letter of transmittal/Preface
  - 1.4.3.1.3 Title page
  - 1.4.3.1.4 Acknowledgements
  - 1.4.3.1.5 Table of Contents
  - 1.4.3.1.6 List of figures and tables
  - 1.4.3.1.7 Abstract/Executive summary
- 1.4.3.2 Main Section
  - 1.4.3.2.1 Introduction
  - 1.4.3.2.2 Discussion/Body
  - 1.4.3.2.3 Summary/Conclusion
  - 1.4.3.2.4 Recommendations
- 1.4.3.3 Documentation
  - 1.4.3.3.1 Notes (Contextual/foot notes)
  - 1.4.3.3.2 Bibliography
  - 1.4.3.3.3 Appendix

Unit V: Writing Research Articles **(2 hours)**

1.1. Introduction
1.2. Procedures

Language lab		30 hours
Unit I: 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
Unit II: 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

1.4.3 Parts and Components of Formal Report
- 1.4.3.1 Preliminary section
  - 1.4.3.1.1 Cover page
  - 1.4.3.1.2 Letter of transmittal/Preface
  - 1.4.3.1.3 Title page
  - 1.4.3.1.4 Acknowledgements
  - 1.4.3.1.5 Table of Contents
  - 1.4.3.1.6 List of figures and tables
  - 1.4.3.1.7 Abstract/Executive summary
- 1.4.3.2 Main Section
  - 1.4.3.2.1 Introduction
  - 1.4.3.2.2 Discussion/Body
  - 1.4.3.2.3 Summary/Conclusion
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- 1.4.3.3 Documentation
  - 1.4.3.3.1 Notes (Contextual/foot notes)
  - 1.4.3.3.2 Bibliography
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1.1. Introduction
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Activity III	Getting students to participate in group discussion on the assigned topics	4 hours

Unit II: Introduction to technical writing process and meeting **(4 hours)**

1. Editing, MLA/APA **(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

Unit III: Writing Proposal **(6 hours)**

1. Introduction

1.1 Parts of the proposal
- 1.1.1 Title page
- 1.1.2 Abstract/Summary
- 1.1.3 Statement of Problem
- 1.1.4 Rationale
- 1.1.5 Objectives
- 1.1.6 Procedure/Methodology
- 1.1.7 Cost estimate or Budget
- 1.1.8 Time management/Schedule
- 1.1.9 Summary
- 1.1.10 Conclusion
- 1.1.11 Evaluation or follow-up
- 1.1.12 Works cited

Unit IV: Reports **(18hours)**

1. Informal Reports **(6 hours)**

1.1 Memo Report
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1.2 Letter Report
- 1.2.1 Introduction
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1.3 Project/Field Report (3 hours)
- 1.3.1 Introduction
- 1.3.2 Parts

1.4 Formal report (9 hours)
- 1.4.1 Introduction
- 1.4.2 Types of Formal Reports
  - 1.4.2.1 Progress Report
  - 1.4.2.2 Feasibility Report
  - 1.4.2.3 Empirical/ Research Report
  - 1.4.2.4 Technical Report

Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	8 hours
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

Units	Testing Items	No. of Questions	Type of Questions	Marks Distribution	Total Marks	Remarks
I	Reading	3	For grammar = objective and for the rest = short	2 Short questions 5+5 Interpretation of text 5 Note + Summary 5+5 Grammar 5	30	For short questions 2 to be done out of 3 from the seen passages, for interpretation an unseen paragraph of about 75 words to be given, for note + summary an unseen text of about 200to 250 to be given, for grammar 5 questions of fill up the gaps or transformation type to be given
II	Introduction to technical writing process and meeting	3	MLA/APA = objective, Editing and Meeting = short	MLA/APA = 4 Editing = 5 Meeting = 5	14	For APA/MLA 4 questions to be given to transform one from another or 4 questions asking to show citation according to APA/ MLA technique, For meeting minute alone or notice with agendas to be given
III	Proposal Writing	1	Long	10	10	A question asking to write a very brief proposal on any technical topic to be given
IV	Report writing	2	Informal report = short, Formal report = long	Informal report = 6 Formal report = 10	16	A question asking to write very brief informal report on technical topic to be given, for formal report a question asking to write in detail on any three elements of a formal report on technical topic to be given
V	Research article	1	Long	10	10	A question asking to write a brief research article on technical topic to be given

