

DEPARTMENT OF ELECTRICAL AND INSTRUMENTATION ENGINEERING							
FOUR YEAR DEGREE PROGRAM IN INSTRUMENTATION AND CONTROL ENGINEERING							
Semester I (20)							
L.No	Sub Code	Subject Name	L	T	P	Hrs. Credits	
1	ME-400	Engineering Mathematics	4	2	0	6 4	
2	CI-401	Applied Chemistry	3	0	2	6 3	
3	CE-411	Communication Skills/ Professional Communication	2	0	2	4 2	
4	WI-411	Workshop Technology & Practice	2	0	6	6 4	
5	ME-411	Engineering Drawing	0	0	4	4 2	
6	CI-411	Elements of Computer Programming	3	0	2	5 3	
7	IS-411	Instrumented Science	3	0	0	3 3	
		Total	17	0	14	24	
Semester II A (20)							
L.No	Sub Code	Subject Name	L	T	P	Hrs. Credits	
1	PH-401	Applied Physics	3	0	2	5 4	
2	ME-402	Economic Studies	2	0	0	2 2	
3	EC-411	Elements of Electronics Engineering	3	0	2	5 4	
4	WI-411	Instrumentation Workshop	2	0	4	6 4	
5	EE-411	Elements of Electrical Engineering	3	0	2	5 4	
6	EE-402	Electrical and Electronic Measurements	3	0	2	5 4	
7	ME-412	Fundamentals of Mechanical Engineering	2	0	0	2 2	
		Total	19	0	10	24	
Semester II B (20-Practical Training)							
CI-401	Two weeks Practical Training, during summer vacations					5	20 5/0/1
Semester III (20)							
L.No	Sub Code	Subject Name	L	T	P	Hrs. Credits	
1	AAA-511	Higher Engineering Mathematics	3	0	0	3 3	
2	PH-511	Modern Physics and Professional Ethics	2	0	0	2 2	
3	EE-511	Digital Electronics	3	0	2	5 4	
4	WI-511	Linear Integrated Circuits	2	0	1	3 4	
5	IS-511	Signals and Systems	3	2	0	5 6	
6	IS-512	Electrical Machines	3	2	1	6 5	
7	IS-513	Circuit Theory	2	0	0	2 2	
		Total	19	4	4	25	
Semester IV (20)							
L.No	Sub Code	Subject Name	L	T	P	Hrs. Credits	
1	CI-511	Industrial Chemistry	3	0	2	5 4	
2	ME-511	Material Science	3	0	2	5 4	
3	EE-511	Process Dynamics and Control	3	0	2	5 4	
4	EE-502	Control System	3	2	2	7 5	
5	IS-511	Industrial Instrumentation I	2	0	2	4 4	
6	IS-512	Seminar	0	0	2	2 1	
		Total	14	2	10	22	
Semester V (20)							
L.No	Sub Code	Subject Name	L	T	P	Hrs. Credits	
1	PH-511	Engineering Economics and Socio-Environment	2	0	0	2 2	
2	AM-511	Statistical Analysis	2	0	2	4 4	
3	IS-511	Microprocessor and Applications	3	0	2	5 4	
4	IS-511	Simulation LAB	3	0	4	4 4	
5	IS-511	Analytical Instrumentation	2	0	2	4 4	
6	IS-514	Non Linear and Adaptive Control System	2	0	0	2 2	
7	IS-515	Industrial Instrumentation II	2	0	2	4 4	
		Total	14	0	11	24	
Semester VI (20)							
L.No	Sub Code	Subject Name	L	T	P	Hrs. Credits	
1	IS-401 (A-1)	Seminar	3	0	0	3 1	
2	IS-402	Optimal and Optimization Techniques	2	2	0	4 4	
3	IS-403	Data Communication and Networking	2	0	0	2 2	
4	IS-404	Soft Acquisition System	2	0	2	4 4	
5	IS-515	Remedial Instrumentation	2	0	2	4 4	
6	IS-414	Computer Control of Process	2	0	0	2 2	
7	IS-517	Microcontroller and Embedded Systems	2	0	2	4 4	
		Total	11	2	4	20	

2.

20/4/14

Semester VI A (20 Industrial Training)							
TP-701	Industrial Training, along summer vacations (4 weeks)					11	00
Semester VI B (24)							
S.No	Sub Code	Subject Name	L	T	P	Prs.	Credits
1	18-711 (A-1)	Electronics	3	0	0	3	3
2	18-712	Introduction to Soft Computing	3	0	0	3	3
3	18-713	VLSI Implementation	3	0	0	4	3
4	18-714	Digital Signal Processing	3	3	2	7	3
5	18-715	Project	8	0	4	4	3
6	18-716	Process Plant Instrumentation	3	0	0	3	3
7	TP-701	Industrial Training / Evaluation / Job				0	0
			Total	24	3	24	21
Semester VI C (20)							
S.No	Sub Code	Subject Name	L	T	P	Prs.	Credits
1	18-711	Technology Construction & Soft Skills	3	0	0	4	0
2	18-711 (A-2)	Electronics	3	0	0	3	3
3	18-716A.1	AI-Elective	3	0	0	3	3
4	18-717	Advance Sensors	3	0	0	3	3
5	18-718	Project	0	0	8	8	4
6	18-719	Power Electronics and Drive	3	0	0	3	4
			Total	14	0	24	17
			Credits Total				100

Elective I

- 18-621A Nuclear Instrumentation
- 18-621B Robotics
- 18-621C Optimal Control System
- 18-621D Environmental Instrumentation
- 18-621E Image Processing

Elective II

- 18-713A Machine Vision
- 18-713B Renewable Energy Resources
- 18-713C Reliability Engineering
- 18-713D Building Automation
- 18-713E Modeling and Simulation

Elective III

- 18-714A Switchgear and Protection
- 18-714B Industrial Safety Engineering
- 18-714C Advance Digital Signal Processing
- 18-714D Introduction to MEMS
- 18-714E Biomedical Signal Processing

[Handwritten mark]

[Handwritten signature]
28/4/14

Title of the course : **Engineering Mathematics**

Subject Code : **AM - 411**

Weekly load : 4 Hrs.

LTP4-0-0

Credit : 4 (Lecture 4; Tutorial 0; Practical 0)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Matrices	Elementary transformations. Row reduced Echelon forms. Rank of a matrix. Normal form. Linearly dependent and independent vectors. System of linear equations. Linear transformations. Eigen values and eigenvectors. Properties of eigenvalues. Reduction to diagonal form. Verification of Cayley-Hamilton Theorem and its use for finding inverse of a matrix. Idempotent matrices. Complex matrices.	15
	2. Solid geometry	Cartesian co-ordinate system. Distance formula. Section formulae. Direction ratios and direction cosines. Equation of a plane. Equations of a straight line. Condition for a line to lie in a plane. Coplanar lines. Shortest distance between two lines. Intersection of three planes. Equation of a sphere. Tangent plane to a sphere. Equations of a cone and a cylinder.	15
Unit-2	3. Differential equation	Solution of differential equation by variable separable method, homogeneous differential equation of first order and their solution, Exact differential equation.	14
	4. Linear differential equations	Solution of linear differential equation of first order. Reducible to linear differential equation. Higher order linear differential equation with constant coefficients, complementary function and particular integral. Method of variation of parameters. Cauchy's and Legendre's equations.	16

Total=60

Recommended Books:

1. R.K. Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishers.
2. Denial A Murray, Elementary Course in Differential Equations, Longman.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited.
4. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill.

Title of the course : **Applied Chemistry**

Subject Code : **CY-411**

Weekly load : **5**

LTP 3-0-2

Credit : **4 (Lecture 3; Practical 1)**

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Electro-analytical Chemistry	Conductivity of electrolytes- Specific, molar and equivalent conductivity, Nernst equation for electrode potential, EMF series, hydrogen electrode, calomel electrode, glass electrode, Electrolytic and galvanic cells, cell EMF, its measurement and applications, reversible and irreversible cells, concentration cell, electrode (hydrogen gas electrode) and electrolyte concentration cell, concentration cell with and without transference. Potentiometry: Principle, instrumentation and applications.	09
	Fuels	Classification, examples, relative merits, Solid Fuels: Coal, Proximate and Ultimate analysis of coal. Gross and Net Calorific Value, Determination of calorific value by Bomb Calorimeter Carbonization process, Low and High Temperature Carbonization. Liquid fuels: Cracking, Thermal and Catalytic Cracking, Synthetic petrol, Knocking, Antiknocking, Octane number, Cetane Number. Antiknocking agents. Gaseous fuels: Biogas, LPG and CNG. Determination of calorific value by Junker's Calorimeter. Flue gas analysis by Orsat's apparatus, problems.	10
	Surface Chemistry	Adsorption, chemisorption and physisorption, application of adsorption of gases on solids. Langmuir's adsorption isotherm, Freundlich's adsorption isotherm, BET theory of multi-layer adsorption (qualitative), adsorption chromatography. Colloidal particles, surfactants, micelles. Enzyme catalysis, Criteria for choosing catalyst for industrial processes.	09
Unit-2	Engineering Materials	Abrasives – Moh's scale of hardness – natural abrasives (diamond, corundum, emery, garnets and quartz) – synthetic abrasives (silicon carbide, boron carbide) – refractories – characteristics – classification (acidic, basic and neutral refractories) – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina magnesite and zirconia bricks.	10
	Lubricants	Classification of lubricant, lubricating oils, semisolid lubricants, solid and synthetic lubricants. Properties of lubricating oils (viscosity, flash and fire points, cloud and pour point, Iodine Value, Acid Value, R. M. Value, mechanical stability and saponification number).	07

Total=45

Recommended Books:

Text Books

1. P. C. Jain & M. Jain, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
3. F.W. Billmayer. Textbook of Polymer Science. 3rd Edn, Wiley. N.Y. 1991.
4. C. N. Banwell & E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn, Tata Mc Graw-Hill Edition, 1995.
5. S. S. Dara, S. S. Umare, A Text Book of Engineering Chemistry, S. Chand Publishing, 2011.

