BACHELOR'S DEGREE IN

ELECTRONICS &

COMMUNICATION ENGINEERING

Tribhuvan University
2009

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 Electronics and Communication Engineering field. The details of the course are as follows:

1.1 Title of the Course

Bachelor of Engineering in **Electronics & Communication 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 including 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's level course). The remaining two digits 01 and 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, 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 he 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 marks 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 the subject.

5.4 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 parts 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 year (both I and II parts)	30%

Depending upon he 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

Teaching Schedule							Examination Scheme						Total	Remarks
S.N.	Course Code	Course Title	L	T	P	Total	Theory			Practical				
							Assessment Marks	Final		Assessment Marks	Final			
								Duration hours	Marks		Duration hours	Marks		
1	SH 401	Engineering Mathematics I	3	2		5	20	3	80				100	
2	CT 401	Computer Programming	3		3	6	20	3	80	50			150	
3	ME 401	Engineering Drawing I	1		3	4		3		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

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

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Year : II

Part: I

Teaching Schedule							Examination Scheme						Total	Remarks
S.N.	Course Code	Course Title	L	T	P	Total	Theory			Practical				
							Assessment Marks	Final		Assessment Marks	Final			
								Duration hours	Marks		Duration 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	25			125	
		Total	21	6	10.5	37.5	140	21	560	175			875	

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Year : II

Part: II

Teaching Schedule							Examination Scheme						Total	Remarks
S.N.	Course Code	Course Title	L	T	P	Total	Theory			Practical				
							Assessment Marks	Final		Assessment Marks	Final			
								Duration hours	Marks		Duration hours	Marks		
1	EE 554	Electrical Machine	3	1	1.5	5.5	20	3	80	25			125	
2	SH 553	Numerical Method	3	1	3	7	20	3	80	50			150	
3	SH 551	Applied Mathematics	3	1		4	20	3	80				100	
4	EE 552	Instrumentation I	3	1	1.5	5.5	20	3	80	25			125	
5	EE 553	Power System	3	1		4	20	3	80				100	
6	EX 551	Microprocessor	3	1	3	7	20	3	80	50			150	
7	CT 551	Discrete Structure	3			3	20	3	80				100	
		Total	21	6	9	36	140	21	560	150			850	

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Year : III

Part: I

Teaching Schedule							Examination Scheme						Total	Remarks
S.N.	Course Code	Course Title	L	T	P	Total	Theory			Practical				
							Assessment Marks	Final		Assessment Marks	Final			
								Duration hours	Marks		Duration hours	Marks		
1	SH 601	Communication English	3	1	2	6	20	3	80	25			125	
2	SH 602	Probability and Statistics	3	1		4	20	3	80				100	
3	EE 602	Control System	3	1	1.5	5.5	20	3	80	25			125	
4	EX 602	Instrumentation II	3	1	1.5	5.5	20	3	80	25			125	
5	EX 603	Computer Graphics	3	1	3	7	20	3	80	50			150	
6	EX 601	Advanced Electronics	3	1	1.5	5.5	20	3	80	25			125	
7	CT 603	Computer Organization & Architecture	3	1	1.5	5.5	20	3	80	25			125	
Total			21	7	11	39	140	21	560	175			875	

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Year : III Part: II

Teaching Schedule							Examination Scheme						Total	Remarks
S.N.	Course Code	Course Title	L	T	P	Total	Theory			Practical				
							Assessment Marks	Final		Assessment Marks	Final			
								Duration hours	Marks		Duration hours	Marks		
1	CE 655	Engineering Economics	3	1		4	20	3	80				100	
2	CT 655	Embedded System	3	1	1.5	5.5	20	3	80	25			125	
3	EX 651	Signal Analysis	3	1	1.5	5.5	20	3	80	25			125	
4	EX 652	Communication System I	3	1	1.5	5.5	20	3	80	25			125	
5	CT 657	Computer Network	3	1	3	7	20	3	80	50			150	
6	EX 653	Propagation and Antenna	3	1	1.5	5.5	20	3	80	25			125	
7	EX 654	Minor Project			4	4				50		25	75	
		Total	18	6	13	37	120	18	480	200		25	825	

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Year : IV

Part: I

Teaching Schedule							Examination Scheme						Total	Remarks
S.N.	Course Code	Course Title	L	T	P	Total	Theory			Practical				
							Assessment Marks	Final		Assessment Marks	Final			
								Duration hours	Marks		Duration hours	Marks		
1	CT 701	Project Management	3	1		4	20	3	80				100	
2	ME 708	Organization & Management	3	1		4	20	3	80				100	
3	EX 701	Energy, Environment & Society	2			2	10	1.5	40				50	
4	EX 702	Communication System II	3	1	1.5	5.5	20	3	80	25			125	
5	EX 703	Telecommunication	3	1	1.5	5.5	20	3	80	25			125	
6	EX 704	Filter Design	3	1	1.5	5.5	20	3	80	25			125	
7	EX 7250	Elective I	3	1	1.5	5.5	20	3	80	25			125	
8	EX 707	Project(Part A)			3	3				50			50	
		Total	20	6	9	35	130	19.5	520	150			800	

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Year : IV Part: II

Teaching Schedule							Examination Scheme						Total	Remarks
S.N.	Course Code	Course Title	L	T	P	Total	Theory			Practical				
							Assessment Marks	Final		Assessment Marks	Final			
								Duration hours	Marks		Duration hours	Marks		
1	CE 752	Professional Practice	2			2	10	1.5	40				50	
2	EX 751	Wireless Communication	3	1		4	20	3	80				100	
3	EX 752	RF & Microwave Engineering	3	1	1.5	5.5	20	3	80	25			125	
4	EX 753	Digital Signal Processing	3	1	1.5	5.5	20	3	80	25			125	
5	EX 7650	Elective II	3	1	1.5	5.5	20	3	80	25			125	
6	EX 7850	Elective III	3	1	1.5	5.5	20	3	80	25			125	
7	EX 755	Project (Part B)			6	6				50		50	100	
Total			17	5	12	34	110	13.5	440	150		50	750	

ENGINEERING MATHEMATICS I

SH401

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

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 Gamma 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. Homogeneous 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”, Sukunda Pustak 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

CT401

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**
   - 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

Lecture : 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, Fours 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 and 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 two intersecting lines
   - 4.13. Dihedral angle between two planes

4.14. Shortest distance between two skew lines

4.15. Angel 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. Multiview, Sectional Drawings and Dimensioning III (5.3) (Sketch and Instrumental Drawing)
10. Projection of Regular Geometrical Solids (Sketch and Instrumental Drawing)
11. Development of Intersection I (6.1) (Sketch and Instrumental Drawing)
12. Development of Intersection II (6.2) (Sketch and Instrumental Drawing)
13. Development of 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 Publishing Co.
4. A. Mitchell, H.C. Spencer and J. T. Dygdone, “Technical Drawing”, F. E. Giescke, Macmillan Publishing Co.
5. N. D. Bhatt, “Elementary Engineering Drawing”, Charotar Publishing 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 **Year : I**
Tutorial : 1 **Part : I**
Practical : 2

Course Objective:

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** **(3 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. User 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 a 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, "Fundamental 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 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objective:

To provide concept and knowledge of engineering mechanics and help 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: Relevant Examples
4. **Center of Gravity, Centroid and Moment of Inertia** **(6 hours)**
   - 4.1. Concepts and Calculation of Center 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 Forces, 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 and 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 and Particle and Rigid Body

   8.4. Uniform Rectilinear Motion of Particle

   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 with 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 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3/2

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. Krichhoff's laws
   - 2.4. Power and energy
3. **Network Theorems** **(12 hours)**
   - 3.1. Application of Krichhoff'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** **(2 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** **(5 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 and delta connection

8.3. Phase and line quantities

8.4. Voltage & current computation in 3-phase balance and unbalance circuits

8.5. Real and reactive power computation

8.6. Measurement of power and power factor in 3-phase system

Practical:

1. Measurement of Voltage, Current and power in DC circuit,
   Verification of Ohm's law
   Temperature effects in Resistance

2. Krichhoff's Voltage and Current law
   Evaluate power from V and I
   Note loading effects of meter

3. Measurement amplitude, frequency and time with oscilloscope
   Calculate and 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 and 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 equations
   - 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 positive 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. Bajracharya, "Differential Calculus", Sukunda Pustak Bhandar, Nepal
4. M.B. Singh, B. C. Bajracharya, "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. Bajracharya, "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 and 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. Angle 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 and Graphical Symbol (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 Publishing Co.
3. A. Mitchell, H.C. Spencer and J. T. Dygdone, “Technical Drawing”, F. E. Giescke, Macmillan Publishing Co.
4. N. D. Bhatt, “Elementary Engineering Drawing”, Charotar Publishing House, India.
5. P. S. Gill, “A Text Book of Engineering Drawing”, S.K. Kataria and Sons, India.
6. R. K. Dhawan, “A Text Book of Engineering 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. Constructions 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 Electronics System** **(5 hours)**

7.1. Instrumentation system: Transducer, strain guage, 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 Lous Nashelsky, "Electronics Devices and Circuit Theory", PHI
2. Thomas L. Floyd, "Electronic Devices", Pearson Education, Inc. 2007
3. A.S. Sedra and K.C. Smith, "Microelectronics Circuits", Oxford University Press, 2006

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 vii) 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. Type of explosives: Primary, Low an 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 fo Geometrical Isomerism

9.3. Optical Isomerism with references 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 E1 and E2

10.5. Factors governing SN^1, SN^2, E1 and E2 reaction mechanism path

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

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

FUNDAMENTALS OF THERMODYNAMICS AND HEAT TRANSFER

ME 452

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

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 mixture
   - 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 Substance

5.8. Carnot Cycle, Heat Engine, Heat Pump and Refrigerator

5.9. Kelvin-Planck and Calusius 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 Tranfer**

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 structure

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. Head 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 **Year : I**
Tutorial : 0 **Part : II**
Practical : 3

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 hour)**
   - 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 hour)**
   - 3.1. Introduction
   - 3.2. Semi-Precision Tools - Calipers, depth Gauge, feeler gauge
   - 3.3. Precision Tools - Micrometers, Vernier Calipers, Vernier Height Gauge, Telescope gauge, Hole gauge, Bevel protractor, Dial indicator, Gauge Blocks and Surface Plate
4. **Drills and Drilling Processes** **(1 hour)**
   - 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, Anglular, 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 hour)**

6.1. Tool material – 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 hour)**

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

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

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 hour)**

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. **Meta 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
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”, McGraw 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 II”, Industrial Press, New York
5. Ryerson, “Technology of Machine Tools”, McGraw Hill

6. Oberg, Jones and Horton, “Machinery’s Handbook”, Industrial Press, New York.

7. S.K. Hajra Choudhury and A.K. Choudhury, “Elements of Workshop Technology - Vol I (Manufacturing Processes)”, Media Promoders and Publishers Pvt. Ltd., Bombay, India.

8. S.K. Hajra Choudhury and A.K. Choudhury, “Elements of Workshop Technology - Vol II (Machine Tools)”, Media Promoders and Publishers Pvt. Ltd., Bombay, India.