Evaluation Scheme for Lab

Units	Testing items	No. of Questions	Type of questions	Marks Distribution	Remarks
I	Listening ▫ instruction ▫ description ▫ conversation	2	objective	5+5	listening tape to be played on any two out of instruction, description and conversation followed by 10multiple choice type or fill in the gaps type questions

II	Speaking ▫ group/round table discussion ▫ presenting brief oral report ▫ delivering talk	2	subjective	Round table discussion 5, talk or brief oral report = 10	Different topics to be assigned in groups consisting of 8 members for group discussion and to be judged individually, individual presentation to be judged through either by talk on assigned topics or by brief oral reports based on their previous project, study and field visit.

Prescribed books

1. Adhikari, Usha, Yadav, Rajkumar, Yadav, Bijaya, ; " A Course book of Communicative English", Trinity Publication.
2. Adhikari, Usha, Yadav, Rajkumar, Shrestha, Rup Narayan ; "Technical Communication in English", Trinity Publication.

   (Note: 50 marks excluding reading to be covered on the basis of first book and reading part (i.e. 30 marks) to be covered on the basis of second book)

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

PROBABILITY AND STATISTICS

SH 602

Lecture : 3
Tutorial : 1
Practical : 0

Year : III
Part : I

Course Objective:

To provide the students with practical 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. Inference Concerning Mean **(6 hours)**

5.1 Point estimation and interval estimation
5.2 Test of Hypothesis
5.3 Hypothesis test concerning One mean
5.4 Hypothesis test concerning two mean
5.5 One way ANOVA

6. Inference concerning Proportion **(6 hours)**

6.1 Estimation of Proportions
6.2 Hypothesis concerning one proportion
6.3 Hypothesis concerning two proportion
6.4 Chi square test of Independence

7. Correlation and Regression **(6 hours)**

7.1 Correlation
7.2 Least square method
7.3 An analysis of variance of Linear Regression model
7.4 Inference concerning Least square method
7.5 Multiple correlation and regression

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

ELECTRIC MACHINES-II

EE 601

Lecture : 2
Tutorial : 1
Practical : 3/2

Year : III
Part : I

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 **(10 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 **(13 hours)**

3.1 Single phase Induction Motors: Construction and Characteristics
3.2 Double Field Revolving Theory
3.3 Split phase Induction Motor
  3.3.1 Capacitor start motor
  3.3.2 Capacitors start and run motor
  3.3.3 Shaded pole motor
  3.3.4 Reluctance start motor
3.4 Single phase Synchronous Motor
  3.4.1 Reluctance motor
  3.4.2 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.

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

CONTROL SYSTEM
EE 602

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : III
Part : I

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 **(7 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
  7.2.1 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.
2. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill.
3. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition.
4. Nagrath&Gopal, "Modern Control Engineering", New Ages International.

ELECTRIC MACHINE DESIGN

EE 603

Lecture : 3
Tutorial : 0
Practical : 3

Year : III
Part : I

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 **(14 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"

POWER SYSTEM ANALYSIS -II

EE 603

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 **(9 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

POWER SYSTEM ANALYSIS -II

EE 603

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

Course Objective:

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- 4.2 Sequence impedances
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- 4.4 Expression for power in terms of symmetrical components
- 4.5 Transformer voltages and currents

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- 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

INSTRUMENTATION II

EX 602

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

Course Objective:

To introduce and apply the knowledge of microprocessor, A/D, D/A converter to design Instrumentation system and to provide the concept of 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
7.4 Bandwidth, Decoupling, Ground Bounce, Crosstalk, Impedance Matching, and Timing
7.5 Low Power Design
7.6 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
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:

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

ENGINEERING ECONOMICS
CE 655

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

Course Objectives:

To provide concept and knowledge of economic studies that will be useful for the evaluation 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 Cash Flows **(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

Tutorial:

1. Assignments
2. Quizzes and Case study

References:

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

HYDROPOWER

CE 660

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : III
Part : II

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.