6. J. D. Lee, Concise Inorganic Chemistry, 5th Edn., Chapman and Hall, London, 1996.
7. Engineering Chemistry by B. Sivasankar, Tata McGraw Hill
8. Engineering Chemistry by A. Mallick, Viva Books, 2008.
9. Organic Chemistry by J. Clayden, Nick Greeves, S. Warren, Oxford Press 2012.
10. Levine, Physical Chemistry, 5/e (7th reprint), Tata McGraw Hill, 2006.
11. Inorganic Chemistry, Principle, structure and reactivity, J.E. Huheey, E.A. Keitler, R.L. Keita, O.K. Medhi, Pearson Education, 4th Ed.
12. Chemistry, J.E. McMurry and R.C. Fay, 5th Ed., Pearson Education, 2008

List of Experiments (CY-411)

1. Determination of strength of unknown solution of Mohr's salt using KMnO_4 and standard oxalic acid solution.
2. Determination of ferrous, ferric and total iron in a given sample using standard $\text{K}_2\text{Cr}_2\text{O}_7$
3. Determination of copper in a given solution by iodometric method using $\text{Na}_2\text{S}_2\text{O}_3$ and standard $\text{K}_2\text{Cr}_2\text{O}_7$
4. To find out the cell constant of a conductivity cell.
5. To find out the strength of the given hydrochloric acid solution by titrating it against sodium hydroxide using pH meter.
6. To prepare and describe a titration curve for phosphoric acid-solution hydroxide titration using pH-meter.
7. Determine the strength of the given hydrochloric acid solution by titrating it against sodium hydroxide conductometrically.
8. Determination of EMF/oxidation/reduction potential of a given metal/metal ion in different conditions.
9. Determination of equilibrium constant of a reaction by potentiometric method.
10. To determine moisture and volatile contents in a given coal sample by proximate analysis.
11. To determine fixed carbon and ash contents in a given coal sample by proximate analysis.
12. To study the adsorption of acetic acid on active charcoal and to verify the Freundlich and Langmuir isotherm.
13. To study the adsorption of Iodine from alcoholic solution by charcoal.
14. Determination of viscosity of heavy oil by means of Redwood Viscometer.
15. Determination of coefficient of viscosity of the given liquids by Ostwald's Viscometer method
16. Determination of Flash point of a given sample.
17. Determination of Fire point of a given sample.
18. Determination of acid value and saponification value of an oil.
19. Determination of aniline point of a lubricating point.
20. Determination of Iodine value of oil.
21. To determine the cloud and pour point of a lubricating oil.

(Any twelve to be performed)

Title of the course : **Communication Skills**

Subject Code : HU-411

Weekly load : 4

LTP 2-0-2

Credit : 3 (Lecture 2; Practical 1)

Course Description	Lecture(s)
Unit- I	
Communication Techniques	
Importance of Communication, One-way and Two-way Communication, Essentials of Good and effective Communication, Barriers to Communication, Techniques to Overcome Barriers	08
Writing Skills	
Précis- writing; Essay- writing, Official e-mail writing	08
Unit- II	
Report Writing	
Reports and their importance, Types of Routine Reports along with their formats- Annual Confidential Report, Progress Report, Inventory Report, Inspection Report, Lab Report, Structure of Reports; Bibliography & References	08
Grammar & Vocabulary	
Tenses, Change of Voice, Change of Narration, Words often confused, Correct use of Prepositions, Use of Idioms and Phrases	08

Total=32

Recommended Books:

1. Bhattacharya, Indrajit. *An Approach to Communication Skills*. Dhanpat Rai & Co.
2. Gibaldi, Joseph. *MLA Handbook for Writers of Research Papers*. MLA.
3. Sinclair, John. *Collins Cobuild English Grammar*. Collins.
4. Wren, P.C. & H. Martin. *High School English Grammar & Composition*. S. Chand & Company Ltd.
5. Sharma, R.C. & Krishna Mohan. *Business Correspondence and Report Writing*. Tata McGraw-Hill.

List of Experiments (10-14):

1. Introducing yourself.
2. Observing and analyzing your environment/ surroundings.
3. Collecting and Using Library Resources.
4. Giving Individual Presentations.
5. English Conversation Skills.
6. Group Discussions.
7. Extempore.
8. Debates.
9. Summarizing newspaper reports.
10. Role Plays.
11. Grammar exercises.
12. Finalization of Team Project Work.
13. Collecting Materials for Project Work & Finalization of Project.
14. Presentation of Project.

Title of the course : Workshop technology & practice
 Sub code : WS-412
 Weekly load : 6
 Credit : 4(Lecture 2; Practical 2)

LTP 2-0-4

Course Description	Lecture(s)
Unit -1	
Sheet Metal	
Introduction to sheet metal work; GI sheets, aluminium, tin plate, copper, brass etc, Hand tools used in sheet metal shop like steel rule, vernier calipers, micrometer, sheet metal gauge etc., scriber, divider, punches, chisels, hammers, snips, pliers, stakes, rivets etc., Operations -shearing, bending, drawing, squeezing etc.	06
Pattern making	
Introduction to pattern making, moulding and foundry practice. Pattern materials like wood, cast iron, brass, aluminium, waxes etc., different types of patterns, pattern allowances.	06
Foundry	
Introduction to casting process, core-boxes, core prints, hand tools-shovel, riddle, rammer, trowel, slick, lifter, sprue pin, bellow, mallet, vent rod, pouring weights etc., moulding sands-green sand, dry sand, loam sand, facing sand etc., grain shape and size, properties of moulding sand, sand preparation and testing etc., casting-permanent mould casting, centrifugal casting etc.	06
Unit-II	
Carpentry	
Introduction to wood working, Types of wood, seasoning methods, Marking and Measuring Tools-rule, try square, marking gauge, mortise gauge etc., Cutting Tools-rip saw, tenon saw, firmer chisel, mortise chisel, iron jack plane, wooden jack plane etc., Drilling Tools-braces, drill bits etc., Striking Tools-hammers, mallet etc., Holding Tools-bench vice, G-cramp etc., Miscellaneous Tools- rasps, files, screw driver, pincer etc.; Operations-marking, sawing, planning, chiseling, boring, grooving etc., Joints- Corner joints, Tenon and Mortise joint, Bridle cross-joint.	06
Fitting	
Introduction to fitting, Tools used in fitting -bench vice, hammers, chisels, files-flat file, square file, half round file, round file, knife edge file, scrapers, hacksaws, try squares, drill machine, drill bits, taps, dies etc, Operations-chipping, filing, scrapping, sawing, marking, drilling, tapping, dieing etc.;	04
Machining	
Turning, Chamfering, Tapering, Facing, Knurling , Lathe	4

Total: 32

Recommended Books

1. Hajra Choudhury, Hazra Choudhary and Nirjhar Roy, 2007, Elements of Workshop Technology, vol. I, Media promoters and Publishers Pvt. Ltd.
2. W A J Chapman, Workshop Technology, 1998, Part -1, 1st South Asian Edition, Viva Book Pvt Ltd.
3. P.N. Rao, 2009, Manufacturing Technology, Vol.1, 3rd Ed., Tata McGraw Hill Publishing Company.
4. Kaushish J.P., Manufacturing Processes, 2008, Prentice Hall India
 Practical: 10-14 jobs from the following list.

LIST OF PRACTICALS FOR WS-411

CARPENTRY SHOP

Making of various joints like:

- a) Cross lap joint
- b) T-lap joint
- c) Corner lap joint
- d) Mortise and tenon joint
- e) Dovetail joint

FITTING SHOP

a) Study and use of instruments in fitting shop, like, vernier calipers, micrometer, height gauge and bevel protractor

b) . Exercise on simple operation viz. cutting, chipping, sawing, filing, drilling,

FOUNDRY SHOP

- a) Familiarization with different patterns and hand tools.
- b) Preparations of green sand mould using single piece pattern three-four exercises.
- c) Preparations of green sand mould using split pattern on bench moulding.
- d) .Preparations of green sand mould using solid pattern by bedded method.

PATTERN SHOP

- a) 1 Familiarization with different tools and patterns in pattern shop.
- b) Exercise on making of solid piece pattern
- c) Exercise on making of split piece pattern
- d) Exercise on making of cored pattern.

SHEET METAL SHOP

- a) Study the layout and different equipment used in sheet metal shop.
- b) Familiarization with different tools and processes in sheet metal shop.
- c) Exercise on sheet cutting, development, folding, bending, piercing, punching, parting, notching and slitting.
- d) Profile and circle cutting exercise.

MACHINE SHOP

- a) To familiarize with safety aspects.
- b). To familiarize with equipment and tools.
- c). Practice of turning operation on lathe
- d). Practice of facing operation on lathe
- e). Practice of taper turning on lathe

Title of the course : **Engineering Drawing**
 Subject Code : ME-411
 Weekly load : 04 LTP 0-0-4
 Credit : 02

Theory

Course Description	Lecture(s)
Unit-I	
Introduction	04
Introduction, Objectives, applications. Fundamentals of engineering drawing, Use and handling of different drawing instruments, title block, sheet sizes, first and third angle projections, orthographic projections.	
Lettering and Dimensioning	04
Free hand sketching of different types of lines in engineering drawing as per IS specifications, Free hand lettering (alphabet and numerals) - lower case and upper case, vertical and inclined at 75° in the ratio of 7:4, Notation of dimensioning, size and location dimensions, aligned and unidirectional systems of dimensioning, general rules for dimensioning, unit of dimensioning.	
Scales	06
Uses of scales, sizes of scale, representative fraction, construction of plain and diagonal scales	
Projection of points, line	12
Introduction on theory of projections and orthographic projections, projection of a point in different quadrants, projection of straight lines in different positions (all possible cases)	
Unit-II	
Projection of Planes	06
Definition of plane, types of planes, traces of plane, projection of planes in different positions	
Projection of Solids	08
Types of solids, projections of solids in simple and typical positions, introduction on sectioning of solids	
Development of surfaces	08
Introduction, Development of a right prism, cylinder, pentagonal prism, and a right pyramid, truncated pentagonal pyramid.	