9. Prof. B.S. Raghuwanshi, “A Course in Workshop Technology - Vol I”, Dhanpat Rai and Co. Ltd., Delhi, India

10. Prof. B.S. Raghuwanshi, “A Course in Workshop Technology - Vol II”, Dhanpat Rai and Co. Ltd., Delhi, India

11. H.S. Bawa, “ Workshop Technology - Vol I”, Tata McGraw Hill Publishing company limited, Delhi, India.

12. H.S. Bawa, “ Workshop Technology - Vol II”, Tata McGraw Hill Publishing company limited, Delhi, India.

13. R.S. Khurmi and J.K. Gupta, “A textbook of Workshop Technology”, S. Chand and Company Ltd, New Delhi, India.

ENGINEERING MATHEMATICS III

SH 451

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

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 use
   - 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. Krezig, "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 of 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 Object 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 Use 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. Destructo 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 Sream 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. Exceptions 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 OOP 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. Deital and Paul J. Deital, "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 **Year : II**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

To continue work in Basic Electrical Engineering including the use of Laplace Transform to determine the time and frequency domain responses of electrical 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 of 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 and 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 Fouier 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 circuits 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 **Year : II**
Tutorial : 1 **Part : I**
Practical : 0

Course Objective:

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 idea: 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 state, 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 Piezo-electricity
4. **Magnetic materials** **(6 hours)**
   - 4.1. Magnetic material classification: diamagnetismm, paramagnetism, ferromagnetism, Anti-ferromagnetism, ferrimagnetism
   - 4.2. Magnetic domain: 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 Prasas 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. Kasam S.O, "Principles of electrical engineering materials and devices, McGraw Hill, New York.
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 **Year : II**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

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 Oscillator

   5.4. Generation of Square and Triangular Waveforms Using Astable Multivibrators

   5.5. Integrated Ciruit 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, "Microelectronics Circuits", Oxford University Press
2. David A. Bell, "Electronics Devices and Circuits", PHI
3. Robert Boylestad and Louis NashelSky, "Electronic Device and Circuit Theory", PHI
4. Thomos L. Floyd, "Electronic Devices", Pearson Education Inc.
5. Mark N. Horenstein, "Microelectronic Circuits and Devices", PHI
6. Paul Horowitz and Winfield Fill, "The Art of Elcetronics", Cambridge Publication
7. Jacob Millman and Christos C. Halkias, ans Satyabratajit, "Millman's Elecronic 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 Computers
   - 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 hour)**
   - 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. Harards 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. Edge-Triggered D Flip-Flops
6.5. Edge-Triggered JK Flip-Flops
6.6. Flip-Flop Timing
6.7. JK Master-Slave Flip-Flops
6.8. Switch Contacts Bounds Circuits
6.9. Various Representation of Flip-Flops
6.10. Analysis of Sequential 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. Counter Design as a Synthesis Problem
8.7. 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 Overview
10.5. Open Collector 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 Goutam Saha, “Digital Principles and Applications”, Tata McGraw-Hill
2. David J Comer, “Digital Logic and State Machine Design”, Oxford University Press
3. William I. Fletcher, “An Engineering Approach to Digital Design”, Prentice Hall of India, New Delhi
4. William H. Gothmann, “Digital Electronics, An Introduction to Theory and Practice”

ELECTROMAGNETICS

EX 502

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

Course Objective:

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 charge, 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 equation 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. Impedance 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 measurements
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, Lauren series
      1.4.5. Analyticity at infinity, zeros, singularities, residues, Cauchy's residue theorem
      1.4.6. Evaluation of real integrals

   1.5.

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 valuer 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 transforms

References:

1. S.K. Mishra, G.B. Joshi, S. Ghimire, V. Parajuli, "A textbook of Applied Mathematics", Dibya Deurali Prakashan
2. E. Kreyzig, "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, 1987

NUMERICAL METHODS

SH 553

Lecture : 3
Tutorial : 1
Practical : 3

Year : II
Part : II

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-False Method, Secant method
   - 2.4. Fixed point iteration method
   - 2.5. Rate of convergence and comparisons of these Methods
3. **Solution of system of linear algebraic equations** **(8 hours)**
   - 3.1. Gauss elimination method with pivoting strategies
   - 3.2. Gauss-Jordan method
   - 3.3. LU Factorization
   - 3.4. Iterative methods (Jacobi method, Gauss-Seidel method)
   - 3.5. Eigen value and Eigen vector using Power method
4. **Interpolation** **(8 hours)**
   - 4.1. Newton's Interpolation (forward, backward)
   - 4.2. Central difference interpolation: Stirling's Formula, Bessel's Formula
   - 4.3. Lagrange interpolation
   - 4.4. Least square method of fitting linear and nonlinear curve for discrete data and continuous function
   - 4.5. Spline Interpolation (Cubic Spline)
5. **Numerical Differentiation and Integration** **(6 hours)**
   - 5.1. Numerical Differentiation formula
   - 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 points)
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. Legrange interpolation. Curve fitting by least square method
5. Differentiation by Newton's finite difference method. Integration using Simpson's 3/8 rule
6. Solution of 1^st order differential equation using RK-4 method
7. Partial differential equation (Laplace equation)
8. Numerical solutions using MATLAB

References:

1. Dr. B.S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publication
2. Robert J. Schilling, Sandra Lharries, "Applied Numerical Methods for Engineers using MATLAB and C", Thompson Brooks/cole. Richard L. Burden, J. Douglas Faires, "Numerical Analysis", Thomson Brooks/cole
3. John H. Mathews, Kurtis Fink, "Numerical Methods Using MATLAB", Prentice Hall Publication
4. Jaan Kiusalaas, "Numerical Methods in Engineering with MATLAB", Cambridge Publication

INSTRUMENTATION I

EE 552

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

Course Objective:

To provide comprehensive treatment of methods and instrument for a wide range of measurement problems.

1. **Instrumentation 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 parameter – response time, frequency response and bandwidth
   - 2.3. Error in measurement
   - 2.4. Statistical analysis of error in measurement
   - 2.5. Measurement of voltage and current (moving coil and moving iron instruments)
   - 2.6. Measurement of low, high and medium resistances
   - 2.7. AC bridge and 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,, fiber 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 converters – weighted resistor type, R-2R ladder type, DAC errors
   - 5.3. Analog to digital converters – 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
6. J.B. Gupta, “A course in Electrical and Electronics Measurement and Instrumentation” , Kataria and Sons

POWER SYSTEM

EE 553

Lecture : 3
Tutorial : 1
Practical : 0

Year : II
Part : II

Course Objective:

To deliver the principle and fundamental analysis techniques for generation, transmission and distribution components of a power system with basic protection system.

1. **General Background** **(4 hours)**
   - 1.1. Power System Evolution
   - 1.2. Generation, Transmission, and Distribution components
   - 1.3. Major electrical components in power station; alternators, transformers, bus bar, voltage regulators, switch and isolators, metering and control panels
   - 1.4. Voltage levels, AC vs DC Transmission
   - 1.5. Single phase and three phase power delivery
   - 1.6. Single line diagram representation of a power system
2. **Mechanical consideration of Transmission** **(8 hours)**
   - 2.1. Overhead lines
     - 2.1.1. Line supports, spacing between conductors
     - 2.1.2. Calculation of sag, equal and unequal supports, effect of ice and wind loadings
     - 2.1.3. Application of GPS system
   - 2.2. Underground cables
     - 2.2.1. Classification, construction of cables, insulation resistance
     - 2.2.2. Dielectric stress in single core/multi core cables
     - 2.2.3. Cable faults and location of faults
3. **Line parameter calculations** **(10 hours)**
   - 3.1. Inductance, resistance and capacitance of a line
   - 3.2. Inductance of line due to internal and external flux linkage
   - 3.3. Skin and proximity effect
   - 3.4. Inductance of single phase two wire line, stranded and bundled conductor consideration, concept of GMR and GMD, inductance of 3 phase line; equilateral and unsymmetrical spacing
   - 3.5. Transposition, inductance of double circuit 3 phase lines
   - 3.6. Concept of GMR and GMD for capacitance calculations
   - 3.7. Capacitance calculations of single phase two wire line, stranded and bundled conductor consideration, capacitance of 3 phase lines, equilateral and unsymmetrical spacing, double circuit
   - 3.8. Earth effect in capacitance of a line
4. **Transmission line performance analysis** **(8 hours)**
   - 4.1. Classification of a line based on short, medium and long lines
   - 4.2. Representation of 'Tee' and 'Pi' of medium lines; calculation of ABCD parameters
   - 4.3. Per unit system; advantage and applications
   - 4.4. Voltage regulations and efficiency calculation of transmission lines
   - 4.5. Transmission line as source and sink of reactive power
   - 4.6. Real and reactive power flow through lines

4.7. Surge impedance loading

4.8. Reactive compensation of transmission lines

5. **Interconnected power system** **(5 hours)**

5.1. Real power/ frequency balance

5.2. Reactive power/ voltage balance

5.3. Computer application in interconnected power system

5.4. Basic concept of Power system load flow

6. **Distribution System** **(5 hours)**

6.1. Distribution system terminology

6.2. Distribution transformer and load centers

6.3. Rural vs urban distribution

6.4. Radial, loop, and network distribution

6.5. Voltage drop computation in a radial DC and AC distribution

7. **Introduction to power system protection** **(5 hours)**

7.1. Power system faults and protection principle

7.2. Fuse as a protection device

7.3. Relays; working and types

7.4. Circuit breaker; working and types

7.5. Basic protection schemes for generators, motors, transformers and transmission lines

7.6. Basic concept of power line carrier communication (PLCC)

References:

1. W,D, Stevension, "Power System Analysis", Tata McGraw Hill Publications
2. P.N. Singh, "Electric power Generation, Transmission & Distribution", Prentice Hall.

ELECTRICAL MACHINES

EE 554

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

Course Objective:

To impart knowledge on constructional details, operating principle and performance of Transformers, DC Machines, 1-phase and 3-phase Induction Machines, 3-phase Synchronous Machines and Fractional Kilowatt Motors.

1. **Magnetic Circuits and Induction** **(4 hours)**
   - 1.1. Magnetic Circuits
   - 1.2. Ohm's Law for Magnetic Circuits
   - 1.3. Series and Parallel Magnetic circuits
   - 1.4. Core with air gap
   - 1.5. B-H relationship (Magnetization Characteristics)
   - 1.6. Hysteresis with DC and AC excitation
   - 1.7. Hysteresis Loss and Eddy Current Loss
   - 1.8. Faraday's Law of Electromagnetic Induction, Statically and Dynamically induced EMF
   - 1.9. Force on Current Carrying Conductor
2. **Transformer** **(8 hours)**
   - 2.1. Constructional Details, recent trends
   - 2.2. Working principle and EMF equation
   - 2.3. Ideal Transformer
   - 2.4. No load and load Operation
   - 2.5. Operation of Transformer with load
   - 2.6. Equivalent Circuits and Phasor Diagram
   - 2.7. Tests: Polarity test, Open Circuit test, Short Circuit test and Equivalent Circuit Parameters
   - 2.8. Voltage Regulation
   - 2.9. Losses in a transformer
   - 2.10. Efficiency, condition for maximum efficiency and all day efficiency
   - 2.11. Instrument Transformers: Potential Transformer (PT) and Current transformer (CT)
   - 2.12. Auto transformer: construction, working principle and Cu saving
   - 2.13. Three phase Transformers
3. **DC Generator** **(6 hours)**
   - 3.1. Constructional Details and Armature Winding
   - 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. Losses in DC generators
   - 3.7. Efficiency and Voltage Regulation
4. **DC Motor** **(6 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 DC motors

4.5. Starting of DC motors: 3 point and 4 point starters

4.6. Speed control of DC motors: Field control, Armature Control

4.7. Losses and Efficiency

5. **Three Phase Induction Machines** **(7 hours)**

5.1. Three phase induction motor

5.1.1. Constructional Details and Types

5.1.2. Operating Principle, Rotating Magnetic Field, Synchronous Speed, Slip, Induced EMF, Rotor current and its frequency, Torque Equation

5.1.3. Torque-Slip characteristics

5.2. Three phase induction generator

5.2.1. Working Principle, voltage build up in an Induction generator

5.2.2. Power stages

6. **Three Phase Synchronous Machines** **(6 hours)**

6.1. Three Phase Synchronous Generator

6.1.1. Constructional Details, Armature Winding, Types of Rotor, Exciter

6.1.2. Working Principle

6.1.3. EMF equation, distribution factor, pitch factor

6.1.4. Armature Reaction and its effects

6.1.5. Alternator with load and its phasor diagram

6.2. Threee Phase Synchronous Motor

6.2.1. Principle of operation

6.2.2. Starting methods

6.2.3. No load and load operation, Phasor Diagram

6.2.4. Effect of Excitation and power factor control

7. **Fractional Kilowatt Motors** **(6 hours)**

7.1. Single phase Induction Motors: Construction and Characteristics

7.2. Double Field Revolving Theory

7.3. Split phase Induction Motor

7.3.1. Capacitors start and run motor

7.3.2. Reluctance start motor

7.4. Alternating Current Series motor and Universal Motor

7.5. Special Purpose Machines: Stepper motor, Schrage motor and Servo motor

Practical:

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

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

3. DC Generator
   - To draw open circuit characteristics (OCC) of a DC shunt generator
   - 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 Machines
   - To draw torque-speed characteristics and to observe the effect of rotor resistance on torque-speed characteristics of a 3-phase Induction Motor
   - To study load characteristics of synchronous generator with (a) resistive load (b) inductive load and (c) capacitive load

6. Fractional Kilowatt Motors
   - To study the effect of a capacitor on the starting and running of a single-phase induction motor
   - Reversing the direction of rotation of a single phase capacitor induct

References:

1. I.J. Nagrath and D.P. Kothari, "Electrical Machines", Tata McGraw Hill
2. S.K. Bhattacharya, "Electrical Machines", Tata McGraw Hill
3. B.L. Theraja and A.K. Theraja, "Electrical Technology (Vol-II)", S. Chand
4. Husain Ashfaq, "Electrical Machines", Dhanpat Rai and Sons
5. A.E. Fitzgerald, C. Kingsley Jr. and Stephen D. Umans, "Electic Machinery", Tata McGraw Hill
6. B.R. Gupta and Vandana Singhal, "Fundamentals of Electrical Machines", New Age International
7. P.S. Bhimbra, "Electrical Machines", Khanna Publishers
8. Irving L. Kosow, "Electric Machine and Transformers", Prentice Hall of India
9. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons
10. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers", Oxford University Press.