Practical:

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.
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

SWITCHGEAR AND PROTECTION

EE 651

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 **(4 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 **(4 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 **(12 hours)**

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

DIGITAL CONTROL SYSTEM

EE 652

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 **(9 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.

INDUSTRIAL POWER DISTRIBUTION AND ILLUMINATION

EE 653

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

Course Objective:

To provide detailed knowledge in design electrical distribution and illumination system, to understand relevant standards, rules and regulation system and to 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" DhanpatRai& Sons, New Delhi

SIGNAL ANALYSIS
EX 651

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : III
Part : II

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), Parsevalsrelation.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.

PROJECT ENGINEERING

CE 701

Lecture : 3
Tutorial : 1
Practical : 0

Year : IV
Part : I

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. IshwarAdhikari and Santosh Kr. Shrestha, "A text book of Project Engineering", Chandeshwori Publication.
2. Dhurba P. Rizal, "Project Management" , Ratna Pustak Bhandar.
3. E.R. Yescombe, "Principles of Project Finance" Yescombe-Consulting Limited.
4. K. Nagarajan, "Project Management", ISBN: 81-224-1340-4, New Age International (P) Limited, New Delhi, India:
5. Dr. Govinda Ram Agrawal, "Project Management in Nepal", M.K. Publishers and Distributors, Kathmandu, Nepal.

TECHNOLOGY ENVIRONMENT AND SOCIETY

CE 708

Lectures : 2
Tutorials : 0
Practical : 0

Year : IV
Part : I

Course Objectives:

To provide knowledge of environment, technology and its impact on society in order to understand the global, national and local environmental issues and challenges of the information society.

1. Technology (8 hours)

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 airpollution
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 and 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
2. H.G. Wells, "Brief History of Civilization"
3. J. Neharu, "Glimps of World History"

ORGANIZATION AND MANAGEMENT
ME 708

Lecture : 3
Tutorial : 2
Practical : 0

Year : IV
Part : I

Course Objective:
To give knowledge about organizational management and internal organization of companies required for managing an enterprise. Also to make familiar with personnel management, case study, management information system motivation and leadership for developing managerial skills.

1. Introduction **(20 hours)**

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 (2 hours)
- 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 **(10 hours)**

3.1 Motivation (6 hours)
- 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)
- 3.2.1 Qualities of a good Leader
- 3.2.2 Leadership Style
- 3.2.3 Blakes and Mouton's Managerial Grid
- 3.2.4 Leadership Approach
- 3.2.5 Leadership Theories

3.3 Entrepreneurship – Introduction (2 hours)
- 3.3.1 Entrepreneurship Development
- 3.3.2 Entrepreneurial Characteristics
- 3.3.3 Need for Promotion of Entrepreneurship
- 3.3.4 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, McGraw Hill.
2. E. S. Buffa and R. K. Sarin "Modern Production / Operations Management", 8th Edition, Wiley.
3. H. J. Arnold and D. C. Feldman "Organizational Behavior" , McGraw – Hill.
4. J. A. Senn, "Information Systems in Management " , Wadsworth Inc.
5. P. Hershey and K. H. Blanchard, "Management of Organizational Behavior – Utilizing Human Resources ", Prentice – Hall Inc.
6. M. Mahajan, "Industrial Engineering and production Management" ,Dhanpat Rai and Co. (P) Ltd. , Delhi.
7. S. Sadagopan, "Management Information System", Prentice Hall of India Pvt Ltd.
8. C. B. Mamoria "Personnel Management", Himalaya Publishing House..
9. O. P. Khanna, "Industrial Engineering and Management", Dhanpat Rai Publications (P) Ltd.
10. S. K. Joshi, "Organization and Management", IOE, Pulchowk Campus.