Total = 48

Recommended Books

<i>Title</i>	<i>Author(s)</i>	<i>Publisher</i>
1. Engineering Drawing	P S Gill	Kataria and Sons, New Delhi
2. Engineering Drawing	R.K.Dhawan	S. Chand & Co, New Delhi
3. Engineering Drawing	N.D,Bhatt	Charotar Publishing House

Title of the course : **Elements of Computer Programming**
 Subject Code : **CS-411**
 Weekly load : 6 LTP 2-0-4
 Credit : 4 (Lecture 2, Practical 2)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Elements of computer processing, Hardware and software, Introduction and feature wise comparison of various Operating Systems, Including DOS, Windows and Linux, Problem solving-algorithms and flowcharts. Structured Programming vs. Object Oriented Programming.	04
	C Programming Basics	Basic program construction, Structure of a C program, Compilation process, preprocessor directives, Comments, Data types, Type conversions, Operators - arithmetic, Relational, Logical, Conditional, Increment/decrement, Library functions, Header files.	04
	Loops and Decision Statements	<i>for</i> loop, <i>while</i> loop, <i>do</i> loop, Various forms of <i>if</i> statement, <i>switch</i> statement, <i>break</i> statement, <i>continue</i> statement, <i>goto</i> statement.	03
	Arrays	arrays and strings, Declaring an array, Initializing arrays, Accessing the array elements, Working with multidimensional arrays, Declaring and initializing string variables, Arithmetic operations on characters, String handling functions.	04
Unit-2	Functions	Defining functions, Passing arguments to functions, Returning values from functions, Reference arguments, Variables and storage classes, Static functions.	05
	Pointers	Pointers, Pointers to pointers, Declaring and initializing pointers, Pointer expressions, Pointer increment and scale factor, Pointers and arrays, Pointers and strings.	05
	Structures and Union	Declaring and initializing a structure, Accessing the members of a structure, Nested structures, Array of structures, Using structures in functions, Pointers and structures, Declaring and initializing a union.	03
	Files	Reading and writing to text and binary files, Character I/O, String I/O, File pointers, Error handling, Redirection, Command line arguments.	04

Total=32

Recommended Books:

1. Kernighan Brian W. and Ritchie, Dennis M, The C Programming language, Dorling Kingsley.
2. Balagurusamy, E., Programming in ANSI C, TMH Publications

Title of the course : **Elements of Computer Programming Lab**
Subject Code : **CS-411**

LIST OF PRACTICALS

1. WAP to find multiplication of two numbers.
2. WAP to swap two numbers without using third variable.
3. WAP to calculate temperature in Fahrenheit to Celsius using formula $C = (F - 32) / 1.8$.
4. WAP to calculate Sum and Average of N numbers using sequence of statements.
5. WAP to convert integer arithmetic to a given number of day and month using switch case.
6. WAP to find maximum out of 3 numbers a, b & c using Control Statements (if, else, nested if, nested else).
7. WAP to find minimum out of 3 numbers a, b & c using Control Statements (if, else, nested if, else)
8. WAP to find whether entered number is palindrome or not.
9. WAP to check entered number is even or odd .
10. WAP to find whether entered year is leap year or not.
11. WAP to find factorial of positive integer using for loop.
12. WAP to print all the number between 1 to 100 which are divisible by 7 using the concept of loops.
13. WAP to generate Fibonacci series up to n using loops.
14. Write a program to calculate area of circle using function.
15. Write an iterative function to calculate factorial of given number.
16. Write a recursive function to calculate factorial of given number
17. WAP to find even & odd up to a given limit using the concept of array and loops.
18. WAP to reverse a string.
19. WAP to find addition of two matrix of n*n order using the concept of 2 dimensional array
20. WAP to find multiplication of two matrix of n*n order using the concept of 2 dimensional array.
21. WAP program to study the concept of structure.
22. WAP to implement the concept of switch and break statements.
23. WAP to implement the concept of continue statements.
24. WAP to create a data file, retrieve data from the file.

Title of the course : **Measurement Science**
Subject Code : **IE-411**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction to measurements	Measurements, Significance, classification of the methods of measurement, instruments and measurement systems, types of instruments, elements of a generalized measurement system, input / output configuration of measurement systems, methods of correction for the various inputs.	08
	Static Characteristics of the instruments	Measurement system performance, static characteristics in detail, calibration, error in measurement, loading effects, input/ output impedance, loading effects due to series and shunt connected instruments .	08
	Errors in measurement and their statistical analysis	Limiting errors, combination of quantities with errors, types of errors, statistical treatment of data, Gaussian curve of errors, Probable error and tables, specifying measurement data, rejection of data, uncertainty analysis.	08
Unit-2	Dynamic characteristics of the instruments	Dynamic response and analysis, time and frequency domain analysis, mathematical models of the measurement system, types of systems, dynamic response of the first order and second order instruments to standard inputs, correlation between the time and frequency response.	08
	Units, Dimensions and standards	Units, Dimensions, systems of electrical units, dimensions in electromagnetic and electrostatic systems, Determination of absolute units, standards of measurement and their classification.	08
	Signals and noise in measurement systems	Introduction, deterministic and random signals, statistical representation of the random signals, effects of noise and interference on the measurement system, noise sources and coupling mechanism , method of reducing effects, reliability , choice and economics of the measurement system.	08

Recommended Books-

1. A K Ghosh: Introduction to Instrumentation and Control, Prentice Hall of India, New Delhi 2004.
2. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat
3. JOHN P. BENTLEY: Principles of Measurement System, Pearson Education
4. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India

Title of the course : **APPLIED PHYSICS**
 Subject Code : **PH-421**
 Weekly load : 5 LTP 3-0-2
 Credit : 4 (Lecture 3; Practical 1)

Theory

Unit	Main Topics	Course outlines	Lecture(s))
Unit-1	RELATIVITY	Newtonian mechanics and Galilean transformations, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, time dilation and length contraction, space-time interval, twin paradox, relativistic addition of velocities, variation of mass with velocity, mass energy equivalence, relativity and Doppler effect	12
	QUANTUM MECHANICS	Need of quantum mechanics, Basis of quantum mechanics, wave function, Schrödinger's time-independent and time-dependent equations, expectation values of physical quantities (position, momentum and energy), applications of time independent equation; for a particle in a box (one dimensional), step potential, finite square well potential, tunnelling effect	12
Unit-2	RADIATION PHYSICS AND LASERS	Elementary ideas about interaction of charged particles, electromagnetic radiations and neutrons with matter, detection of radiations by: proportional counter, GM counter, scintillation detectors, solid state detectors (basic principle only), applications of radiations in industry, agriculture and health science, radiation hazards. Principle of lasers, types of lasers : He-Ne, Ruby, CO ₂ and semiconductor laser, Applications of Lasers.	12
	FIBER OPTICS	Optical Fiber, physical structure and basic theory, modes in optical fibers, step index and graded index fibers, losses in optical fibers, Sources and sensors for optical fibers, applications of Optical fibers in communication.	06
	ELECTRODYNAMICS	Gauss's law in dielectric medium, Equation of continuity, displacement current, Maxwell's equations, wave equation for electromagnetic radiation, electromagnetic wave propagation in free space and isotropic dielectric medium, Poynting theorem & Poynting vector, vector potential, Lorentz gauge.	06

Total=48

Recommended Books:

1. Arthur Beiser ; Concepts of Modern Physics (McGraw Hill)
2. C. Kittel: Introduction to Solid State Physics(John-Wiley&Sons) Engineer Serway, Moses and Moyer Modern Physics (Thomson)

List of Experiments

PH-421

1. To find the value of Planck's constant by using a Photoelectric cell.
2. To verify inverse square law of radiation using a photoelectric cell.
3. To determine the frequency of an unknown signal by drawing the Lissajous patterns for various frequency ratios and evaluate the phase difference between two sinusoidal signals applied to X and Y input of cathode ray oscilloscope.
4. To measure the velocity of ultrasonic waves through a given liquid medium.
5. Measurement of wavelength of given He-Ne LASER by diffraction method.
6. To determine the wavelength of a sodium (Na) light by using the Michelson's Interferometer.
7. Determination of the value of e/m of an electron by helical method.
8. To determine the numerical aperture (Na) of a given multimode optical fiber by using Laser beam.
9. To determine the g – factor by using ESR Spectrometer.

Title of the course : **Environmental Studies**
 Subject Code : **MC-421**
 Weekly load : 2 LTP 2-0-0
 Credit : 2 (Lecture 2)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Ecology and environment	Ecosystem; components, functioning, food chain and web, ecological pyramids. Biogeochemical cycles; water cycle, carbon cycle, nitrogen cycle. Biodiversity and its conservation.	08
	Sustainable development	Sustainable development; conflict between development and environmental conservation, international endeavors. Sustainable utilization of resources; energy resources, water resources, forest resources.	08
Unit-2	Environmental pollution	Water pollution; wastewater characterization, primary treatment, secondary biological treatment, general discharge standards. Air pollution; major pollutants, treatment devices, ambient standards. Solid waste management.	10
	Environmental Regulations	Green House Effect and Kyoto Protocol. Ozone layer depletion and Montreal Protocol. Environment Protection Act. Hazardous waste management.	06

Total=32

Recommended Books:

1. E. Bharucha, Textbook for Environmental Studies; UGC Publication.
2. K.D. Wanger, Environmental Management; W.B. Saunders Publication.
3. E.P. Odum, Fundamentals of Ecology; W.B. Saunders Publication..
4. Pollution Control Acts, Rules and Notifications; CPCB Publication.

Title of the course : Elements of Electronics Engineering
Subject Code : EC-421
 Weekly load : 5 LTP 3-0-2
 Credit : 4 (Lecture 3; Tutorial 0; Practical 1)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Semiconductors	Semiconductors p-type, n-type, pn junction diodes, pn junction as a circuit element, its characteristics, half wave and full wave and bridge type rectifier circuits basic filter circuits, Diode as voltage multiplier, clipper & clamper circuit. Zener diode as a voltage regulator. LED its characteristics construction & applications	12
	2. Amplifiers	Concept of d.c. and a.c. load line and operating point selection. Various amplifiers configurations their h-parameter equivalent circuits determination of voltage gain current gain input resistance and output resistance & power gain. Concept of feedback in amplifiers, different oscillators circuits (without analysis) Differential amplifier and its transfer characteristics.	12
Unit-2	3. Operational Amplifiers	IC Op-Amps, its ideal & practical specifications and measurement of parameters. Op-Amp in different modes as inverting amplifier non inverting amplifier scale changer, differentiator & integrator.	12
	4. Transistors	Characteristics of JFET, MOSFET, Various amplifier configurations using FET. Characteristics and Construction of SCR, TRIAC, UJT. Their basic areas applications.	12

Total=48

Recommended Books:

1. Electronic Devices & Circuits - Boylstad & Nashelsky
2. Integrated Electronics By Millman & Halkias
3. Electronic Principles – Malvino
4. Principles of Electronics – V.K. Mehta, Shalu Melta
5. Electronic Circuits – Donald L. Shilling & Charles Belowl

List of Experiments (EC-421)

1. To study single stage amplifiers and calculate its gain
2. To study the two stage R-C coupled amplifiers and calculate its gain
3. To study the two stage R-C coupled amplifier's frequency response
4. To study the frequency response of single stage amplifier
5. To study the voltage feedback amplifiers
6. To study the Wein bridge oscillator
7. To study the Hartley oscillator
8. To study the class-B push pull amplifier
9. To study the tuned collector oscillator
10. To study the crystal oscillator
11. To study the basic principles of R-C oscillator i.e. phase oscillator
12. To study the negative feedback, its merits, demerits and calculate its gain

Title of the course : **Instrument Workshop**
Subject Code : **IE-421**
Weekly load : **6** **LTP-2 0 4**
Credit : **4**

1. Use of Various hand tools for manufacturing and testing e.g. pliers, cutter, crimpers, stripper, screw driver etc.
2. Familiarization , use and practice of measuring instruments for testing and measurement e.g. Analog and Digital Multimeters, CRO, frequency meter, signal generators, signal sources, LCR meter and IC tester.
3. Use of various chemicals used in instrumentation workshop and safety precautions to be observed.
4. Demonstration of various steps of PCB fabrication techniques:
 - (i) Identification of PCB board materials, their characteristics, corrosion and its prevention
 - (ii) Photo processing including photo print, etching, buffing, printing, high speed drilling, surface treatment, plated through holes, double sided PCBs.
 - (iii) Assembly of circuits on PCB, soldering and de-soldering techniques, wire shaping, edge connectors.