MICROPROCESSORS

EX 551

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

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 and Architectures

6.2.1. Register Based and Accumulator Based Architecture

6.2.2. RISC and CISC Architecture

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. Water A. Triebel and Avatar Singh, "The 8088 and 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications", Prentice Hall.
6. William Stalling,"Computer Orgarnization and Architecture", Prentice Hall.

DISCRETE STRUCTURE

CT 551

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

Course Objective:

To gain knowledge in discrete mathematics and finite state automata in an algorithmic approach and to gain fundamental and conceptual clarity in the area of Logic, Reasoning, Algorithms, Recurrence Relation, Graph Theory, and Theory of Automata.

1. **Logic, Induction and Reasoning** **(12 hours)**
   - 1.1. Proposition and Truth function
   - 1.2. Propositional Logic
   - 1.3. Expressing Statements in Logic Propositional Logic
   - 1.4. The predicate Logic
   - 1.5. Validity
   - 1.6. Informal Deduction in Predicate Logic
   - 1.7. Rules of inference and Proofs
   - 1.8. Informal Proofs and Formal Proofs
   - 1.9. Elementary Induction and Complete Induction
   - 1.10. Methods of Tableaux
   - 1.11. Consistency and Completeness of the System
2. **Finite State Automata** **(10 hours)**
   - 2.1. Sequential Circuits and Finite State Machine
   - 2.2. Finite State Automata
   - 2.3. Language and Grammars
   - 2.4. Non-deterministic Finite State Automata
   - 2.5. Language and Automata
   - 2.6. Regular Expression and its characteristics
3. **Recurrence Relation** **(8 hours)**
   - 3.1. Recursive Definition of Sequences
   - 3.2. Solution of Linear recurrence relations
   - 3.3. Solution to Nonlinear Recurrence Relations
   - 3.4. Application to Algorithm Analysis
4. **Graph Theory** **(15 hours)**
   - 4.1. Undirected and Directed Graphs
   - 4.2. Walk Paths, Circuits, Components
   - 4.3. Connectedness Algorithm
   - 4.4. Shortest Path Algorithm
   - 4.5. Bipartite Graphs, Planar Graphs, Regular Graphs
   - 4.6. Planarity Testing Algorithms
   - 4.7. Eulerian Graph
   - 4.8. Hamiltonian Graph

4.9. Tree as a Directed Graph

4.10. Binary Tree, Spanning Tree

4.11. Cutsets and Cutvertices

4.12. Network Flows, Maxflow and Mincut Theorem

4.13. Data Structures Representing Trees and Graphs in Computer

4.14. Network Application of Trees and Graphs

4.15. Concept of Graph Coloring

References:

1. Kenth Rosen, "Discrete Mathematical Structures with Applications to Computer Science", WCB/ McGraw Hill
2. G. Birkoff, T.C. Bartee, "Modern Applied Algebra", CBS Publishers
3. R. Johnsonbaugh, "Discrete Mathematics", Prentice Hall Inc.
4. G. Chartand, B.R. Oller Mann, "Applied an Algorithmic Graph Theory", McGraw Hill
5. Joe L. Mott, Abrahan Kandel, and Theodore P. Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Prentice Hall of India.

COMMUNICATION ENGLISH

SH 601

Lecture : 3
Tutorial : 1
Practical : 2

Year : III
Part : I

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 Objective:

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 comparision
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 (18 hours)

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
2. **Project/Field Report** **(3 hours)**
   - 2.1. Introduction
   - 2.2. Parts
3. **Formal report** **(9 hours)**
   - 3.1. Introduction
   - 3.2. Types of formal reports
     - 3.2.1. Progress report
     - 3.2.2. Empirical/Research report
     - 3.2.3. Technical report
   - 3.3. Parts and Components of formal report
     - 3.3.1. Preliminary section
       - 3.3.1.1 Cover page
       - 3.3.1.2 Letter of transmittal/Preface

3.3.1.3 Title page
3.3.1.4 Acknowledgements
3.3.1.5 Table of contents
3.3.1.6 List of figures and tables
3.3.1.7 Abstract/Executive summary
3.3.2. Main Section
3.3.2.1 Introduction
3.3.2.2 Discussion/Body
3.3.2.3 Summary/Conclusion
3.3.2.4 Recommendations
3.3.3. Documentation
3.3.3.1 Notes(Contextual/foot notes)
3.3.3.2 Bibliography
3.3.3.3 Appendix

Unit V: Writing Research Articles (2 hours)

1. Introduction
2. Procedures

Practical:

Language Lab		30 hours
Unit I: Listening		12 hours
Activity I	General instruction on effective listening, factors influencing listening, and note-taking to ensure attention. (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 II	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, Overhead projector, power point, DVD, video, screen)	2 hours
Activity II	Making students express their individual views on the assigned topics (Equipment Required : Microphone, movie camera)	2 hours
Activity III	Getting students to participate in group discussion on the assigned topics	4 hours
Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector, 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 question (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 and summary an unseen text of about 200 to 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 techincal 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	Total Marks	Remarks
I	Listening : instruction, Description, conversation	2	Objective	5 + 5	10	Listening tape to be played on any two out of instruction, description and conversation followed by 10 multiple 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)	15	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, Yadav, Bijaya ; "Technical Communication English", Trinity publication
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 pvt. ltd.
5. Kumar, Ranjit, "Research Methodology", Pearson Education
6. Laxminarayan, K.R., "English for Technical Communication", Chennai, Scitech Publication Pvt. Ltd
7. Mishra, Sunita et. al., "Communication Skills for Engineers", Pearson Education
8. Prasad, P. et. al., "The functional Aspects of Communication skills", S.K., Kataria and Sons.
9. Rutherfoord, Andrea J. Phd, "Basic Communication Skills for Technology", Pearson Education Asia
10. Rizvi, M. Ashraf, "Effective Technical Communication", Tata McGraw Hill
11. Reinking A James et. al., "Strategies for Successful Writing: A rhetoric, reshearch guide, reader and handbook", Prentice Hall, New Jersey
12. Sharma R.C. et. al.,"Business correspondence and Report Writing: A practical Approach to Business and Technical communication", Tata McGraw Hill
13. Sharma, Sangeeta et. al, "Communication skills for Engineers and Scientists", PHI Learning Pvt. Ltd, New Delhi
14. Taylor, Shirley et. al, "Model Business letters, E-mails and other Business documents", Pearson Education

PROBABILITY AND STATISTICS

SH 602

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

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 centre, 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. Poisson 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. Gamma 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. eg. 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.

CONTROL SYSTEM

EE 602

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

Course Objective:

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 of manual calculations 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 DC motor and familiarization with different components in DC 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
4. Nagrath & Gopal, “Modern Control Engineering”, New Ages International

ADVANCED ELECTRONICS

EX 601

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

Course Objective:

To provide knowledge on data conversion, amplifiers, instrumentation and power circuits.

1. **Operational Amplifier Circuits** **(6 hours)**
   - 1.1. Bias circuits suitable for IC Design
   - 1.2. The Widlar current source
   - 1.3. The differential amplifier
   - 1.4. Active loads
   - 1.5. Output Stages
2. **Operational Amplifier Characterization** **(8 hours)**
   - 2.1. Input offset voltage
   - 2.2. Input bias and input offset currents
   - 2.3. Output impedance
   - 2.4. Differential and common-mode input impedance
   - 2.5. DC gain, bandwidth, gain-bandwidth product
   - 2.6. Common-mode and power supply rejection ratios
   - 2.7. Higher frequency poles settling time
   - 2.8. Slew rate
   - 2.9. Noise in operational amplifier circuits
3. **Digital-To-Analog and Analog-To-Digital Conversion** **(8 hours)**
   - 3.1. The R-2R ladder circuit
   - 3.2. Unipolar and bipolar D/A converters
   - 3.3. Count-up and tracking A/D's based on D/A's
   - 3.4. Successive approximation A/D converters
   - 3.5. Integrating voltage-to-time conversion A/D converters, dual and quad slop types
   - 3.6. Sigma delta A/D converters
   - 3.7. Flash A/D converters
4. **Instrumentation and Isolation Amplifiers** **(4 hours)**
   - 4.1. One and two operational amplifier instrumentation amplifiers
   - 4.2. The three operational amplifier instrumentation amplifiers
   - 4.3. Consideration of non-ideal properties
   - 4.4. Isolation amplifier principles and realization
   - 4.5. Consideration of non-ideal properties
5. **Operational Amplifier-Bipolar Transistor Logarithmic Amplifier** **(3 hours)**
   - 5.1. The basic logarithmic amplifier
   - 5.2. Non-ideal effects
   - 5.3. Stability consideration

5.4. Anti-logarithmic operations

6. **Log-Antilog Circuit Application** **(5 hours)**

6.1. Analog multiplier based on log-antilog principles

6.2. The multifunction converter circuit

6.3. Proportional to absolute temperature (PTAT) devices

6.4. RMS to dc conversion

7. **Introduction to Power Electronics** **(7 hours)**

7.1. Diodes, thyristors, triacs, IGBT

7.2. Controlled rectifier circuits

7.3. Inverters

7.4. Choppers

7.5. DC-to-DC conversion

7.6. AC-to-AC conversion

8. **Switched Power Supplies** **(4 hours)**

8.1. Voltage step-down regulators

8.2. Voltage step-up regulators

8.3. Step-up/step-down regulators

8.4. Filtering considerations

8.5. Control circuits, IC switched

Practical:

1. Characteristics of operational amplifier
2. 4 bit D to A converter
3. Differential amplifier, Instrumentation amplifier
4. Logarithmic amplifier
5. Study of switched voltage regulator
6. Study of Silicon-controlled-rectifier (SCR) and TRIAC circuit

Reference:

1. A.S. Sedra adn K.C. Smith, "Microelectronic Circuits", Oxford University Press.
2. W. Stanely, "Operational Amplifiers with Linear Integrated Circuits", Charles E. Merrill Publishing Company, Toronto
3. Jacob Millman and Christos C. Halkais, "Integrated Electronics", TATA McGraw Hill Ediiton
4. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education.
5. Ramakant A. Gayakwad, "Operational Amplifiers with Linear Integrated Circuits", Prentice Hall, New Delhi
6. Robert F. Coughlin and Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Prentice Hall, New Delhi
7. C.W. Lander, "Power Electronics", McGraw Hill Book Company, New York
8. J.G. Graeme, "Application of Operational Amplifiers: Third Generation Techniques", The Burr-Brown Electronics Series, McGraw Hill, New York
9. N. Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics Converters, Applications and Design", John Wiley and Sons, New York

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 Base 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 of 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. Componetnt 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 seed 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 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 specification, 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 and 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
10. S.E. Derenzo, "Interfacing: A laboratory Approach Using the Microcomputer for Instrumentation, Data Analysis, and Control", Prentice Hall

COMPUTER GRAPHICS

EX 603

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

Course Objective:

History of computer graphics, Applications of computer graphics, Hardware: Raster-Scan Displays, Vector Displays, Hard copy devices, Input hardware, display architectures, Applications in various fields like medicine, engineering, art, uses in virtual realism.

1. **Introduction and application** **(2 hours)**
   - 1.1. History of computer graphics
   - 1.2. Applications of computer graphics
   - 1.3. Hardware: Raster-Scan Displays, Vector Displays, Hard copy devices, Input hardware, display architectures
   - 1.4. Applications in various fields like medicine, engineering, art, uses in virtual realism.
2. **Scan-Conversion** **(6 hours)**
   - 2.1. Scan-Converting A point
   - 2.2. Scan-Converting A straight line: DDA line Algorithm, Bresenham's Line Algorithm
   - 2.3. Scan-Converting a Circle and an Ellipse: Mid-Point Circle and Ellipse algorithm
   - 2.4.
3. **Two-dimensional Transformations** **(6 hours)**
   - 3.1. Two-dimensional translation, rotation, scaling, reflection, shear transforms
   - 3.2. Two-dimensional composite transformation
   - 3.3. Two-dimensional viewing pipeline, world to screen viewing transformations and clipping (Cohen-Sutherland Line clipping, Liang-Barsky line clipping)
4. **Three-dimensional Graphics** **(6 hours)**
   - 4.1. Three-dimensional translation, rotation, scaling, reflection, shear transforms
   - 4.2. Three-dimensional composite transformation
   - 4.3. Three-dimensional viewing pipeline, world to screen viewing transformations and clipping (orthographic, parallel, perspective projections)
5. **Curve Modeling** **(4 hours)**
   - 5.1. Introduction to Parametric cubic curves, Splines, Bezier curves
6. **Surface Modeling** **(4 hours)**
   - 6.1. Polygon surface, vertex table, edge table, polygon table, surface normal, and spatial orientation of surfaces
7. **Visible Surface Determination** **(6 hours)**
   - 7.1. Image Space and Object Space techniques
   - 7.2. Back Face Detection, Z-Buffer, A-Buffer, Scan-line method
8. **Illumination and Surface Rendering methods** **(8 hours)**
   - 8.1. Algorithms to simulate ambient, diffuse and specular reflections
   - 8.2. Constant, Gouraud and Phong shading models
9. **Introduction to OpenGL** **(3 hours)**
   - 9.1. Introduction to OpenGL, callback functions, Color commands, drawing pixels, lines and polygons using OpenGL, Viewing, Lighting.