POWER ELECTRONICS

EE 701

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

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 **(5 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 **(4 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" DhanpatRai and Sons
2. B.R Gupta and V.Singhal " Power Electronics" Kataria and Sons

UTILIZATION OF ELECTRICAL ENERGY

EE 702

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 **(11 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 Microwave 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*

POWER PLANT EQUIPMENT

EE 703

Lecture : 4 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 3/2

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 **(8 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 **(8 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 **(4 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"

PROJECT-I

EE 707

Lecturer : 0
Tutorial : 0
Practical : 3

Year : IV
Part : I

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

EE72501

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

RELIABILITY ENGINEERING

EE72503

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : IV
Part :I

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 (5 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.

RURAL ELECTRIFICATION

EE72502

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : IV
Part : I

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 (5 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

ENGINEERING PROFESSIONAL PRACTICE

CE 752

Lecture : 2
Tutorial : 0
Practical : 0

Year : IV
Part : II

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.
2. Dr Rajendra Adhikari, "Engineering Professional Practice – Nepalese and international Perspectives" Pashupati Publishing House, Kathmandu Nepal.
3. M. Govindarajan; S Natarajan and V.S. Senthikumar., " Engineering Ethics" – PHI Learning Pvt. Ltd. New Delhi.
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

HIGH VOLTAGE ENGINEERING

EE 751

Lecture : 3
Tutorial : 1
Practical : 0

Year : IV
Part : II

Course Objective:

To provide knowledge for

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

1. Evolution of power system **(6 hours)**

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 hours)**

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 hours)**

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 hours)**

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 hours)**

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 hours)**

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 hours)**

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

POWER PLANT DESIGN

EE 753

Lecture : 3 **Year : IV**
Tutorial : 0 **Part : II**
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 (5 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. J.B. Gupta, "Generation and Economic Considerations"
9. AK Raja, Amit Prakash Srivastava, Manish Dwivedi, "Power Plant Engineering",

TRANSMISSION AND DISTRIBUTION DESIGN

EE 754

Lecture : 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 **(5 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 **(9 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 **(8 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

PROJECT-II

EE755

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

EE76501

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : IV
Part : II

Course Objective:

To make student familiar with different methods of transmission line compensation

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.

BIOMEDICAL INSTRUMENTATION

EX76505

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

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
  - 5.2.1.1 Functional X-ray Machine
  - 5.2.1.1 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

Practical:

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

APPLIED PHOTOVOLTAIC ENGINEERING

EX76502

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : IV
Part : II

Course Objectives:

To be familiar with solar photovoltaic principle, design and application.

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 **(5 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 **(9 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 **(9 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

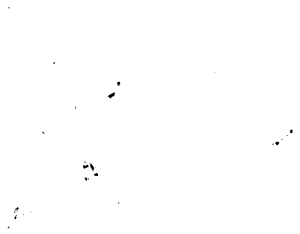
Practical Works (Experiment and Simulation)

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. AK Mukharji, "Photovoltaic System Analysis and Design", PHI.
2. Kalogirou, S. A. "Solar Energy Engineering: Processes and Systems", Academic Press, ISBN-10: 0123745012
3. G Masters, "Renewable and Efficient Electric Power Systems", Wiley Publication.
4. Messenger, R. A., Ventre, J., "Photovoltaic Systems Engineering", CRC Press, ISBN-10: 0849317932
5. Foster, R.; Ghassemi, M.; Cota, A.; "Solar Energy: Renewable Energy and the Environment", CRC Press, ISBN-10: 1420075667



ELECTIVE III

MICRO-HYDRO POWER

EE78501

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : IV
Part : II

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 **(7 hours)**

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", Prentice Hall of India Ltd.

ARTIFICIAL NEURAL NETWORK

EE78502

Lecture : 3
Tutorial : 1
Practical : 1.5

Year : IV
Part : II

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 **(9 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.

WIND ENERGY CONVERSION SYSTEM

EE7803

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 **(9 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 **(9 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 **(9 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
2. Renewable and efficient power system
3. Wind Energy: Fundamentals, Resource analysis and Economics, Mathew Sathyajith
4. Wind Energy Explained: theory, Design and Application, James F. Manwell, Jon G. McGowan, Anthony L. Rogers.