Recommended Books-

1. Modern Electronic Equipment by RS Khandpur, Tata McGraw Hill
2. Maintenance of Electronic Equipment by KS Jamwal, Dhanpat Rai and Sons

Title of the course : **Elements of Electrical Engineering**
Subject Code : **EE-421**
Weekly load : **5** **L T P-3 0 2**
Credit : **4**

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Basic Elements	Concepts of Electric Charge, Current and Electromotive force, Potential and Potential Difference; conductor, semiconductor insulator and dielectric, Electrical Power and Energy; Basics of Instruments used for Measuring Current, Voltage, Power and Energy, Methods and precautions in use of these and other instruments e.g. digital multimeters, oscilloscopes, signal generators etc.; Basics of various protection and safety devices e.g. Fuses, Earthing, MCBs and ELCBs	04
	Concepts of DC	Ohm's Law, Resistance, and color coding; Capacitance and Inductance, their ratings; Effects of Temperature on Resistance, Series and Parallel Connection of Resistances and capacitances, Kirchoff's Laws and Their Applications.	04
	AC Fundamentals	Concept of Alternating Voltage and Alternating Current, Difference between AC and DC, Various Terms Related with AC Waves; RMS and Average Values, Concept of Phase Difference and Phasor, Single Phase and Three Phase Supply; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Impedance and Power in AC Circuit.	07
	Three phase AC	Phasor representation of three phases, Star and Delta connections, Inter-Relation between phase and line values of voltage/current, power measurement in three phase system;	06
Unit-2	Electromagnetic Induction	Concept of Magnetic Field, Magnetic Flux, Reluctance, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws, Effects on a Conductor Moving in A Magnetic Field, various losses in magnetic circuits;	04
	Electrical Machines	Elementary concepts and classification of electrical machines, Common features of rotating electrical machines, Basic principle of a motor and a generator, Need of Starters and their classifications..	09
	Transformers	Transformer- Classification, Principle of operation, Construction, Working and applications	04
	Basic Troubleshooting	Basic Testing and faults diagnosis in electrical systems, various tools and their applications, replacement of different passive components e.g. fuses, lamps and lamp holders, switches, cables, cable connectors, electromagnetic relays.	04

Recommended Books:

Title	Author	Publisher
Electrical Technology	Edward Hugh	Pearson Education
Basic Electrical Engineering	D P Kothari & I J Nagrath	TMH
Electrical Machines	D P Kothari & I J Nagrath	TMH
Electrical Machines	S K Bhattacharya	TMH

Practicals: EE-421

1. Study of various passive components and measuring instruments and their connections in electrical circuits.
2. Verification of Ohm's Law.
3. Verification of Kirchoff's laws (KCL & KVL).
4. Verification of equivalent resistances in series and parallel connections.
5. Measurement of various characteristic values of a Sinusoidal waveform with the help of CRO.
6. Measurement of voltage, current and power in RL and RLC circuits and Verification of phase angle and power factor concept.
7. Study of various types of earthings.
8. Study of various types of protection devices e.g. fuses, MCBs and ELCBs
9. Verification of Faraday's laws and Lenz's law.
10. Study of various types of DC motors and their starters.
11. Study of various types of AC motors and their starters.
12. Study of various types of transformers and Verification of turns ratio.
13. Starting and reversing various AC and DC motors.
14. Fault diagnosis and removal in general electrical connection /apparatus.

Title of the course : **ELECTRICAL AND ELECTRONIC MEASUREMENTS**
Subject Code : **IE-422**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Analog instruments	Analog instruments, classification of analog instruments, Principles of operation, operating forces, constructional details of PMMC, moving iron, electro-dynamometer and electrostatic types of instruments, ohmmeters-series and shunt type, rectifier type instruments, Advantages , disadvantages and their comparison	06
	Measurement of power and energy	Power in ac and dc circuits, electro-dynamometer wattmeter, measurement of power in single and three phase circuits, Energy meter for ac circuits, single phase induction type watt hour meter, poly phase energy meters.	06
	Instrument Transformer	Introduction, current and potential transformer, relationships, characteristics, constructional details, reduction of errors and their comparison.	06
	DC and AC Bridges	Wheatstone bridge, measurements of resistance ,General form of ac bridge, Measurement of self inductance , capacitance , mutual inductance and frequency , sources of error and their minimization	06
Unit-2	Electronic measurements	Introduction, Electronic voltmeter, VIVM Transistor voltmeter, , BJT, FET and MOSFET voltmeters, electronic multi-meters, vector voltmeter, vector impedance meter, Current measurements using electronic instruments.LCR meter.	06
	Cathode Ray Oscilloscope	Introduction, CRO block diagram, CRT circuits, observation of waveform on CRO, Measurement of voltage, current , phase and frequency.	06
	Instruments for generation and analysis of waveforms	Signal generators, function generator, wave analyzer, harmonic distortion analyzer, spectrum analyzer, spectrum analysis	06
	Frequency and time interval measurement	Frequency measurement, period measurement, errors in measurement, universal counters and extension of the range of counters	06

Recommended Books-

1. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat
2. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India

Title of the course : **Fundamentals of Mechanical Engineering**
Subject Code : **ME-424**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Unit	Main Topics	Course Outline	Lectures
Unit-1	Basic concept of fluid mechanics	Classification, types of fluids ,properties, laws of pressure atmospheric, gauge, absolute pressure, pressure measurement, manometers, mechanical gauges.	6
	Flow of fluids	Types of fluid flow, velocity, rate equation of continuity, energy of a liquid in motion, head of a liquid, Bernoulli's theorem, orifice and venturimeter	6
	Dimensional and model analysis	Dimensions, dimensional analyses, Rayleigh's and Buckingham's method - similitude, dimensionless numbers and their significance, similarity laws, model studies.	6
	Pumps and Turbines	Introduction, types of pumps, reciprocating pump, construction details, co-efficient of discharge, slip, power required, centrifugal pump, classification, working principle, specific speed, turbine, classification working principle.	6
Unit-2	Basic Thermodynamics	Systems zeroth law, first law of thermodynamics, concept of internal energy and enthalpy applications to closed and open systems, second law of thermodynamics, concept of entropy, clausius inequality and principles of increase in irreversible processes. Basic IC engine and gas turbine cycles single and multistage reciprocating compressors	9
	Introduction to Refrigeration and Air Conditioning	Properties of steam, Ranking cycle, one dimensional flow through nozzles and applications to jet and rocket propulsion, basic thermodynamics of refrigerators and heat pumps.	9
	Introduction to Boilers and Steam Turbines	Types of Boilers: Water tube and Fire Tube Boilers, Mountings and Accessories, steam turbines: types, properties of steam.	6

Recommended Books-

1. Shames, I.H., 'Mechanics of fluids', Kogakusha, Tokyo, 1998.
2. Kumar, K.L., 'Fluid Mechanics', Eurasia publishers, 1990
3. Radhakrishnan, E., 'Introduction to fluid Mechanics', Prentice Hall, India 1999.
4. Rajput R.K., 'Fluid Mechanics and Hydraulic Machines', S.Chand and Co., India 1998.
5. Nag, P.K., Engineering Thermodynamics, Tata McGraw-Hill Co. Ltd., 1993.
6. Reynolds, Thermodynamics, Int. Student Edition, McGraw-Hill Co. Ltd., 1990.

Title of the course : **Higher Engineering Mathematics**
 Subject Code : **AM - 511**
 Weekly load : 3 Hrs. LTP 3-0-0
 Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Laplace transforms	Laplace transforms of elementary functions. Properties of Laplace transform. Transform of derivatives and integrals. Evaluation of integrals by Laplace transforms. Inverse Laplace transforms. Convolution theorem. Solution of ordinary differential equations. Unit step function and unit impulse function. Engineering applications.	7
	2. Fourier series	Fourier series. Change of interval. Even and odd functions. Half-range series.	5
	3. Partial derivatives and expansions	Functions of two or more variables. Partial derivatives. Homogenous functions. Euler's Theorem. Total derivative. Derivative of an implicit function. Tangent and normal to a surface. Change of variables. Jacobians. Taylor's and Maclaurin's series expansions for a function of two variables.	9
Unit-2	4. Complex functions	Limit of a complex function. Differentiation. Analyticity. Cauchy-Riemann equations. Harmonic functions. Conformal mapping. Some special transformations- translation, inversion and rotation. Bilinear transformation.	7
	5. Multiple integral	Double integral. Change of order of integration. Triple integral. Change of variables. Applications to area and volume. Beta and Gamma functions.	8
	Vector Calculus	Differentiation of a variable vector. Scalar and vector point functions. Vector operator - Del. Gradient, curl and divergence - their physical interpretation and applications. Directional derivative. Line, surface and volume integrals. Theorems of Green (in plane), Gauss and Stoke (without proof) - their verification and applications.	9

Total=45

Recommended Books:

1. R.K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishers.
2. G.B. Thomas & R.L. Finney, Calculus: Analytical Geometry, Addison Wesley.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern.
4. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill.

Title of the course : **Human values and professional ethics**
 Subject Code : **MC-511/ MC-521**
 Weekly load : 01 Hr Lecture LTP 1-0-0
 Credit : 0

Course Description	Lecture(s)
Unit-I	
Values and Self Development	
Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non moral valuation, Standards and principles, Value judgments. Importance of cultivation of values, Sense of duty, Devotion, Self reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.	04
Personality and Behavior Development	
Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self destructive habits, Association and cooperation, Doing best, Saving nature.	04
Unit-II	
Character and Competence	
Science vs. God, Holy books vs. blind faith, Self management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of women, All religions and same message, Mind your mind, Self control, Honesty, Studying effectively.	03
Human Rights	
Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.	02
Competence in professional ethics	
Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems	03

Total=16

Recommended Books:

- 1) S.K.Chakraborty, Values and Ethics for Organizations Theory and Practice; Oxford University Press, New Delhi,2001.
- 2) S.K. Kapoor, Human rights under International Law and Indian Law; Prentice Hall of India, New Delhi, 2002.
- 3) D.D. Basu, Indian Constitution; Oxford University Press, New Delhi, 2002.
- 4) W.K. Frankena, Ethics; Prentice Hall of India, New Delhi, 1990.
- 5) R. R. Gaur, R. Sangal, G. P. Bagaria, A Foundation Course in Value Education. 2009,
- 6) M Govindrajran, S Natrajan, V.S. Senthil Kumar, Engineering Ethics(including Human Values); Eastern Economy Edition, Prentice Hall of India Ltd.