Practical:

There shall be 5 to 6 lab exercise including following concepts:

1. DDA Line Algorithm
2. Bresenham's Line Algorithm
3. Mid-point Circle Algorithm
4. Mid-point Ellipse Algorithm
5. Lab on 2D Transformations
6. Basic Drawing Techniques in OpenGL

References:

1. Donald Hearn and M. Pauline Baker, "Computer Graphics C version"
2. Donald D. Hearn and M. Pauline Baker, "Computer Graphics with OpenGL"
3. Foley, Van Dam, Feiner, Hughes, "Computer Graphics Principles and Practice"

COMPUTER ORGANIZATION AND ARCHITECTURE

CT 603

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : III
Part : I

Course Objective:

To provide the organization, architecture and designing concept of computer system including processor architecture, computer arithmetic, memory system, bus organization and multiprocessors.

1. **Introduction** **(3 hours)**
   - 1.1. Computer organization and architecture
   - 1.2. Structure and function
   - 1.3. Designing for performance
   - 1.4. Computer components
   - 1.5. Computer function
   - 1.6. Interconnection structures
   - 1.7. Bus Interconnection
   - 1.8. PCI
2. **Central processing Unit** **(10 hours)**
   - 2.1. CPU structure and function
   - 2.2. Arithmetic and logic Unit
   - 2.3. Instruction formats
   - 2.4. Addressing modes
   - 2.5. Data transfer and manipulation
   - 2.6. RISC and CISC
   - 2.7. 64-bit Processor
3. **Control Unit** **(6 hours)**
   - 3.1. Control Memory
   - 3.2. Addressing sequencing
   - 3.3. Computer Configuration
   - 3.4. Micro-instruction format
   - 3.5. Symbolic Micro-instructions
   - 3.6. Symbolic Micro-program
   - 3.7. Control Unit Operation
   - 3.8. Design of control unit
4. **Pipeline and Vector processing** **(5 hours)**
   - 4.1. Pipelining
   - 4.2. Parallel processing
   - 4.3. Arithmetic Pipeline
   - 4.4. Instruction Pipeline
   - 4.5. RISC pipeline
   - 4.6. Vector processing

4.7. Array processing

5. **Computer Arithmetic** **(8 hours)**

   5.1. Addition algorithm
   5.2. Subtraction algorithm
   5.3. Multiplication algorithm
   5.4. Division algorithms
   5.5. Logical operation

6. **Memory System** **(5 hours)**

   6.1. Microcomputer Memory
   6.2. Characteristics of memory systems
   6.3. The Memory Hierarchy
   6.4. Internal and External memory
   6.5. Cache memory principles
   6.6. Elements of Cache design
      6.6.1. Cache size
      6.6.2. Mapping function
      6.6.3. Replacement algorithm
      6.6.4. Write policy
      6.6.5. Number of caches

7. **Input-Output organization** **(6 hours)**

   7.1. Peripheral devices
   7.2. I/O modules
   7.3. Input-output interface
   7.4. Modes of transfer
      7.4.1. Programmed I/O
      7.4.2. Interrupt-driven I/O
      7.4.3. Direct Memory Access
   7.5. I/O processor
   7.6. Data Communication processor

8. **Multiprocessors** **(2 hours)**

   8.1. Characteristics of multiprocessors
   8.2. Interconnection Structures
   8.3. Interprocessor Communication and Synchronization

Practical:

1. Addition of two unsigned Integer binary number
2. Multiplication of two unsigned integer binary numbers by partial-product method
3. Subtraction of two unsigned integer binary number
4. Division using Restoring
5. Division using non-restoring methods
6. To simulate a direct mapping cache

References:

1. M. Morris Mano, “Computer System Architecture”
2. William Stalling, “Computer organization and architecture”
3. John P. Hayes, “Computer Architecture and Organization”
4. V.P. Heuring, H.F. Jordan, “Computer System design and architecture”
5. S. Shakya, “Lab Manual on Computer Architecture and design”

ENGINEERING ECONOMICS

CE 655

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

Course Objective:

To provide concept and knowledge of economic studies that will be useful for the evaluation engineering projects and make decisions related to investments.

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 Life-cycle 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 Method 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", McMillan Publishing Company
3. James L. Riggs, David D. Bedworth and Sabah U. Randhawa, "Engineering Economics", Tata McGraw Hill.

EMBEDDED SYSTEM

CT 655

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

Course Objective:

To introduce students to understand and familiarization on applied computing principles in emerging technologies and applications for embedded systems.

1. **Introduction to Embedded System** **(3 hours)**
   - 1.1. Embedded Systems overview
   - 1.2. Classification of Embedded Systems
   - 1.3. Hardware and Software in a system
   - 1.4. Purpose and Application of Embedded Systems
2. **Hardware Design Issues** **(4 hours)**
   - 2.1. Combination logic
   - 2.2. Sequential logic
   - 2.3. Custom Single-purpose processor design
   - 2.4. Optimizing custom single-purpose processors
3. **Software Design Issues** **(6 hours)**
   - 3.1. Basic Architecture
   - 3.2. Operation
   - 3.3. Programmer's View
   - 3.4. Development Environment
   - 3.5. Application-Specific Instruction-Set Processors
   - 3.6. Selecting a Microprocessor
   - 3.7. General-Purpose Processor Design
4. **Memory** **(5 hours)**
   - 4.1. Memory Write ability and storage permanence
   - 4.2. Types of memory
   - 4.3. Composing memory
   - 4.4. Memory Hierarchy and Cache
5. **Interfacing** **(6 hours)**
   - 5.1. Communication Basics
   - 5.2. Microprocessor Interfacing: I/O Addressing, Interrupts, DMA
   - 5.3. Arbitration
   - 5.4. Multilevel Bus Architectures
   - 5.5. Advanced Communication Principles
6. **Real-Time Operating System (RTOS)** **(8 hours)**
   - 6.1. Operating System Basics
   - 6.2. Task, Process, and Threads
   - 6.3. Multiprocessing and Multitasking

6.4. Task Scheduling
6.5. Task Synchronization
6.6. Device Drivers

7. **Control System** **(3 hours)**
   7.1. Open-loop and Closed-loop control system overview
   7.2. Control System and PID controllers
   7.3. Software coding of a PID controller
   7.4. PID Tuning
8. **IC Technology** **(3 hours)**
   8.1. Full-Custom (VLSI) IC technology
   8.2. Semi-Custom (ASIC) IC technology
   8.3. Programming Logic Device (PLD) IC technology
9. **Microcontrollers in Embedded Systems** **(3 hours)**
   9.1. Intel 8051 microcontroller family, its architecture and instruction sets
   9.2. Programming in Assembly language
   9.3. A simple interfacing example with 7 segment display
10. **VHDL** **(4 hours)**
    10.1. VHDL overview
    10.2. Finite state machine design with VHDL

Practical:

Students should complete lab works and project work in practical classes.

Reference Books:

1. David E. Simon, "An Embedded Software Primer", Addison-Wesley
2. Muhammad Ali Mazidi, "8051 Microcontroller and Embedded Systems", Prentice Hall
3. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley & Sons
4. Doughlas L. Perry, "VHDL Programming by example", McGraw Hill

COMPUTER NETWORKS

CT 657

Lecture : 3
Tutorial : 1
Practical : 3

Year : III
Part : II

Course Objective:

To understand the concepts of computer networking, functions of different layers and protocols, and know the idea of IPV6 and security.

1. **Introduction to Computer Network** **(5 hours)**
   - 1.1. Uses of Computer Network
   - 1.2. Networking model Client/Server, p2p, active network
   - 1.3. Protocols and Standards
   - 1.4. OSI model and TCP/IP model
   - 1.5. Comparison of OSI and TCP/IP model
   - 1.6. Example network: The Internet, X.25, Frame relay, Ethernet, VoIP, NGN and MPLS, xDSL
2. **Physical Layer** **(5 hours)**
   - 2.1. Network monitoring: delay, latency, throughput
   - 2.2. Transmission media: Twisted pair, Coaxial, Fiber optic, Line-of-site, Satellite
   - 2.3. Multiplexing, Circuit switching, Packet switching, VC Switching, Telecommunication switching system (Networking of Telephone exchanges)
   - 2.4. ISDN: Architecture, Interface, and Signaling
3. **Data Link Layer** **(5 hours)**
   - 3.1. Functions of Data Link Layer
   - 3.2. Framing
   - 3.3. Error Detection and Corrections
   - 3.4. Flow Control
   - 3.5. Example of Data Link Protocol, HDLC, PPP
   - 3.6. The Medium Access Sub-layer
   - 3.7. The channel allocation problem
   - 3.8. Multiple Access Protocols
   - 3.9. Ethernet
   - 3.10. Networks: FDDI, ALOHA, VLAN, CSMA/CD, IEEE 802.3, 802.4, 802.5 and 802.11
4. **Network Layer** **(9 hours)**
   - 4.1. Inter-networking and devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway
   - 4.2. Addressing: Internet address, classful address
   - 4.3. Subnetting
   - 4.4. Routing: techniques, static vs dynamic routing, routing table in classful address
   - 4.5. Routing protocols: RIP, OSPF, BGP, Unicast and multicast routing protocols
   - 4.6. Routing algorithms: Shortest path algorithm, flooding, distance vector routing, link state routing;, Protocols: ARP, RARP, IP, ICMP
5. **Transport Layer** **(5 hours)**
   - 5.1. The transport service: Services provided to the upper layers

5.2. Transport protocols: UDP, TCP
5.3. Port and Socket
5.4. Connection establishment, Connection release
5.5. Flow control and buffering
5.6. Multiplexing and de-multiplexing
5.7. Congestion control algorithm: Token Bucket and Leaky Bucket

6. **Application Layer** **(5 hours)**

6.1. Web: HTTP and HTTPS
6.2. File Transfer: FTP, PuTTY, WinSCP
6.3. Electronic Mail: SMTP, POP3, IMAP
6.4. DNS
6.5. P2P applications
6.6. Socket programming
6.7. Application server concept: proxy caching, Web/Mail/DNS server optimization
6.8. Concept of traffic analyzer: MRTG, PRTC, SNMP, Packet tracer, WireShark

7. **Introduction to IPV6** **(4 hours)**

7.1. IPv6 Advantages
7.2. Packet formats
7.3. Extension headers
7.4. Transition from IPv4 to IPv6: Dual stack, Tunneling, Header Translation
7.5. Multicasting

8. **Network Security** **(7 hours)**

8.1. Properties of secure communication
8.2. Principles of cryptography: Symmetric Key and Public Key
8.3. RSA Algorithm
8.4. Digital Signatures
8.5. Securing e-mail (PGP)
8.6. Securing TCP connection (SSL)
8.7. Network Layer Security (IPsec, VPN)
8.8. Securing wireless LANs (WEP)
8.9. Firewalls: Application Gateway and Packet Filtering, and IDS

Practical:

1. Network wiring and LAN setup
2. Router Basic Configuration
3. Static and Dynamic Routing
4. Creating VLAN
5. Router access-list configuration
6. Basic Network setup on Linux
7. Setup of Web Server
8. DNS Server setup
9. Setup of DHCP server
10. Virtualizations

References:

1. A.S. Tanenbaum, “Computer Networks”, Prentice Hall
2. W. Stallings, “Data and Computer Communications”, McMillian press
3. Kurose Ross, “Computer Networking: A top down approach”, Pearson Education
4. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Morgan Kaufmann Publishers.

SIGNAL ANALYSIS

EX 651

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

Course Objective:

To provide understanding of basic concept 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), Parseval's relation. Discrete time Fourier series representation, Properties of discrete time Fourier series (linearity, time shift, frequency shift, time reversal, time scaling, conjugation 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, conjugation conjugate symmetry, multiplication, convolution), Parseval's relation, Fourier transform of square wave function, impulse 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, time scaling, conjugation 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, 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.

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.

COMMUNICATION SYSTEM I

EX 652

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

Course Objective:

To introduce the student to the principles and building blocks of analog communication systems.

1. **Introduction** **(4 hours)**
   - 1.1. Analog and Digital communication sources, transmitters, transmission channels and receivers
   - 1.2. Noise , distortion and interference. Fundamental limitation due to noise, distortion and interference
   - 1.3. Types and reasons for modulation
2. **Representation of signals and systems in communication** **(4 hours)**
   - 2.1. Review of signals (types, mathematical representation and applications)
   - 2.2. Linear/non-linear, time variant/invariant systems. Impulse response and transfer function of a system. Properties of LTI systems
   - 2.3. Low pass and band pass signals and systems, bandwidth of the system, distortionless transmission, the Hilbert transform and its properties
   - 2.4. Complex envelops rectangular (in-phase and quadrature components) and polar representation of band pass band limited signals
3. **Spectral Analysis** **(4 hours)**
   - 3.1. Review of Fourier series and transform, energy and power, Parseval's theorem
   - 3.2. Energy Density Spectrum, periodogram, power spectral density function (psdf)
   - 3.3. Power spectral density functions of harmonic signal and white noise
   - 3.4. The autocorrelation (AC) function, relationship between psdf and AC function
4. **Amplitude Modulation** **(12 hours)**
   - 4.1. Time domain expressions, frequency domain representation, modulation index, signal bandwidth
   - 4.2. AM for a single tone message, carrier and side-band components, powers in carrier and side-band components bandwith and power efficiency
   - 4.3. Generation of DSB-FC AM
   - 4.4. Double Side Band Suppressed Carrier AM (DSB-AM), time and frequency domain expressions, powers in side-bands, bandwidth and power efficiency
   - 4.5. Generation of DSB-AM (balanced, ring modulators)
   - 4.6. Single Side Band Modulation, time and frequency domain expressions, powers
   - 4.7. Generation of SSB (SSB filters and indirect method)
   - 4.8. Vestigial Side Bands (VSB), Independent Side Bands (ISB) and Quadrature Amplitude Modulations (QAM)
5. **Demodulation of AM signals** **(6 hours)**
   - 5.1. Demodulation of DSB-FC, DSB-SC and SSB using synchronous detection
   - 5.2. Square law and envelop detection of DSB-FC
   - 5.3. Demodulation of SSB using carrier reinsertion, carrier recovery circuits
   - 5.4. Phase Locked Loop (PLL), basic concept, definitions, equations and applications, demodulation of AM using PLL.

6. **Frequency Modulation (FM) and Phase Modulation (PM) (12 hours)**

   6.1. Basic definitions, time domain expressions for FM and PM

   6.2. Time domain expression for single tone modulated FM signals, spectral representation, Bessel's functions

   6.3. Bandwidth of FM, Carson's rule, narrow and wideband FM

   6.4. Generation of FM (direct and Armstrong's methods)

   6.5. Demodulation of FM and PM signals, synchronous (PLL) and non-synchronous (limiter-discriminator) demodulation

   6.6. Stereo FM, spectral detail, encoder and decoder

   6.7. Pre-emphasis and de-emphasis networks

   6.8. The superheterodyne radio receivers for AM and FM

7. **Frequency Division Multiplexing (FDM) (3 hours)**

   7.1. Principle of frequency division multiplexing, FDM in telephony, hierarchy

   7.2. Frequency Division Multiple Access (FDMA) systems - SCPC, DAMA, SPADE, etc.

   7.3. Filter and oscillator requirements in FDM.

Practical:

1. Demonstration of power spectrum of various signals using LF spectrum analyzer
2. Generation of DSB-SC, DSB-Fc and SSB signals
3. Demodulation of AM signals (Synchronous and non-synchronous methods)
4. Generation of FM signals
5. Demodulation of FM signal (limiter-discriminator)
6. Operation of PLL, PLL as demodulator of AM and FM signals.

References:

1. S. Haykin, Analog and Digital communication systems
2. Leon Couch, Digital and analog communication systems
3. B.P. Lathi, Analog and Digital communication systems
4. J. Proakis, Analog and Digital communication systems
5. D. Sharma, Course manual "Communication Systems I"

PROPAGATION AND ANTENNA

EX 653

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

Course Objective:

To provide the student with an understanding of antennas, EM wave propagation and optical fiber communications.

1. **Radiation and Antenna Fundamentals** **(5 hours)**
   - 1.1. Retarded Potentials: EM wave generation with a conduction current, the short uniform current dipole, the radiate electric and magnetic fields.
   - 1.2. Radiation patterns and input impedance of the short uniform current dipole, the short Dipole and long dipole
   - 1.3. Antenna theorems: reciprocity, superposition, Thevenin, minimum power transfer, compensation, equality of directional patterns, equivalence of receiving and transmitting impedances.
2. **Antenna Parameters and Arrays** **(5 hours)**
   - 2.1. Basic antenna parameters: Pattern multiplication: Linear and two-dimensional antenna arrays, end fire and Broadside arrays.
3. **Antennas classification** **(10 hours)**
   - 3.1. Isotropic antenna
   - 3.2. Omni directional antenna: Dipole
   - 3.3. Directional antennas
   - 3.4. Travelling wave antennas - single wire, V and Rhombus Reflector antennas – large plane sheet, small plane sheet, linear, corner, parabolic, elliptical, hyperbolic and circular reflector. Aperture antenna – horn array antennas – Yagi-Uda, Lag periodic, other antennas – Monopole, Loop, Helical, Microstrip.
4. **Propagation and Radio Frequency Spectrum** **(7 hours)**
   - 4.1. Ground or surface wave
   - 4.2. Space wave: direct and ground reflected wave, duct propagation
   - 4.3. Ionospheric or sky wave: critical frequency, MUF, Skip distance
   - 4.4. Tropospheric wave
   - 4.5. Radio frequency spectrum and its propagation characteristics
5. **Propagation between Antennas:** **(7 hours)**
   - 5.1. Free space propagation: power density of the receiving antenna, path loss
   - 5.2. Plane earth propagation: the ground reflection, effective antenna heights, the two ray
   - 5.3. Propagation model, path loss
   - 5.4. Fresnel Zones and Knife edge diffraction
6. **Optical Fibers (Introductory)** **(11 hours)**
   - 6.1. Optical fiber communication system and its advantages and disadvantages over metal wire communication system
   - 6.2. Types of optical fibre and its structural difference
   - 6.3. Light propagation characteristics and Numerical Aperture (NA) in optical fiber
   - 6.4. Losses
   - 6.5. Light source and photo detector

Practical:

1. Two experiments in properties of EM waves: refraction, diffraction, polarization
2. Two experiments in radiation patterns of various types of antennas
3. Two experiments in measurements on optical fiber transmission systems

References:

1. J.D. Kraus, “Antenna”, McGraw Hill
2. C.A. Balanis, “Antenna Theory Analysis and Design”, John Wiley and Sons Inc.
3. Collins, R.E., “Antenna and Radio Wave Propagation”, McGraw Hill
4. Gerd Kaiser, “Optical Fiber Communications”, McGraw Hill
5. John Gowar, “Optical Communication Systems”, PHI Publications

MINOR PROJECT

EX 654

Lecture : 4
Tutorial : 0
Practical : 4

Year : III
Part : II

Course Objective:

To carry out a small scale project to develop hands-on experience of working in a project. During the course, the student will also develop knowledge of application development platforms and tools (Java / C# dotnet / Visual C++ / PHP or any platform of current trend). The students will learn working as a team and basic collaboration and project management skills. The students will also learn about formulating project documentations.

1. **Project ideas and proposal guidance** **(4 hours)**
2. **Application development** **(10 hours)**
   - 2.1. Visual programming (object oriented)
     - 2.1.1. Language basics
     - 2.1.2. Frameworks and APIs
   - 2.2. Programming basics and design patterns
3. **Project management, team work and collaboration** **(8 hours)**
   - 3.1. Project management techniques
   - 3.2. Collaborative development environment
4. **Project guidance** **(5 hours)**
5. **Project work** **(30 hours)**
6. **Project documentation guidance** **(3 hours)**

PROJECT MANAGEMENT

CT 701

Lecture : 3
Tutorial : 1
Practical : 0

Year : IV
Part : I

Course Objective:

To make the students able to plan, monitor and control project and project related activities.

1. **Introduction** **(2 hours)**
   Definition of project and project management, Project objectives, classification of projects, project life cycle

2. **Project Management Body of Knowledge** **(4 hours)**
   Understanding of project environment, general management skill, effective and ineffective project managers, essential interpersonal and managerial skills, energized and initiator, communication, influencing, leadership, motivator, negotiation, problem solver, perspective nature, result oriented, global illiteracies, problem solving using problem trees.

3. **Portfolio and Project Management Institutes' (PMI) Framework** **(2 hours)**
   Portfolio, project management office, drivers of project success, inhibitors of project success

4. **Project Management** **(4 hours)**
   Advantages of project management, project management context as per PMI, Characteristics of project life cycles, representative project life cycles, IT Product Development Life Cycle, Product life cycle and project life cycle, System Development methodologies, role and responsibilities of key project members.

5. **Project and Organizational Structure** **(2 hours)**
   System view of project management, functional organization, matrix organization, organizational structure influences on projects.

6. **Project Management Process Groups** **(2 hours)**
   Project management processes, Overlaps of process groups in a phase, mapping of project management process groups to area of knowledge

7. **Project Integration Management** **(4 hours)**
   Develop project charters, develop preliminary project scope statement, Develop project management plan, direct and manage project execution, monitor and control project work, integrated change control, close project, project scope management, Create work break down structure, Scope verification, Scope control

8. **Project Time Management** **(4 hours)**
   Activity definition, decomposition of activities, activity attributes, Activity sequencing, precedence relationship, network diagram, precedence diagram method, arrow diagramming method, Activity resources estimating, determining resource requirements, Schedule development and control, principles of scheduling, milestones, forward pass, backward pass, critical path method, critical chain technique, gantt chart, schedule control.

9. **Project Cost Management** **(4 hours)**
   Cost and project, cost management, Cost estimating, types of cost estimates, estimating process and accuracy, enterprise environmental factors, organizational process assets, cost estimating tools, Cost budgeting, Cost aggregation, deriving budget from activity cost, Cost control process, cost control methods, earned value management, EVM benefits, variance analysis.

10. **Project quality management** **(3 hours)**
    Quality theories, Quality planning, project quality requirements, cost of quality, quality management plan, Quality assurance, quality audit, approach to a quality audit, Quality control process, control chart, pareto charts, testing of IT system, the test life cycle.

11. **Project Communication Management** **(3 hours)**
    Importance of communication management, Communications planning process, communication requirement analysis, organizing and conducting effective meeting, Information distribution process, Performance reporting process, integrated reporting system.

12. **Project Risk Management** **(4 hours)**
    Understanding Risk, project risk, Risk management planning process, risk management plan, risk identification, risk identification techniques, Qualitative risk analysis process, Quantitative risk analysis process, modeling techniques, Risk response planning, resolution of risk, strategies for negative risks or threats, strategies for positive risks or opportunities, Risk monitoring and control process.

13. **Project Procurement Management** **(3 hours)**
    Procurement management process flow, Plan purchases and acquisition process, enterprise environmental factor, organizational process assets, Plan contracting process, standard forms, evaluation criteria, Request seller response process, Select seller process, Contract administration process, Contract closure process.

14. **Developing Custom Processes for IT projects** **(3 hours)**
    Developing IT project management methodology, Moving forward with customized management processes, Certified associate in project management, Project management maturity, Promoting project Excellency through awards and assessment, Certification process flow, Code of ethics, Future trends.

15. **Balanced scorecard and ICT project management** **(1 hour)**

References:

1. M.C. Christensen and R.H. Thayer, "The Project Manager's Guide to Software Engineering's Best Practices", IEEE computer society
2. Clifford F. Gray, Erik W. Larson, "Project Management: The management of Process", McGraw Hill
3. Nick Jenkins, "A Project Management Primer"
4. Trevor L. Young, "A handbook of Project Management", Kogan Page India Pvt. Ltd.
5. M. Gentle, "Balance Supply and Demand", Compuware
6. Kelkar, "IT project Management"

ORGANIZATION AND MANAGEMENT

ME 708

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

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 Organization
   - 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 disadvantages
     - 1.5.2. Functional Organization – Advantages and disadvantages
     - 1.5.3. Line and Staff Organization – Advantages and disadvantages
     - 1.5.4. Committee Organization – Advantages and disadvantages
   - 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 (2 hours)
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
3.2.6.
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.

References:

1. H.B. Maynard, "Industrial Engineering Handbook", Editor-in-Chief, McGraw Hill
2. E.S. Buffa and R.K. Sarin, "Modern Production / Operations Management", 8*th* Edition, Wiley
3. H.J. Arnold and D.C. Feldman, "Organizational Behaviour", 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 Resource", 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", Himalayan 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.

ENERGY, ENVIRONMENT AND SOCIETY

EX 701

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

Course Objective:

To understand the various types of energy sources and their environmental impact. To know the role of engineers for creating better and responsible society.