Title of the course : **Digital Electronics**

Subject Code : **IE-511**

Weekly load : **5**

LTP-3 0 2

Credit : **4**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Number System & Codes	Review of number systems, binary number systems, octal number system, hexadecimal number system, signed & unsigned numbers, different types of codes & their conversions, binary operations- addition, subtraction, multiplication, division, 1's & 2's complement of a number.	08
	Combinational Logic	Concept of positive & negative logic, introduction to Boolean variables, Logical functions using Karnaugh map & Quine-Macluskey methods, multiplexers, demultiplexers, encoders, decoders, address, subtractors, parity generators, parity checkers, code converter.	08
	Sequential Logic Concepts And Components	Flip flops - SR, JK, D and T flip flops - Level triggering and edge triggering, Shift registers, type of registers, circuit diagrams, synchronous & asynchronous Counters, Excitation tables ,design with state equation state diagram counters, up & down counters, ring counters & mod, Counters. Introduction to finite state machines.	10
Unit-2	INTRODUCTION TO VHDL	Overview of digital design with very-high-speed integrated circuits (VHSIC) hardware description language (VHDL), HDL format and Syntax, entity, Data representation in VHDL, Truth table using VHDL, Decision Control structure and Sequential Circuit using VHDL.	08
	Digital Logic Families	Introduction, characteristics of digital ICs, resistor transistor logic, integrated injection logic, direct coupled transistor 109lc, diode transistor logic & transistor-transistor logic, emitter coupled logic, MOS logic, and high threshold logic families.	08
	Semiconductor Memories	Introduction, memory organization, classification & characteristics of memories, sequential memories, read only memories, read & write memories, content addressable memories, and programmable logic arrays, charged coupled device memory.	08

Recommended Books-

Title	Author	Publisher
Digital Electronics	R. P. Jain	TMH
Digital Circuits and Logic Design	Katre	Techmax
Digital Electronics & Computer Fundamentals	Albert Paul Malvino	TMH
Digital Computer Design	Radhakrishanan & Rajaraman	PHI
Digital Computer	Thomas Bartee	TMH

Practical: IE-511

1. Verification of the truth tables of TTL gates.
2. Verify the NAND and NOR gates as universal logic gates.
3. Design and verification of the truth tables of Half and Full adder circuits.
4. Design and verification of the truth tables of Half and Full subtractor circuits.
5. Verification of the truth table of the Multiplexer 74150.
6. Verification of the truth table of the De-Multiplexer 74154.
7. Design and test of an S-R flip-flop using NOR/NAND gates.
8. Verify the truth table of a J-K flip-flop (7476)
9. Verify the truth table of a D flip-flop (7474)
10. Operate the counters 7490, 7493.
11. Design of 4 bit shift register(shift right).
12. Design of modulo-4 counter using J K flip flop.

Title of the course : **Linear Integrated Circuits**

Subject Code : **IE-512**

Weekly load : **5**

LTP-3 0 2

Credit : **4**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction	The Operational Amplifier, block diagram representation and analysis, Differential amplifier, buffer, level translator and output driver. Block diagram, specifications, ideal op-amp, emitter coupled differential amplifiers, Various Parameters: Input Offset Voltage, Input Bias Current, CMRR, SVRR, Differential Input Resistance, slew rate familiarization with 741, offset null adjustments, measurement of op-amp parameters, frequency response op-amp.	08
	Operational Amplifier	Ideal Op-Amp, equivalent circuits, configurations, differential amplifier, inverting amplifier, non inverting amplifier, negative feedback, block diagram representation of feedback configurations, Voltage Series Feedback Amplifier, voltage shunt feedback amplifier, Differential Amplifiers, Voltage Follower.	08
	Op-Amp Linear Applications	DC and AC Amplifiers, Summing, Scaling and Averaging Amplifiers, Instrumentation Amplifier, Differential Input and Output Amplifier, V/I converter with grounding and floating load, I/V converter, Integrator and differentiator,	06
	Active Filters	Introduction, Butterworth Filter, Higher Order Filters, Band Pass and Band Reject Filters, All Pass filter	06
Unit-2	Oscillators	Principles, Types, Frequency Stability, Phase Shift, Wein Bridge, Quadrature Oscillators, Square Wave Generator, Triangular Wave Generator, Sawtooth Wave Generator, Voltage Controlled Oscillators.	04
	Comparators	Introduction, Basic Comparator, Zero Crossing Detector, Schmit Trigger, Comparator Characteristics, Limitations of Op-Amps as Comparators, Voltage Limiters	04
	Converters	High Speed and Precision type Comparators, V/F and F/V Converters, Clippers and Clampers, Peak Detector, Sample and Hold Circuit.	06
	Specialized IC Applications	Universal Active Filter, Switched Capacitor Filter, 555 Timer, Power Amplifiers, Concept of regulation, 723 voltage regulator, three terminal voltage regulators (positive, negative, variables) applications, commercial voltage regulators ICs, universal active filter, switched capacitor filter, phased locked loop.	08

Recommended Books-

Linear integrated circuits	JAIN & CHAUDHARY	Tata Mcgraw
Op-amp & Linear Integ. Ckts	COUGHLIN	PHI
Integrated Electronics	MILLMAN & HALKIES	Tata Mcgraw
Op-amp & Linear Integ. Ckts	GAEKWAD	PHI

Practical: IE-512

1. To experimentally study the performance of inverting amplifier-using op-amp.
2. To experimentally study the performance of non-inverting amplifier using op-amp.
3. To experimentally study the performance of differential amplifier using op-amp
4. To demonstrate working of an op-amp as a voltage follower.
5. To demonstrate working of an op-amp as a square wave generator.
6. To demonstrate working of an op-amp as a low pass filter.
7. To demonstrate working of an op-amp as a high pass filter.
8. To demonstrate working of an op-amp as a band pass filter.
9. To demonstrate working of an op-amp as a band rejection filter.
10. To demonstrate the operation of a 555 timer as monostable multivibrator.
11. To demonstrate the operation of a 555 timer as astable multivibrator.
12. To demonstrate working of instrumentation amplifier using 3 op-amp configurations.

Title of the course : **Signals and Systems**
Subject Code : **IE-513**
Weekly load : **5** **LTP-3 2 0**
Credit : **4**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction	Introduction to Signals and Systems, System Properties, Convolution of Signals, Linear Shift Invariant Systems and their Properties.	12
	Introduction to Transforms	Introduction to Transforms, Fourier Series and Fourier Transform, Convergence of Fourier Transform, Properties of Fourier Transform.	12
Unit-2	Sampling and reconstruction of the signal	Sampling Theorem, Sampling/Reconstruction of Signals, Realistic Sampling, Aliasing, Introduction to Digital Signal Processing, Advantages and disadvantages of digital signal processing over analog signal processing	12
	Laplace and Z-transforms	Introduction to Laplace Transform and Z-Transform, Region of Convergence, Properties of Laplace and Z Transform, Inverse Laplace and Z Transforms, Rational System Functions.	12

Recommended Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, Pearson Education, 2007.
2. Edward W Kamen & Bonnie's Heck, "Fundamentals of Signals and Systems", Pearson Education, 2007.

Title of the course : **Electrical Machine**
Subject Code : **IE-514**
Weekly load : **7** **LTP-3 2 2**
Credit : **5**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	D.C. MACHINE	Construction of D.C. machines – theory of operation of D.C. generator – characteristics of D.C. generators – armature reaction – commutation – principle of operation of D.C. motor – voltage equation – type of D.C. motor and their characteristics – speed control of D.C. motors.	12
	TRANSFORMER	Theory of ideal transformer – EMF equation – constructional details of shell and core type transformer – test on transformer – equivalent circuit – phasor diagram – regulation and efficiency of a transformer.	12
Unit-2	SYNCHRONOUS MACHINE	Principle of alternators – construction details – equation of induced EMF – vector diagram – method of starting of synchronous motor – torque developed by the motor – V curves – speed control.	08
	INDUCTION MACHINES	Construction and principle of operation – classification of induction motor – relation between torque and rotor power factor – starting and running condition – condition for maximum torque – comparison between synchronous motor and induction motors – speed control of induction motors.	08
	SPECIAL MACHINES	Types of single phase motor – double revolving field theory – cross field theory – capacitor start capacitor run motors – shaded pole motor – repulsion type motor – universal motor – hysteresis motor.	08

Recommended Books-

1. Fitzgerald A.E., Kingsly C., Umans S.D., 'Electrical Machinery', McGraw-Hill, Singapore, 1990.
2. Cotton H. 'Advanced Electrical Technology', Sir Isaac Pitman and Sons Ltd., London, 1971.
3. Del Toro V. 'Electrical Engineering Fundamentals', Prentice Hall of India, New Delhi, 1995.
4. Verinott, C.C., 'Fractional and sub-fractional horsepower electric motors', McGraw Hill, Singapore, 1985.
5. Theraja, B.L., 'A Text book of Electrical Technology', Vol.II, S.C.Chand and Co., New Delhi, 1997.

Practical: IE-514

1. Determination of coupling coefficient.
2. Series and parallel resonance.
3. Power measurement in single phase and three phase circuits.
4. Open circuit characteristics of DC generators.
5. Load characteristic of DC motors.
6. Speed control of DC motors
7. Brake test of DC motors.
8. Regulation of three-phase alternator.
9. Open circuit and short circuits of transformer.
10. Brake test of induction motors.
11. V-curve of synchronous motor.

Title of the course : **CIRCUIT THEORY**
Subject Code : **IE-515**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Graph Theory	Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Node methods of analysis.	08
	Network Theorems (Applications to ac networks)	Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman's theorem, compensation theorem, Tellegen's theorem.	06
	Network Functions	Concept of Complex frequency , Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, frequency response and Bode plots.	10
Unit-2	Two Port Networks	Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T & II Representation.	09
	Network Synthesis	Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Caue first and second forms.	08
	Filters	Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, highpass,band pass, band elimination filters.	07

Recommended Books-

1. M.E. Van Valkenburg," Network Analysis", Prentice Hall of India
2. D.Roy Choudhary,"Networks and Systems" Wiley Eastern Ltd.
3. Donald E. Scott : "An Introduction to Circuit analysis: A System Approach"McGraw Hill Book Company.
4. A.Chakrabarti,"Circuit Theory" Dhanpat Rai & Co.