1. **Technology and Development** **(3 hours)**
   - 1.1. Introduction to technology
   - 1.2. Appropriate technology
   - 1.3. Role of Appropriate technology in Transformation of Society
   - 1.4. Importance of technology transfer
   - 1.5. Impact of technology on Society
2. **Energy Basics** **(4 hours)**
   - 2.1. Importance of Energy in achieving Maslow's hierarchy of Needs, Human Development Index and Energy Consumption
   - 2.2. Current Energy Trends, Demand and Supply of Energy in World and Nepal
   - 2.3. Introduction to Global warming, Clean Development Mechanism, and Sustainability Issues
   - 2.4. Conventional and Non-Conventional/Renewable Energy Sources
   - 2.5. Conventional Energy Sources: Fossil Fuel, Nuclear Energy
3. **Renewable Energy Source** **(14 hours)**
   - 3.1. Solar Energy
     - 3.1.1. Solar radiation
     - 3.1.2. Solar thermal energy
     - 3.1.3. Solar Cell (Photovoltaic Technology)
   - 3.2. Hydropower
     - 3.2.1. Water sources and power
     - 3.2.2. Water turbines and hydorelectric plants
     - 3.2.3. Hydro Power Plant Classification (pico, micro, small, medium, large)
   - 3.3. Wind Energy
     - 3.3.1. Availability of Wind Energy sources
     - 3.3.2. Wind turbines, wind parks and power control
   - 3.4. Geothermal Energy
     - 3.4.1. Sources of Geothermal Energy
     - 3.4.2. Uses of Geothermal Energy
   - 3.5. Bio-mass and Bio-energy
     - 3.5.1. Synthetic fuels from the biomass
     - 3.5.2. Thermo-chemical, physio-chemical and bio-chemical conversion
     - 3.5.3. Bio-fuel cells
   - 3.6. Hydrogen Energy and Fuel Cell
     - 3.6.1. Basics of electrochemistry
     - 3.6.2. Polymer membrane electrolyte (PEM) fuel cells

3.6.3. Solid oxide fuel cells (SOFCs)
3.6.4. Hydrogen production and storage
3.6.5. Coal-fired plants and integrated gassifier fuel cell (IGFC) systems

4. **Environmental Impact of Energy sources** **(4 hours)**

4.1. Emission hazard
4.2. Battery hazard
4.3. Nuclear hazard

5. **Energy Storage** **(3 hours)**

5.1. Forms of energy storage
5.2. Hybrid vehicles
5.3. Smart grid systems
5.4. Batteries
5.5. Super-capacitors

6. **Relevant International/national case studies** **(2 hours)**

References:

1. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", Oxford University Press, Latest Edition
2. Aldo V. da Rose, "Fundamentals of Renewable Energy Processes"

COMMUNICATION SYSTEMS II

EX 702

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

Course Objective:

To introduce the student to the principles and building blocks of digital communication systems and effects of noise on the performance of communication systems.

1. **Introduction** **(3 hours)**
   - 1.1. Digital communication sources, transmitters, transmission channels and receivers
   - 1.2. Noise, distortion and interference. Fundamental limitations due to noise, distortion and interference
   - 1.3. Source coding, coding efficiency, Shannon-Fano and Huffman codes, coding of continuous time signals (A/D conversion)
2. **Sampling Theory** **(4 hours)**
   - 2.1. Nyquist-Kotelnikov sampling theorem for strictly band-limited continuous time signals, time domain and frequency domain analysis, spectrum of sampled signal, reconstruction of sampled signal.
   - 2.2. Ideal, flat-top and natural sampling processes, sampling of band-pass signals, sub-sampling theory
   - 2.3. Practical considerations: non-ideal sampling pulses (aperture effect), non-ideal reconstruction filter and time-limitness of the signal to be sampled (aliasing effects)
3. **Pulse Modulation Systems** **(8 hours)**
   - 3.1. Pulse Amplitude Modulation (PAM), generation, bandwidth requirements, spectrum, reconstruction methods, time division multiplexing
   - 3.2. Pulse position and pulse width modulations, generation, bandwidth requirements
   - 3.3. Pulse code modulation as the result of analog to digital conversion, uniform quantization.
   - 3.4. Quantization noise, signal to quantization noise ratio in uniform quantization
   - 3.5. Non-uniform quantization, improvement in average SQNR for signals with high crest factor, companding techniques (μ and A law companding)
   - 3.6. Time Division Multiplexing with PCM, data rate and bandwidth of a PCM signal The T1 and E1 TDM, PCM telephone hierarchy
   - 3.7. Differential PCM, encoder, decoder
   - 3.8. Delta Modulation, encoder, decoder, noises in DM, SQNR. Comparison between PCM and DM
   - 3.9. Parametric speech coding, vocoders
4. **Baseband Data Communication Systems** **(7 hours)**
   - 4.1. Introduction to information theory, measure of information, entropy, symbol rates and data (bit) rates
   - 4.2. Shannon Hartley Channel capacity theorem. Implications of the theorem and theoretical limits.
   - 4.3. Electrical representation of binary data(line codes), Unipolar NRZ, bipolar NRZ, unipolar RZ, bipolar RZ, Manchester (split phase), differential (binary RZ-alternate mark inversion) codes, properties, comparisons
   - 4.4. Baseband data communication systems, Inter-symbol interference (ISI), pulse shaping (Nyquist, Raised-cosine) and bandwidth considerations
   - 4.5. Correlative coding techniques, duobinary and modified duobinary encoders
   - 4.6. M-ary signaling, comparison with binary signaling
   - 4.7. The eye diagram

5. **Bandpass (modulated) data communication systems** **(4 hours)**

   5.1. Binary digital modulations, ASK, FSK, PSK, DPSK, QPSK, GMPSK, implementation, properties and comparisons

   5.2. M-ary data communication systems, quadrature amplitude modulation systems, four phase PSK systems

   5.3. Demodulation of binary digital modulated signals (coherent and non-coherent)

   5.4. Modems and its applications

6. **Random signals and noise in communication systems** **(7 hours)**

   6.1. Random variables and processes, random signals, statistical and time averaged moments, interpretation of time averaged moments of a random process stationary process, ergodic process, psdf and AC function of a ergodic random process

   6.2. White noise, thermal noise, band-limited white noise, the psdf and AC function of white noise

   6.3. Passage of wide-sense stationary random signals through a LTI

   6.4. Ideal low-pass and RC filtering of white noise, noise equivalent bandwidth of a filter

   6.5. Optimum detection of a pulse in additive white noise, the matched filter. Realization of matched filters (time co-relators). The matched filter for a rectangular pulse, ideal LPF and RC filters as matched filters

   6.6. Performance limitation of baseband data communications due to noise, error probabilities in binary and M-ary baseband data communication.

7. **Noise performance of band-pass(modulated) communication systems** **(8 hours)**

   7.1. Effect of noise in envelop and synchronous demodulation of DSB-FC AM, expression for gain parameter (ratio of output SNR to input SNR), threshold effect in non-linear demodulation of AM

   7.2. Gain parameter for demodulations of DSB-SC and SSB using synchronous demodulators

   7.3. Effect of noise (gain parameter) for non-coherent (limiter-discriminator-envelop detector) demodulation of FM, threshold effect in FM. Use of pre-emphasis and de-emphasis circuits in FM

   7.4. Comparison of AM (DSB-FC, DSB-SC, SSB) and FM (Narrow and wide bands) in terms power efficiency, channel bandwidth and complexity

   7.5. Noise performance of modulated digital systems. Error probabilities for ASK, FSK, PSK, DPSK with coherent and non-coherent demodulation

   7.6. Comparison of modulated digital systems in terms of bandwidth efficiency, power efficiency and complexity

8. **Error control coding techniques** **(4 hours)**

   8.1. Basic principles of error control coding, types, basic definitions (hamming weight), hamming distance, minimum weight), hamming distance and error control capabilities

   8.2. Linear block codes (systematic and non-systematic), generation, capabilities, syndrome calculation

   8.3. Binary cyclic codes (systematic and non-systematic), generation, capabilities, syndrome calculation

   8.4. Convolution codes, implementation, code tree, trellis and decoding algorithms

Practical:

1. Study of line codes
2. Study of PCM
3. Study of DPCM
4. Study of DM
5. Study of ASK, FSK and PSK
6. Study of eye diagram

References:

1. S. Haykin, Analog and Digital communication systems
2. Leon Couch, Digital and analog communication systems
3. B.P. Lathi, Analog and Digital communication systems
4. J. Proakis, Analog and Digital communication systems
5. D. Sharma, Course manual “Communication Systems II”

TELECOMMUNICATION

EX 703

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

Course Objective:

To continue the study of modern communication systems, their characteristics and design.

1. **Telecommunication Networks:** **(4 hours)**
   - 1.1. Evolution of telecommunications
   - 1.2. Classification of switching system
2. **Transmission Media** **(4 hours)**
   - 2.1. Transmission media characteristics
   - 2.2. Transmission lines
   - 2.3. Hybrid Transformer and circuits
   - 2.4. Signal and noise measurement
3. **Signal Multiplexing** **(4 hours)**
   - 3.1. Frequency division multiplex, Wavelength division multiplex
   - 3.2. Space division multiplex
   - 3.3. Time division multiplex; North American TDM system, The European E1
4. **Signaling System** **(4 hours)**
   - 4.1. Classification of Signaling Systems: Channel Associated Signaling and Common Channel Signaling
   - 4.2. ITU Common Channel Signalling System # 7 (SS7)
5. **Telephone Traffic** **(9 hours)**
   - 5.1. Network Traffic load and parameters
   - 5.2. Loss System: Grade of service(GoS) and Blocking probability
   - 5.3. Delay System: Queuing theory
   - 5.4. Routing
   - 5.5. Numbering Plans, Charging Plans
6. **Telecommunication Regulations** **(2 hours)**
   - 6.1. Purpose of ITU (International Telecommunications Union)
   - 6.2. NTA (Nepal Telecommunications Authority)
7. **Data Communication** **(10 hours)**
   - 7.1. Switching Techniques in data communication
   - 7.2. IP Switching
   - 7.3. Soft Switching
   - 7.4. Routing and Flow control
   - 7.5. ISDN
   - 7.6. DSL

Practical:

Six laboratory to illustrate course principles

References:

1. John C. Bellamy, “Digital Telephony”, John Wiley & Sons. Inc
2. Roger L. Freeman, “Telecommunication System Engineering”, John Wiley & Sons, Inc
3. A.S. Tanenbaum, “ Computer Networks”, Prentice Hall
4. Thiagarajan Vishwanathan, “Telecommunication Switching Systems and Networks”

FILTER DESIGN

EX 704

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

Course Objective:

To familiarize student with the concept of analog filter design: passive filters, RC active filters and switched-capacitor filters

1. **Introduction** **(4 hours)**
   - 1.1. Filter and its importance in communication
   - 1.2. Kinds of filters in terms of frequency response
   - 1.3. Ideal response and response of practical filters
   - 1.4. Normalization and de-normalization in filter design
   - 1.5. Impedance (magnitude) scaling and frequency scaling
   - 1.6. History of filter design and available filter technologies
2. **Approximation Methods** **(8 hours)**
   - 2.1. Approximation and its importance in filter design
   - 2.2. Lowpass approximations methods
   - 2.3. Butterworth response, Butterworth pole locations, Butterworth filter design from specifications
   - 2.4. Chebyshev and inverse Chebyshev characteristics, network functions and pole zero locations
   - 2.5. Characteristics of Cauer (elliptic) response
   - 2.6. Bessel-Thomson approximation of constant delay
   - 2.7. Delay Equalization
3. **Properties and Synthesis of Passive Networks** **(7 hours)**
   - 3.1. One-port passive circuits
     - 3.1.1. Properties of passive circuits, positive real functions
     - 3.1.2. Properties of lossless circuits
     - 3.1.3. Synthesis of LC one-port circuits, Foster and Cauer circuits
     - 3.1.4. Properties and synthesis of RC one-port circuits
   - 3.2. Two-port passive circuits
     - 3.2.1. Properties of passive two-port circuits, residue condition, transmission zeros
     - 3.2.2. Synthesis of two-port LC and RC ladder circuits based on zero-shifting by partial pole removal
4. **Design of Resistively-terminated lossless filter** **(4 hours)**
   - 4.1. Properties of resistively-terminated lossless ladder circuits, transmission and reflection coefficients
   - 4.2. Synthesis of LC ladder circuits to realize all-pole lowpass functions
   - 4.3. Synthesis of LC ladder circuits to realize functions with finite transmission zeros
5. **Active Filter** **(7 hours)**
   - 5.1. Fundamentals of Active Filter Circuits
     - 5.1.1. Active filter and passive filter
     - 5.1.2. Ideal and real operational amplifiers, gain-bandwidth product
     - 5.1.3. Active building blocks: amplifiers, summers, integrator

5.1.4. First order passive sections and active sections using inverting and non-inverting op-amp configuration

5.2. Second order active sections (biquads)

5.2.1. Tow-Thomas biquad circuit, design of active filter using Tow-Thomas biquad

5.2.2. Sallen-Key biquad circuit and Multiple-feedback biquad (MFB) circuit

5.2.3. Gain reduction and gain enhancement

5.2.4. RC-CR transformation

6. **Sensitivity** **(3 hours)**

6.1. Sensitivity and importance of sensitivity analysis

6.2. Definition of single parameter sensitivity

6.3. Centre frequency and Q-factor sensitivity

6.4. Sensitivity properties of biquads

6.5. Sensitivity of passive circuits

7. **Design of High-Order Active Filters** **(6 hours)**

7.1. Cascade of biquads

7.1.1. Sequencing of filter blocks, centre frequency, Q-factor and gain

7.2. Active simulation of passive filters

7.2.1. Ladder design with simulated inductors

7.2.2. Ladder design with frequency-dependent negative resistors (FDNR)

7.2.3. Leapfrog simulation of ladders

8. **Switched-Capacitor Filters** **(4 hours)**

8.1. The MOS switch and switched capacitor

8.2. Simulation of resistor by switched capacitor

8.3. Switched-capacitor circuits for analog operations: addition, subtraction, multiplication and integration

8.4. First-order and second-order switched-capacitor circuits

Practical:

The laboratory experiments consist computer simulation as well hardware realization for analysis and design of passive and active filters which include.