Reference Books :

5. M.E. Van Valkenburg,"An Introduction to Modern Network Synthesis",Wiley Eastern Ltd.
6. W.H. Hayt & Jack E-Kemmerly, Engineering Circuit analysis" Tata McGraw Hill.
7. Soni, Gupta ,"Circuit Analysis", Dhanpat Rai & Sons.
8. Ram Kalyan, Linear Circuits Oxford University Press.

Title of the course : **Industrial Chemistry**
Subject Code : **CY-521**
Weekly load : **3** **LTP 3-0-2**
Credit : **4 (Lecture 3; Practical 1)**

Unit	Main Topics	Course outlines	Lecture (s)
Unit-1	Water and its Treatment	Water and its Treatment: Introduction, Hardness and its determination, Degree of Hardness, Treatment and Purification of water for domestic and Industrial purposes- Sedimentation, Filtration, Sterilization, Break point chlorination, Ozonation, Permutit or Zeolite process, Deionization or Demineralization, Desalination of Brackish Water. Numerical Problems	10
	Solid State Chemistry	Introduction to Solid State Chemistry, Band theory of solids, semiconductors and insulators crystallography, crystal systems, polymorphism, Law of rational indices, Miller indices, Interplanar spacing, Structure of crystals, X-ray diffraction, Bragg method, x-ray analysis of sodium chloride Solid State, Stoichiometric Defects	08
	Molecular Electronics	Need for molecular devices, molecular electronics, definition, molecular wires and rectifiers, types of molecular wires with examples, insulation of molecular wires, preliminary idea about measurement of conductivity by various methods(AFM, optical electron transfer etc.), molecular switches : types(pH, optical, temperature, fluorescence with example), logic gates: YES, NOT, AND and OR logic gates with examples, self-assembly.	08
Unit-2	Spectroscopic Techniques for Analysis	Introduction, interaction of EMR radiation and matter, atomic and molecular spectroscopy, Absorption laws, Atomic absorption spectroscopy: Basic principles, instrumentation, interferences, typical applications. Atomic emission spectroscopy: Basic principle, instrumentation and applications. UV-VIS and IR Spectroscopy- Introduction, theory, instrumentation, applications of UV & IR spectroscopy (including finger print region in IR)	12
	Thermal Analysis	Thermogravimetric analysis(TGA), Derivative thermogravimetric analysis(DTG), Differential thermal analysis(DTA), Differential Scanning Calorimetry-Basic principles, Instrumentation and analytical applications.	07

Total=45

List of Experiments (CY-521)

- 1.) Determination of Total Hardness of water (tap, lake, pond, river) using standard EDTA solution and Eriochrome Black T (EBT) indicator.
- 2.) Determination of available Chlorine in treated and untreated water titrimetrically.
- 3.) Determination of available Chlorine in Bleaching Powder titrimetrically
- 4.) Analysis of water samples by BOD and COD.
- 5.) Estimation of Iron in water.
- 6.) Investigation of rusting of iron in different conditions of rusting.
- 7.) Investigation of the effect of metal coupling on rusting of iron.
- 8.) To determine the acidity of water sample.
- 9.) To determine the alkalinity of a given water sample.
- 10.) Determination of free CO₂ in a given sample of water.
- 11.) To sketch a typical DTA plot for the melting of a pure metal.
- 12.) To sketch a typical DSC plot for the melting of a pure metal.

- 13.) To study of the phase changes (glass transition temperature, melting, phase separation) in solid and gel polymer electrolytes of different composition for lithium power sources.
- 14.) Determination of the Curie point, crystallization temperature and energy in metal glasses
- 15.) Identification of functional group by FT-IR spectroscopy
- 16.) Determination of concentration of an unknown sample of UV spectroscopy.
- 17.) To determine λ_{max} (wavelength of maximum absorption) of a solution of KMnO_4 using a spectrometer.
- 18.) To determine the concentration of ferrous ions in a given sample spectrophotometrically by O-phenanthroline method.

Recommended Books:

1. P. C. Jain & M. Jain, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
3. F.W. Billmeyer. Textbook of Polymer Science. 3rd Edn, Wiley. N.Y. 1991.
4. C. N. Banwell & E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn, Tata Mc Graw-Hill Edition, 1995.
5. S. S. Dara, S. S. Umare, A Text Book of Engineering Chemistry, S. Chand Publishing, 2011.
6. J. D. Lee, Concise Inorganic Chemistry, 5th Edn., Chapman and Hall, London, 1996.
7. Engineering Chemistry by B. Sivasankar, Tata Mcgraw Hill
8. Engineering Chemistry by A. Mallick, Viva Books, 2008.
9. Organic Chemistry by J. Clayden, Nick Greeves, S. Warren, Oxford Press 2012.
10. Levine, Physical Chemistry, 5/e (7th reprint), Tata McGraw Hill, 2006.
11. Inorganic Chemistry, Principle, structure and reactivity, J.E. Huheey, E.A. Keitler, R.L. Keita, O.K. Medhi, Pearson Education, 4th Ed.
12. Chemistry, J.E. Mcmerry and R.C. Fay, 5th Ed., Pearson Education, 2008

Title of the course : **Material Science**
 Subject Code : **PH-511/PH-521**
 Weekly load : 5
 Credit : 4 (Lecture 3; Practical 1)

LTP 3-0-2

Unit	MAIN TOPICS	Course outlines	Lecture(s)
Unit-1	ELEMENTS OF CRYSTALLOGRAPHY	A brief Introduction to material science, Space lattices, Unit cell, primitive cell, Bravais lattice, Atomic packing factor, Miller Indices, directions and planes in crystal lattice (cubic and hexagonal only), distribution of atoms in lattice planes (in cubic crystal only), Important structures (NaCl, CsCl, Diamond and ZnS), structure determination; X-ray diffraction, Neutron and electron diffraction	08
	IMPERFECTIONS IN CRYSTALS	Point imperfections, Frenkel, and Schottky defects and their equilibrium concentration determination, Color centres, types of color centres, generation of color centres, Edge and screw dislocation, Burger vector, Surface defects	05
	BAND THEORY OF SOLIDS	Free electron theory, Concept of energy bands, Bloch theorem, Electron in a periodic field of crystal (The Kronig – Penny Model) distinction between metal, semiconductor and insulator, effective mass of an electron, Hall effect.	06
	NANO-MATERIALS	Fundamentals of nonmaterial's and nanotechnology, nano particles, properties of nonmaterial's, synthesis and characterisation, applications of nonmaterials.	05
Unit-11	DIELECTRIC MATERIALS	Introduction of dielectric materials, Polarization, Different types of polarization, Electronic, ionic, orientational and space charge polarization, polarizability, Clausius-Mossotti relation, temperature and frequency dependence of polarizability, dielectric breakdown, measurement of dielectric properties, Dielectric constant, Dielectric loss, ferroelectric and piezoelectric materials, examples of materials and their applications.	08
	MAGNETIC MATERIALS	Terminology and classification of engineering materials, Type of magnetism (dia, para, ferro, ferri and anti ferromagnetisms), Theory of para, dia and ferromagnetic materials, magnetic anisotropy and magnetrostriction, magnetic domains, hard and soft magnetic materials, ferrites and their applications	08
	SUPERCONDUCTIVITY	Introduction, type I & type II superconductors, Meissner's effect, isotope effect, effects of magnetic field, London's equations, penetration depth, specific heat, BCS theory (electron-lattice-electron interaction, Cooper-pair, coherence length, energy gap), high temperature superconductors, applications of superconductivity.	08

Theory

Total=48

Recommended Books:

- a) Raghvan :Materials Science
- b) Srinivasan &Srivastava :Science of Engineering Materials
- c) Callister JR Materials Science and Engg.: An Introduction
- d) Askeland &Phule :The Science and Engineering of Materia

List of Experiments**PH-511/PH-521**

1. To prepare a metallic sample and measure the grain size using the metallurgical microscope.
2. To study the creep nature in metallic wires at room temperature.
3. To find the mobility and carrier concentration in a semiconductor sample using Hall Effect experiment.
4. To study the B-H curves of different materials using B-H curve tracer.
5. To determine the Stefan's constant using Stefan's constant kit.
6. To find the resistivity of a given semiconductor material using four probe method.
7. To find the Curie temperature of the given ferrite material.
8. To find the Curie temperature of the given ferroelectric material.
9. To calculate the dielectric constant of the given dielectric material.
10. To find the capacitance and permittivity of the given material.

Title of the course : **Process Dynamics and Control**
Subject Code : **IE-521**
Weekly load : **5** **LTP-3 0 2**
Credit : **4**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction to process control	Introduction, Basic components, diagrammatic representation, symbol and Terminology, process control block diagram	06
	Process dynamics and mathematical modelling	Process variables, mathematical modeling of liquid, gas, and thermal, mechanical and chemical systems, Linearizing techniques, Liquid level control in a tank, Dynamics of manometer, response of non-interacting and interacting first-order elements in series, Mixing process, Heat transfer process, Distillation column.	08
	Controller principles	control system parameters – discontinuous controller modes – two position mode – multiposition mode – floating control mode – continuous controller modes – proportional controller mode – integral control mode – derivative control mode – composite controller modes – PI, PD, and three mode controller.	06
Unit-2		Closed loop response and controller tuning Single and combined modes in closed loop, static error, velocity error. Dynamic behaviour of feedback control processes for different modes, IAE, ISE, IATE criteria, Tuning of controllers, closed loop method – ultimate method – damped oscillation method – process reaction curve method – open loop tuning – variation on the open loop fit – Ziegler Nichols method – frequency response method – comparing tuning methods – integral criteria in tuning	06
	Controller Hardware	Electronic and digital controller's - design considerations and implementation, single and composite modes of controllers, Direct digital control (DDC)- components, benefits, digital controller realization.	06
	Controller Hardware	Electronic and digital controller's - design considerations and implementation, single and composite modes of controllers, Direct digital control (DDC)- components, benefits, digital controller realization.	06
	Final Control	Final control operation – signal conversion (analog and digital electrical signals) –Actuators (electrical, pneumatic and hydraulic) – Control valve classification and types, selection criteria for control valves, function (mechanical, electrical and fluid valves).	06
	Multiple loop Control Schemes	On-off Controllers, Cascade and Feed forward Controllers, Split Range Controllers, ratio controls, Single loop, multi loop & self tuning controllers, set point control (SPC)	

		Multiloop Interaction: Introduction, features and examples of Mimo Process, Design of cross controllers, Relative gain array and selection of control loop.	04
--	--	---	----

Recommended Books-

1. Bhanot S, “ Process Control- Principles and Applications”, Oxford University Press, 2008.
2. Process Control : Peter Harriott, TMH
3. Handbook of Instrumentation : Process control : B.G.Liptak, Chilton
4. Process Control Systems : F. G. Shinskey, TMH
5. Chemical Process Control : George Stephanopolous, PHI
6. Computer based Industrial Control : Krishna Kant, PHI
7. Process Control: Modeling, Design and Simulation : B. Wayne Bequette, PHI
8. Process Dynamics and Control : Dale E. Seborg
9. Process Instrumentation and control Handbook : Considine

Practicals: IE-521

1. Characteristics of ratio control.
2. Characteristics of cascade control.
3. Characteristics of feed-forward control.
4. Design of proportional controller.
5. Design of proportional plus integral controller.
6. Design of proportional plus derivative controller.
7. Design of proportional plus integral plus derivative controller
8. Characteristics of feed-back control.
9. Study of I/P Converter out put to control valve displacement.
10. Study of feed back pressure control plant with DCS panel.
11. Study of feedback temperature control system.
12. Tuning of P controller.
13. Tuning of PI controller.
14. Tuning of PID controller.
15. Study of pressure transmitter.