- Analysis and design of passive and active filter circuits using computer simulation
- Design of active filters using biquad circuits
- Design of higher order active filters using inductor simulation
- Design of higher order active filters using functional simulation

References:

1. Rolf Schaunmann, Mac E. Van Valkenburg, “Design of Analog Filters”
2. Wai-Kai Chen, “ Passive and Active Filters (Theory and Implementations)”
3. Kendal L. Su., “Analog Filter”

ELECTIVE I

BIOMEDICAL INSTRUMENTATION

EX 725 03

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

Course Objectives:

To provide specific engineering and instrumentation methods and principles to acquire basic knowledge of design, its 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. **Bioelectrical 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. Electroencephalography 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. Application 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 Principles of generation of X-rays and its medical properties
5.2.1.2 Functional X-ray Machine
5.2.1.3 Biological Effects of X-rays
5.2.2. Ultrasonography Imaging System
5.2.3. Computer Tomography (CT-Scan) System
5.2.4. Magnetic Resonance Imaging System (MRI)
5.2.5. Nuclear Medicine Machine

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

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

8. **Electrical Safety of Medical Equipment** **(4 hours)**
8.1. Physiological Effects of Electricity
8.2. Leakage Currents and Methods of Accident Prevention
8.3. Micro shocks and Macro shocks hazards
8.4. Electrical Safety Codes and Standards
8.5. Special Safety Measures for Electrical Susceptible Patients
8.6. Power Distribution and Protection System of the Hospital

Practicals:

1. Three practical exercises based on availability of the portable medical and clinical based equipment
2. Field Visit to Medical Institution
3. Field Visit Report and Viva Voce.

References:

1. Leslie Cromwell, et al., "Biomedical Instrumentation and Measurements", Prentice Hall, India
2. R.S. Khandpur, "A Hand Book of Biomedical Instrumentation", Tata McGraw Hill.

ENGINEERING PROFESSIONAL PRACTICE

CE 752

Lecture : 2
Tutorial : 0
Practical : 0

Year : IV
Part : II

Course Objectives:

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 Practices and 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
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

WIRELESS COMMUNICATIONS

EX 751

Lecture : 3
Tutorial : 0
Practical : 0

Year : IV
Part : II

Course Objectives:

To introduce the student to the principles and building blocks of wireless communications.

1. **Introduction** **(2 hours)**
   - 1.1. Evolution of Wireless (mobile) communications, worldwide market, examples
   - 1.2. Comparison of available wireless systems, trends
   - 1.3. Trends in cellular radio (2G, 2.5G, 3G, beyond 3G) and personal wire wireless communication systems.
2. **Cellular mobile communication concept** **(4 hours)**
   - 2.1. Frequency re-use and channel assignment strategies
   - 2.2. Handoff strategies, types, priorities, practical considerations
   - 2.3. Interference and system capacity, co-channel and adjacent channel interference, power control measures
   - 2.4. Grade of Service, definition, standards
   - 2.5. Coverage and capacity enhancement in cellular network, cell splitting, sectoring, repeaters, microcells
3. **Radio wave propagation in mobile network environment** **(12 hours)**
   - 3.1. Review Free space propagation model, radiated power and electric field
   - 3.2. Review Propagation mechanisms (large-scale path loss) – Reflection, ground reflection, diffraction and scattering
   - 3.3. Practical link budget design using path loss models
   - 3.4. Outdoor propagation models (Longley-Rice, Okumura, Hata, Walfisch and Bertoni, microcell)
   - 3.5. Indoor propagation models (partition losses, long-distance path loss, multiple breakpoint, attenuation factor)
   - 3.6. Small scale fading and multipath (factors, Doppler shift), Impusle response model of multipath channel, multipath measurements, parameters of mobile multipath channel (time dispersion, coherence bandwidth, Doppler spread and coherence time)
   - 3.7. Types of small-scale fading (flat, frequency selective, fast, slow), Rayleigh and Ricean fading distribution
4. **Modulation-Demodulation methods in mobile communications** **(4 hours)**
   - 4.1. Review of amplitude (DSB, SSB, VSB) and angle (frequency, phase) modulations and demodulation techniques
   - 4.2. Review of line coding, digital linear (BPSK, DPSK, QPSKs) and constant envelop (BFSK, MSK, GMSK) modulation and demodulation techniques
   - 4.3. M-ary (MPSK, MFSK, QAM and OFDM) modulation and demodulation techniques
   - 4.4. Spread spectrum modulation techniques, PN sequences, direct sequence and frequency hopped spread spectrums
   - 4.5. Performance comparison of modulations techniques in various fading channels
5. **Equalization and diversity techniques** **(4 hours)**
   - 5.1. Basics of equalization. Equalization in communications receivers, linear equalizers

5.2. Non-linear equalization, decision feedback and maximum likelihood sequence estimation equalizations

5.3. Adaptive equalization algorithms, zero forcing, least mean square, recursive least square algorithms, fractionally spaced equalizers

5.4. Diversity methods, advantages of diversity, basic definitions

5.5. Space diversity, reception methods (selection, feedback, maximum ratio and equal gain diversity)

5.6. Polarization, frequency and time diversity

5.7. RAKE receivers and interleaving

6. **Speech and channel coding fundamentals** **(4 hours)**

6.1. Characteristics of speech signal,s frequency domain coding of speech (sub-band and adaptive transform coding)

6.2. Vocoders (channel, formant, cepstrum and voice-excited), Linear predictive coders (multipulse, code and residual excited LPCs), Codec for GSM mobile standard

6.3. Review of block codes, Hamming, Hadamard, Golay, Cyclic, Bosh-Chaudhary-Hocquenghgem(BCH), Reed-Solomon (RS) codes

6.4. Convolutional codes, encoders, coding gain, decoding algorithms (Viterbi and others)

6.5. Trellis Code Modulation (TCM), Turbo codes

7. **Multiple Access in Wireless communications** **(9 hours)**

7.1. Frequency Division Multiple Access (FDMA), principles and applications

7.2. Time Division Multiple Access (TDMA), principles and applications

7.3. Spread Spectrum Multiple Access, Frequency Hopped Multiple Access, Code Division Multiple Access, Hybrid Spread Spectrum Multiple Access Techniques

7.4. Space Division Multiple Access

7.5. Standards for Wireless Local Area Networks

8. **Wireless systems and standards** **(6 hours)**

8.1. Evolution of wireless telephone systems: AMPS, PHS, DECT, CT2, IS-94, PACS, IS-95, IS-136, IS-54 etc.

8.2. Global system for Mobile (GSM): Services and features, system architecture, radio sub-system, channel types (traffic and control), frame structure, signal processing, example of a GSM call

8.3. CDMA standards: Frequency and channel specifications, Forward and Reverse CDMA channels

8.4. WiFi, WiMax, UMB, UMTS, CDMA-EVDO, LTE, and recent trends

8.5. Regulatory issues (spectrum allocation, spectrum pricing, licensing, tariff regulation and interconnection issues)

Practicals:

1. Case study and field visit
2. Visit to mobile service operator, network service provider, internet service provider

References:

1. K. Feher, Wireless Digital Communications
2. T. Rappaport, Wireless Communications
3. J. Schiller, Mobile Communications
4. Leon Couch, Digital and analog communication systems
5. B.P. Lathi, Analog and Digital Communication systems
6. J. Proakis, Digital communication systems
7. D. Sharma, Course manual “Communication Systems II”

RF AND MICROWAVE ENGINEERING

EX 752

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

Course Objectives:

To understand the fundamentals of Radio Frequency (RF) and Microwave (M/W) theory and applications, design and analysis practices, and measurement techniques.

1. **Introduction** **(3 hours)**
   - 1.1. Standard Frequency bands
   - 1.2. Behaviour of circuits at conventional and RF/Microwave bands
   - 1.3. Microwave applications
2. **RF and M/W Transmission Lines** **(6 hours)**
   - 2.1. Types of transmission lines
   - 2.2. Transmission line theory
   - 2.3. Smith Chart analysis
   - 2.4. Impedance transformations and matching analysis
3. **RF and M/W Network Theory and Analysis** **(4 hours)**
   - 3.1. Scattering matrix and its properties
   - 3.2. S-parameter derivation and analysis
4. **RF/Microwave Components and Devices** **(8 hours)**
   - 4.1. Coupling probes
   - 4.2. Coupling loops
   - 4.3. Waveguide
   - 4.4. Termination, E-plane Tee, H-plane Tee, Magic Tee
   - 4.5. Phase-Shifter
   - 4.6. Attenuators
   - 4.7. Directional coupler
   - 4.8. Gunn diode
   - 4.9. Microwave transistor
   - 4.10. MASER
   - 4.11. Resonator and circulators
5. **Microwave Generators** **(5 hours)**
   - 5.1. Transit-time effect
   - 5.2. Limitations of conventional tubes
   - 5.3. Two-cavity and multi-cavity klystrons
   - 5.4. Reflex klystron
   - 5.5. TWT and magnetrons
6. **RF Design Practices** **(10 hours)**
   - 6.1. RF Low pass filter
     - 6.1.1. Insertion loss

6.1.2. Frequency scaling
6.1.3. Microstrip implementation

6.2. RF Amplifier
6.2.1. Amplifier theory
6.2.2. Design and real world consideration

6.3. Oscillator and mixer
6.3.1. Oscillator and super mixing theory
6.3.2. Design and real world consideration

7. **Microwave Antennas and Propagation** **(3 hours)**

7.1. Antenna types
7.2. Propagation characteristics of microwave antennas
7.3. RF and M/W radiation, safety practices and standards

8. **RF/Microwave Measurements** **(6 hours)**

8.1. Power measurement
8.2. Calorimeter method
8.3. Bolometer bridge method
8.4. Thermocouples
8.5. Impedance measurement
8.6. RF frequency measurement and spectrum analysis
8.7. Measurement of unknown loads
8.8. Measurement of reflection coefficient
8.9. VSWR and Noise

Practicals:

1. Illustration of Smith Chart and load analysis
2. Introduction to RF and M/W signal and circuits, measuring techniques, instrumentation, and practices
3. Designing and analysis of simple strip-line and two-port circuits using network and spectrum analysers
4. Software-based (ADS-like) RF signal & circuit simulation practices

References:

1. Herbert J. Reich and et. al., Van Nostard Reinhold, "Microwave Principles"
2. K.C. Gupta, "Microwave Electronics", Tata McGraw Hill
3. A.K. Gautam, "Microwave Engineering", S.K. Kataria & Sons
4. D.C. Agrawal, "Microwave Techniques", Tata McGraw Hill
5. R. Chatterjee, "Elements of Microwave Engineering", Tata McGraw Hill
6. Samuel Y. Liao, " Microwave Devices & Circuits", PHI
7. David M. Pozer, "Microwave Engineering", John Wiley & Sons.
8. Newington "ARRL UHF/Microwave Experimenter's Manual", CT
9. W.H. Hayt, "Engineering Electromagnetics", McGraw Hill Book Company
10. A. Das, "Microwave Engineering", Tata McGraw Hill
11. William Sinnema, "Electronic Transmission Technology: Lines, Waves, and Antennas", Prentice Hall.

DIGITAL SIGNAL PROCESSING

EX 753

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

Course Objectives:

To introduce digital signal processing techniques and applications, and to design and implement IIR and FIR digital filter.