Title of the course : **Control System**
Subject Code : **IE-522**
Weekly load : **7** **LTP-3 2 2**
Credit : **5**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introductory Concept	Plant, Systems, Servomechanism, Regulating Systems, Disturbances, Open loop control system, Closed loop control system, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems, Concept of feedback, Block diagrams	06
	Modelling	Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic system, electrical mechanical analogies, Use of Laplace transforms, Transfer function, concept of state variable modelling, Block diagram representation, Block diagram simplification for linear systems, signal flow graphs, Mason gain rules.	08
	Time Domain Analysis	Typical test-input signals, transient and steady state response of the first order systems, second order systems and higher order systems, Transient response analysis with MATLAB, Steady state error and coefficients, pole zero location and stability, Routh-Hurwitz Criterion	08
	Root Locus Analysis	Introduction, Root-Locus Plots, General Rules for Constructing Root Loci, Root-Locus Plots with MATLAB, Positive Feedback Systems, Conditionally Stable Systems, Root Loci for Systems with Transport Lag	06
Unit-2	Frequency Domain Analysis	Introduction, Bode Diagrams, Plotting Bode Diagrams with MATLAB, Polar Plots, Drawing Nyquist Plots with MATLAB, Log-Magnitude-versus-Phase Plots, Nyquist Stability Criterion, Stability Analysis, Relative Stability, Closed-Loop Frequency Response of Unity-Feedback Systems	08
	Compensation	Necessity of compensation, series and parallel compensation, compensating networks, application of lag and lead compensation	06
	Control Components	Proportionate, derivative and integral control, feed back control, Error detectors-Potentiometers and Synchros, AC and DC servomotors, Tachogenerators	06

Recommended Books-

1. Ogata K, "Modern Control Engineering", Prentice Hall of India, 5th ed.' 2012.
2. Kuo BC, "Automatic Control System", John Wiley & Sons, 2009.
3. Nagrath IJ and Gopal M, "Control System Engineering", New Age International, 2007
4. Distefano JJ, Stuberud AR and Williams IJ, "Schaum's Outlines of Theory and problems of Feedback and control Systems", 2nd ed., Tata McGraw Hill, 2007.

Practicals: IE-522

1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To design Lag, Lead and Lag-Lead compensators using Bode plot.
5. To study DC position control system
6. To study synchro-transmitter and receiver and obtain output V/S input characteristics
7. To determine speed-torque characteristics of an ac servomotor.
8. To study performance of servo voltage stabilizer at various loads using load bank.
9. To study behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.
10. To study PID Controller for simulation proves like transportation lag.

Software based experiments (Use MATLAB, LABVIEW software etc.)

11. To determine time domain response of a second order system for step input and obtain performance parameters.
12. To convert transfer function of a system into state space form and vice-versa.
13. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfer functions and examine the stability of the closed loop system.

Title of the course : **Industrial Instrumentation-I**
Subject Code : **IE-523**
Weekly load : **5** **LTP-3 0 2**
Credit : **4**

Theory:

Unit	Main Topics	Course Outline	Lectures
Unit-1	Temperature Measurement	Temperature scale and conversion, principle of vapor, gas, liquid filled thermo meters, bimetallic thermo meter, pressure spring thermometer, thermocouple and its configuration, extension wires, resistance temperature detector & compensation techniques, Thermistor, Pyrometry- Stefan Boltzmann's law- Black body radiation- Optical radiation pyrometers- Disappearing filament photo electric pyrometer- Unchopped DC& chopped AC broad band radiation thermometers- Two colour radiation thermometers- Pneumatic and electrical temperature transmitters, Digital thermometers.	10
	Pressure Measurement	Introduction to static and dynamic pressure, unit of pressure and conversions, differential pressure elements – U tube manometer – inclined manometer- ring balanced type manometer, elastic transducers like ordinary and diaphragm, bourdan tube, bellows, capsules etc. sealed pressure gauges, differential pressure transducers –pneumatic and electrical pressure transmitters, pressure switches and strain gauge pressure pickups, methods for measurement of vacuum Pirani Gauge, Mclead Gauge, Knudsen Gaug, very high pressure measurement,calibration of pressure,	08
	Measurement of flow rate	Differential pressure meter(primary elements)-theory, construction and applications of orifice plate, venturimeter, flow nozzle, pitot tube,dall tube – Pressure taps- Manometers, differential pressure measurement- Square root extraction.	08
Unit-2	Flow Measurement	Variable headmeters, orifice plate, venturi tube, flow nozzle, pitot tube, rotameter, magnetic meter, turbine meter, vortex meter, mass flow meter. Ultrasonic meter, thermal flow meter. Positive displacement meters.	10
	Level Measurement	visual level indicators, differential presuure, ordinary float type, purge method, Buoyancy method, resistance probes for level measurement, capacitive level meter, ultrasonic level measurement, Gamma rays level measurement, microwaves, level limit switches, level measurement of closed vessel. measurement of level of solids- paddle wheel type	12

Recommended Books-

1. Jain.R.K,*Mechanical and industrial measurements*, Khanna
2. Patranabis.D, *Principles of industrial instrumentation*,TMH

3. Fribance, *Industrial instrumentation fundamentals*, Mcgraw hill.
4. Birdie G.S. & Birdie J.S., *Water Supply and Sanitary Engineering*, Dhanpat Rai & Sons
5. Andrew and Williams, *Applied instrumentation in process industries*, Gulf pub. Vol- 1,2
6. Jones.E.B, *Instrument technology*, Scientific Pub.
7. Liptak.B.G , *Instrument Engineers H/B Vol- 1*, Chilton book.co.
8. Doebelin.E.O, *Measurement system- Application and design*, Mcgrow hill
9. Trade journals like I&C.S, Intech, Control and instrumentation etc.
10. Fairgeyer & Okun, *Water and Waste Water Technology*, Prentice Hall of India.
11. Mark .J.Hammer& Mark.J.Hammer.jr, *Water and Waste Water Technology*, Prentice Hall of India.

Practicals: IE-523

1. To Study the Characteristics of RTD.
2. To Study the Characteristics of Thermocouple.
3. To Study the Characteristics of an n.t.c Thermistor.
4. To Study the Characteristics of Infrared thermometer.
5. To Study the Characteristics of optical pyrometer.
6. To Study the Characteristics of digital thermometer.
7. To calibrate pressure gauge using Dead Weight Tester.
8. To Study the Rotameter.
9. Study of vacuum pressure gauge.
10. Pressure Sensor calibration using mercury Column Monometer.
11. Pressure Sensor calibration using water Column Monometer.
12. Study of Water Level measurement using capacitive principal
13. To Study the working of orifice meter.
14. Study of flow measurement using differential pressure measurement.
15. Study of C-Type bourdon tube.
16. Study of positive displacement flowmeter.

Title of the course : **Engineering Economics and Entrepreneurship**
Subject : HU-611/ HU-621
Weekly Load : 3 LTP 3- 0 -0
Credit : 3 (Lecture 3)

Course Description	Lectures
UNIT- I	
Introduction	
Engineers and Economics, Utility of its study, Managerial Economics, Nature and scope, basic terms and concept of economics like goods, kinds of goods.	02
Theory of Demand and Supply	
Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, The meaning of Supply, Supply function, Law of supply- Explanation of law of supply.	08
Environment Analysis	
Concept of National income- GDP, GNP, Monetary policy, Fiscal Policy.	05
Entrepreneurship-Enterprise	
Conceptual issues, Entrepreneurship vs. Management, Concept of Social Entrepreneurship and Women Entrepreneurship, Roles and functions of engineer in relation to the enterprise and in relation to the economy.	07
Business Excellence	
Role of creativity and innovation and business research, Sources of business idea, TQM, Six Sigma	02
UNIT- II	
The process of setting up a small business	
Preliminary screening and aspects of the detailed study of the feasibility of the business idea , Preparation of Project Report and Report on Experiential Learning of successful and unsuccessful entrepreneurs..	04
Communication skills	
Introduction, process of communication, barriers to communication, Removal of barriers, channels of communication, Verbal and non-verbal communication.	03
Issues in small business marketing.	
The concept and application of product life cycle ,Advertising and publicity, sales and distribution management, National, state level and grass-root level financial and non-financial institutions in support of small business development, MSME Act	09
Human Resource Management	
Introduction, definition, types, tools of motivation, Theories of motivation- Alderfer's ERG theory, Herzberg's theory of motivation, Mc Clelland theory. Introduction , objectives, scope, functions. Introduction to concept of IR.Regulation and abolition of Contract Labour Act 1970	08

Total= 48

RECOMMENDED BOOKS:

1. Economics – Samuelson, Pauls & W.D. Nordhan – McGraw Hill
2. Engineering Economics, R.Panneerselvam
3. Advanced Cost Accounting – Nigam, Sharma – Himalaya Publishing House
4. Managerial Economics – Mote and Paul – TMH
5. Macro Economics for management Students – A. Nag – Macmillan India Ltd
6. Dynamics of entrepreneurial development & Management, Vasant Desai/Himalaya Pub.House.
7. Entrepreneurship New venture creation, David H.Holt, PHI

8. Entrepreneurship & Small Business Management, Nicholas, Siropolis Houghton Mifflin company, Boston-Newyork
9. Management, Stephen P. Robbins, Mary(Pearson education Asia)