1. **Introduction** **(4 hours)**
   - 1.1. Basic elements of Digital Signal Processing
   - 1.2. Need of Digital Signal Processing over Analog Signal Processing
   - 1.3. A/D and D/A conversion
   - 1.4. Sampling continuous signals and spectral properties of sampled signals
2. **Discrete-time Signals and System** **(6 hours)**
   - 2.1. Elementary discrete-time signals
   - 2.2. Linearity, Shift invariance, Causality of discrete systems
   - 2.3. Recursive and Non-recursive discrete-time systems
   - 2.4. Convolution sum and impulse response
   - 2.5. Linear Time-invariant systems characterized by constant coefficient difference equations
   - 2.6. Stability of LTI systems, Implementation of LTI system.
3. **Z-Transform** **(6 hours)**
   - 3.1. Definition of the z-transform
   - 3.2. One-side and two-side transforms, ROC, Left-side, Right-sided and two-sided sequences, Region of convergence, Relationship to causality
   - 3.3. Inverse z-transform-by long division, by partial fraction expansion
   - 3.4. Z-transform properties– dealay advance, Convolution, Parseval's theorem
   - 3.5. Z-transform function H(z)-transient and steady state sinusoidal response, pole-zero relationship stability
4. **Discrete Fourier Transform** **(7 hours)**
   - 4.1. Definition and applications, Frequency domain sampling and for reconstruction, Forward and Reverse transforms, Relationship of the DFT to other transforms
   - 4.2. Properties of Discrete Fourier Transform: Periodicity, Linearity, and Symmetry Properties, Multiplication of two DFTs and Circular Convolution, Time reversal, Circular time shift and Multiplication of two sequences circular frequency shift, Circular correlation and Parseval's Theorem
   - 4.3. Efficient computation of the DFT: Algorithms, applications, applications of FFT algorithms
5. **Implementation of Discrete-time System** **(8 hours)**
   - 5.1. Structures of FIR and IIR, Direct Form, Cascaded and parallel form, Lattice for FIR
   - 5.2. Conversion between direct form and lattice and vice versa, Lattice and lattice-ladder for IIR
   - 5.3. Frequency response
   - 5.4. Digital filters, finite precision implementations of discrete filters
   - 5.5. Representation of Numbers: Fixed point and floating binary point, Effect of Rounding and truncation, Limit cycle oscillations effect

5.6. Quantization of filter coefficients and effects on location of poles, and zeros, poles perturbation, Overflow and underflow error, Scaling to prevent overflow and underflow

6. **IIR Filter Design** **(5 hours)**

6.1. IIR Filter Design: IIR Filter design by classical filter design using low pass approximations Butterworth, Chebychev, Inverse Chebyshev, Elliptic and Bessel-Thompson filters

6.2. IIR filter design by Impulse-invariant method, Bilinear Transformation Method, Mathched z-transform method

6.3. IIR Lowpass discrete filter design using bilinear transformation

6.4. Spectral transformations, highpass, bandpass and Notch filters

7. **FIR Filter Design** **(5 hours)**

7.1. FIR filter design by Fourier approximation

7.2. Gibbs phenomena in FIR filter design, Design of Linear Phase FIR filters using window function, Applications of window functions to frequency response smoothing

7.3. Window functions, Rectangular, Hamming, Blackman, and Kaiser windows

7.4. Design of linear phase FIR filter by the frequency sampling method

7.5. FIR filter design using the Remez exchange algorithm

7.6. Design of optimum equiripple linear-phase FIR filters

8. **Digital Filter Implementation** **(4 hours)**

8.1. Implementations using special purpose DSP processor

8.2. Bit-serial arithmetic, pipelined implementations

8.3. Distributed arithmetic implementations.

Practical:

1. Study the behavior of a simple digital notch filter
2. Response of a recursive digital filter
3. Scaling, dynamic range and noise behaviour of a recursive digital filter, observation of nonlinear finite precision effects
4. Response of a non-recursive digital filter, Implementation in Impulsive Invariant and Bilinear Transformation
5. Band pass filters implemented using cascade second order sections and wave or ladder filters, Comparison of implementations
6. Design of FIR filter using window method, Comparison of FIR filter for different windowing method.

References:

1. J.G. Proakis and D.G. Manolakis, “Digital Signal Processing”, Prentice Hall
2. A.V. Oppenheim, “ Discrete-Time Signal Processing”, Prentice Hall
3. S.K. Mitra, “Digital Signal Processing, A computer- based Approach”, McGraw Hill

PROJECT II

EX 755

Lecture : 0
Tutorial : 0
Practical : 6

Year : IV
Part : II

Course Objectives:

The objective of this project work is to develop hands-on experience of working in a project. During the course, students have to design and complete a functional project which should require integration of various course concepts. Students will develop various skill related to project management like team work, resource management, documentation and time management.

1. Group formation (Not exceeding 4 persons per group)
2. Project concept development (software engineering concept must include for computer engineering and hardware / software elements include electronics and communication engineering)
3. Proposal preparation (proposal content: title, objective, scope of project, methodology, expected outcome, hardware/software element, list of equipment, historical background and reviewed should be clearly reflected)
4. Project Documentation (follow the project documentation guideline)

Evaluation Scheme:

Project (Part B) : Internal and Final Evaluation is done on the basis of Regularity of the work, Completeness of project, Documentation, Progress Presentation and Final Presentation.

ELECTIVE II

OPTICAL FIBER COMMUNICATION SYSTEM

EX 765 01

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

Course Objectives:

To introduce the concept of optical fiber communication.

1. **Introduction to Optical Fiber Communication** **(2 hours)**
   - 1.1. Evolution of optical fiber communication
   - 1.2. Optical fiber communication system
   - 1.3. Advantages of optical fiber communication
   - 1.4. Applications of optical fiber communication
2. **Light Transmission in Optical Fiber** **(2 hours)**
   - 2.1. Introduction of optical fiber structure
   - 2.2. Total internal reflection
   - 2.3. Acceptance angle
   - 2.4. Numerical aperture
   - 2.5. Meridional and skew rays in optical wave guide
3. **Electromagnetic Theory for Optical Propagation** **(2 hours)**
   - 3.1. Review of Maxwell's equation
   - 3.2. The wave equation for slab waveguide
   - 3.3. Wave equation for cylindrical waveguide
4. **Mode Propagation in Optical Waveguide** **(3 hours)**
   - 4.1. Modes in a planar optical guide
   - 4.2. Phase and group velocity
   - 4.3. Evanescent field
   - 4.4. Modes in cylindrical optical waveguide
   - 4.5. Mode coupling
5. **Optical Fibers** **(5 hours)**
   - 5.1. Introduction and types
   - 5.2. Modes in multimode fibers: step index and graded index
   - 5.3. Modes in step index and graded index single mode fiber
   - 5.4. Cutoff wavelength, mode-field diameter and spot size
   - 5.5. Transmission properties of optical fiber
   - 5.6. Fiber attenuation
   - 5.7. Fiber bend loss
   - 5.8. Fiber dispersion
6. **Optical Source for Optical Fiber Communication** **(4 hours)**

6.1. Introduction, types and requirements
6.2. Light emitting diode (LED)
6.3. Laser diode (LD)
6.4. Properties of optical sources

7. **Optical Detectors** **(4 hours)**

7.1. Introduction
7.2. Semiconductor photodiode
7.3. PIN photodiode
7.4. Avalanche photodiode
7.5. Comparision of different photodiodes
7.6. Properties of photodiodes

8. **Optical Modulation** **(3 hours)**

8.1. Introduction and types
8.2. Analog modulation
8.3. Digital modulation

9. **Connectors and Couplers** **(6 hours)**

9.1. Introduction to optical connections
9.2. Optical fiber connectors: Principle and types
9.3. Characteristic losses in connectors
9.4. Optical fiber splices: Principle and types
9.5. Comparison of different types of splices
9.6. Comparison between splice and connector
9.7. Introduction to optical couplers and their types
9.8. Fused biconical taper (bus) coupler
9.9. Fused star coupler
9.10. Characteristic properties of optical couplers
9.11. Fully bidirectional four port optical coupler
9.12. Asymmetrical bidirectional three port optical coupler (ABC)
9.13. Comparison between four port full bidirectional coupler made with traditional three port coupler and ABC

10. **Fiber Amplifiers and Integrated Optics** **(4 hours)**

10.1. Introduction
10.2. Rare earth doped fiber amplifier
10.3. Raman and Brillouin fiber amplifier
10.4. Integrated optics
10.5. Optical Switch

11. **Optical Fiber Network** **(10 hours)**

11.1. Introduction to analog and digital fiber optic transmission
11.2. Optical fiber local area networks
11.3. Design of passive digital fiber optic networks

Practicals:

1. Familiarization with optical fiber laboratory, safety and precaution
2. Demonstration of the concept of light propagation in optical waveguide with the help of polymer rod and water spout
3. Determination of fiber numerical aperture and fiber attenuation
4. Plotting a power-current characteristic for LED
5. Determination of different optical fiber connector losses. Determination of coupling efficiency/loss from source to fiber, fiber to fiber, and fiber to photodetector
6. Digital optical transmission

References:

1. John M. Senior, "Optical Fiber Communications – Principles and Practice", Prentice Hall
2. William B. Jones Jr., "Introduction to Optical Fiber Communication Systems", Holt, Rinheart and Winston,Inc.
3. Gerd Keiser, "Optical Fiber Communication", Second Edition, McGraw Hill Inc.
4. Roshan Raj Karmacharya, "Passive Optical Fiber LAN Design", M.Sc. Thesis, University of Calgary, Canada.

ELECTIVE III

REMOTE SENSING

CT 785 01

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

Course Objectives:

To present an introduction to technological and scientific aspects of remote sensiong (RS) of the Earth and its atmosphere.

1. **Introduction** **(7 hours)**
   - 1.1. General concepts of remote sensing
   - 1.2. History and basics of remote sensing of the Earth and its atmosphere
   - 1.3. Classifications
2. **Physical Principles of Remote Sensing** **(10 hours)**
   - 2.1. Basic quantities
   - 2.2. Electromagnetic principles
   - 2.3. Emission/radiation theory
   - 2.4. Radar backscattering theory
3. **Remote Sensing Technology** **(12 hours)**
   - 3.1. Passive remote sensing
     - 3.1.1. Visible and infrared techniques
     - 3.1.2. Microwave radiometry
   - 3.2. Active remote sensing
     - 3.2.1. Radar remote sensing
     - 3.2.2. Lider remote sensing
   - 3.3. Basics of satellite remote sensing, and ground truths
4. **Applications** **(10 hours)**
   - 4.1. Earth and its atmosphere
     - 4.1.1. Precipitation, winds, clouds and aerosols, temperature and trace gases
     - 4.1.2. Vegetation, forestry, ecology
     - 4.1.3. Urban and land use
     - 4.1.4. Water planet: meteorological, oceanographic and hydrologic RS
     - 4.1.5. Geological: Landforms, structure, topography, mine and resource exploration
     - 4.1.6. Geographic information system (GIS): GIS approach to decision making Remote sensing into the 21st century: Outlook for the future RS
5. **Remote Sensing Data** **(6 hours)**
   - 5.1. Processing and classification of remote sensing data
   - 5.2. Data formats
   - 5.3. Retrieval algorithms
   - 5.4. Analysis and image interpretations

Practical:

1. Familiarization to remote sensing data available from department's capacity (via web and/or possible collaborations with national/international remote sensing agencies/institutions)
2. Data visualization/graphics
3. Data processing and pattern recognition
4. Computer simulations
5. Technical Writing

References:

1. Campbell, J.B., "Introduction to Remote sensing", The Guilford Press
2. Drury, S.A., "Image Interpretation in Geology", Chapman & Hall, 243 pp.
3. Drury, S.A., "Images of the Earth: A Guide to Remote Sensing", Oxford press 212pp.
4. Kuehn, F.(Editor), "Introductory Remote Sensing Principles and Concepts", Routledge, 215pp
5. Lillesand, T.M. and Kiefer, R. W., Remote Sensing and Image Interpretation", J. Wiley & Sons, 720pp.
6. Sabins, Jr., F.F., "Remote Sensing: Principles and Interpretation", W.H. Freeman & Co., 496pp
7. Siegal, B.S. and Gillespie, A.R., "Remote Sensing in Geology", J. Wiley and Sons (especially Chapter 1 through 11)
8. Swain, P.H. and Davis, S.M., "Remote sensing-the Quantitative Approach", McGraw Hill
9. Chen, H.S., "Space Remote Sensing System: An Introduction", Academic press, Orlando
10. Jensen J.R., "Remote sensing of the environment: An Earth resource perspective academic Press Orlando
11. Ulaby, F.T., R.K. Moore, and A. K. Fung, "Microwave Remote Sensing Active and Passive
12. Periodicals devoted largely to remote sensing methods and applications.
13. IEEE Transactions on Geoscience and Report Sensing
14. IEEE Geoscience and Remote Sensing letters, International Journal of Remote Sensing
15. Photogrammetric Engineering and Remote Sensing
16. Remote Sensing of the Environments
17. Canadian Journal of Remote Sensing
18. Journal of Remote Sensing Society of Japan.