Title of the course : **Numerical Analysis**
 Subject Code : **AM - 521/AM-611**
 Weekly load : 5 Hrs. LTP 3-0-2
 Credit : 4 (Lecture 3; Tutorial 0; Practical 1)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Errors	Errors in arithmetic operations and functions. Round-off error, truncation error. Absolute error. Relative error. Percentage error. Principles of equal effect. Significant digits.	4
	2. Roots of equations	Intermediate value property. Bisection method. Method of false position. Secant Method. Newton-Raphson method. Iteration method. Convergence of these methods.	6
	3. Solution of linear equations	Gauss Elimination method (with and without partial pivoting). Gauss-Seidel, Jacobi's methods. Triangularization method.	5
	4. Eigenvalue	Rayleigh's power method for finding dominant eigenvalue.	4
	5. Finite differences	Finite differences-forward, backward and central differences. Shift and averaging operators.	4
Unit-2	6. Interpolation	Newton's forward, backward and divided difference interpolation formulae. Lagrange's formula. Gauss forward and backward difference interpolation formulae. Spline interpolation-quadratic and cubic.	7
	7. Numerical differentiation and integration	Numerical differentiation using Newton's forward and backward difference formulae. Numerical integration – Trapezoidal rule, Simpson's one third and three-eighth rules. Romberg's integration. Error in integration.	8
	8. Numerical solution of ODEs	Taylor series method. Picard's method. Euler method. Modified Euler's method. Runge-Kutta methods (upto fourth order) for solution of ODE of first order.	7

Total=45

Recommended Books:

1. S.S. Sastry, Introductory Method of Numerical Analysis, PHI.
2. Gerald Wheatley, Applied Numerical Analysis, Pearsons Education.
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Sc. and Engg. Computation.
4. J.H. Mathew, Numerical Methods for Maths., Science and Engg., PHI.

Experiments:

AM-521/AM-611

1. Finding roots of the equation $f(x) = 0$ using
 - i) Bisection Method
 - ii) Secant Method
 - iii) Method of false position
2. Finding roots of the equation $f(x) = 0$ using
 - i) Iterative Method
 - ii) Newton - Raphson's Method
3. To check consistency and finding Solution of a system of linear algebraic equations using
 - i) Gauss elimination Method
 - ii) Gauss - Seidal Method
 - iii) Jacobi Method
4. Solution of a system of linear equations by triangularization method.

5. Finding dominating Eigen value and Eigen vector using Rayleigh's power Method.
6. Interpolation using
 - i) Newton's forward difference formula
 - ii) Newton's backward difference formula
7. Interpolation using
 - i) Newton's divided difference formula
 - ii) Lagrange's interpolation formula
8. Interpolation using
 - i) Gauss's forward formula
 - ii) Gauss's backward difference formula
9. Interpolation using Splines
 - i) Linear
 - ii) Quadratic
 - iii) Cubic
10. Numerical differentiation using
 - i) Newton's forward interpolation formula
 - ii) Newton's backward interpolation formula
11. Numerical Integration using
 - i) Trapezoidal rule
 - ii) Simpson's 1/3rd rule
 - iii) Simpson's 3/8th rule
 - iv) Romberg's rule
12. Solution of Ist order ordinary differential equations using
 - i) Taylor's series method
 - ii) Picard's method
 - iii) Euler's method
 - iv) Euler's modified method
13. Solution of Ist order ordinary differential equations using
 - i) Runge-Kutta method of IIIrd order
 - ii) Runge-Kutta method of IVth order

Title of the course : **Microprocessor and Applications**
Subject Code : **IE-611**
Weekly load : **5** **LTP-3 0 2**
Credit : **4**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction to Microprocessors	Types of computers, Microprocessor Evolution and types, CPU operation and terminology, idea of 8-bit, 16-bit, 32-bit and 64-bit Microprocessors from Intel, Motorola and Zilog and their comparisons.	08
	Introduction to 8-bit Microprocessor	8085 Microprocessor architecture, Instruction format, Addressing Techniques, classification of instructions, and overview of the 8085 instruction set. Simple programs.	08
	Introduction to 16-bit Microprocessor	8086 Internal Architecture, Instruction Format, Addressing modes, program development steps, and 8086 instruction set, Assembler directives, Assembly language, program development tools.	08
Unit-2	Programming of 8086	Simple sequence programs, jumps, flags, conditional Jumps, IF THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros.	08
	8086 System Connections, Timing, Troubleshooting	Pin-diagram, max/min. modes, timing diagrams, use of logic analyzer to observe Bus Signals, troubleshooting a simple 8086 based system, 8086 Interrupts, responses & applications.	08
	Interfacing of 8086	Memory Interfacing, Programmable parallel ports & handshake, 8254 software-programmable timer/counter, 8259 A priorities Interrupt Controller, Interfacing a Microprocessor to Keyboards and alphanumeric displays, D/A converter operation, interfacing and applications, A/D converter specifications	08

Recommended Books-

1. Gaonkar, Ramesh S. *Microprocessor Architecture, Programming and Applications with the 8085*, Penram International
2. Ram B, *Fundamentals of Microprocessors and Microcomputers*, Dhanpat Rai & Sons,
3. Hall, Douglas V. *Microprocessors and interfacing: Programming and Hardware*, Tata McGraw Hill
4. Brey, Barry B. *The INTEL Microprocessors 8086/88, 80186, 286, 386, 486, Pentium Pro Processors, Architecture, Programming and Interfacing*, 4th Edition, Prentice Hall (India)
5. Ray A.K. and Bhurchandi K.M., *Advanced Microprocessors and Peripherals*, Tata McGraw Hill

Practical: IE-611

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8 bit numbers using 8085.
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program to arrange an array of data in ascending and descending order.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.

9. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085 through RS-232 C port.

Title of the course : **Simulation Lab**
Subject Code : **IE-612**
Weekly load : **4** **LTP-0 0 4**
Credit : **2**

Practicals:

1. To perform various arithmetic operations in Microsoft Excel and create various types of 2D plots.
2. To create arrays and matrices in MATLAB and perform various arithmetic operations.
3. To write a programme in MATLAB for getting the desired data (largest, smallest, a range etc) from a set.
4. To write a programme in MATLAB for creating various types of 2D plots (single and multiple) from a set of data.
5. To measure and plot the Instantaneous, RMS and average values of current/voltage, power, power factor, crest factor, frequency and various other waveform parameters while simulation of behaviour of basic circuit components supplied from a DC and an AC source in MATLAB.
6. To simulate the steady state and transient behaviour of circuits having a pure resistance or pure inductance or pure capacitance supplied from a DC and an AC source in MATLAB. Plot their source and load current and voltage waveforms and comment on it.
7. To simulate the steady state and transient behaviour of circuits having RL, RC and RLC series combinations fed from a DC and an AC source in MATLAB. Plot their source and load current and voltage waveforms and comment on it.
8. To simulate the steady state and transient behaviour of circuits having RL, RC and RLC parallel combinations fed from a DC and an AC source in MATLAB. Plot their source and load current and voltage waveforms and comment on it.
9. To simulate the steady state and transient behaviour of a diode bridge rectifier (single phase and three phase) in MATLAB for R and RL load. Plot their current/voltage waveforms at source, diodes and load and comment on it.
10. To simulate the steady state and transient behaviour of DC Motors (shunt, series and compound) in MATLAB. Plot various current/voltage waveforms and characteristics and comment on it.
11. To simulate the steady state and transient behaviour of Transformers (single phase/three phase) in MATLAB. Plot various current/voltage waveforms and comment on it.
12. To simulate the steady state and transient behaviour of a single phase center tapped transformer based diode rectifier in MATLAB for R and RL load. Plot their current/voltage waveforms at source, diodes and load and comment on it.
13. To simulate the speed control of DC Motors (shunt, series and compound) in MATLAB using variable AC source and diode bridge rectifier and by armature and field control methods. Plot various current/voltage waveforms and comment on it.
14. To model a multiphase transformer using single phase/three phase Transformers in MATLAB and simulate its steady state and transient behaviour. Plot various current/voltage waveforms and comment on it.
15. Introduction to Labview and examples.

Recommended Books:

Title	Author	Publisher
Getting Started with MATLAB	Rudra Pratap	Oxford University Press
Mastering MATLAB 7	Hanselman & Littlefield	Prentice Hall
Electric Machinery	Fitzgerald, Kingslay and Umans	McGraw Hills

Title of the Course : **Analytical Instrumentation**
Subject Code : **IE-613**
Weekly Load : **5** **LTP 302**
Credit : **4**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction	Difference between analytical and other instruments, sampling, sampling system for liquids and gases, sampling components, automatic and faithful sampling.	06
	Spectrometry - I	Electromagnetic Radiation, Radiation Sources, Beer's Law, Lambert's Law, UV, IR and Visible Spectrophotometer, Flame Photometer and Atomic Absorption Spectrometer : Basic principle, block diagram and related instrumentation	06
	Spectrometry - II	Basic principle, block diagram and related instrumentation of X-ray analyzers, NMR spectrometry, Mass spectrometry and its types.	06
	Chromatography	Basic Principle and Types of Chromatography: Types, Block Diagram and related instrumentation of gas and Liquid Chromatography	06
Unit-2	Electron microscopy	Introduction, types of electron microscopy: SEM and TEM, Difference between optical microscopy, SEM and TEM	06
	Gas analyzer	Types: paramagnetic oxygen analyzer, IR gas analyzer, thermal conductive gas analyzer, analyzer based on gas density	06
	Potentiometry	Electro chemical cell, Ion sensitive Electrodes, Solid state sensors, gas sensing electrode, bio catalytic membrane electrode	06
	Data presentation and analysis	Analytical data presentation, error analysis	06

Recommended Books:

Handbook of Analytical Instruments	R S Khandpur	TMH
Analytical Instrumentation: an Introduction	R P Khare	C.B.S. Publication
Instrumental methods of analyses	H.H. Willaird, Lynnell Merrikt Jr., John A. Dean, F.A. Settle	Wadsworth Publishing Company
Principles of Industrial Instrumentation	Patranbis	TMH
Instrument Technology Vol II	E B Jones	Butterworths Scientific Publication

Practicals: IE-613

1. To estimate the concentration of given sample in a solution (PPM) in on flame photometer.
2. To measure the viscosity of given solution using viscometer.
3. To measure the transmittance of a given sample solution using UV spectrometer.
4. To measure the transmittance of a given sample solution using Visible spectrometer.

5. To measure the conductivity of given sample solution using Conductivity meter.
6. To measure the absorbance of a given sample solution using UV spectrometer.
7. To measure the concentration of a given sample solution using UV spectrometer.
8. To measure the concentration of a given sample solution using Visible spectrometer.
9. To measure the absorbance of a given sample solution using Visible spectrometer.
10. To determine the composition of a given sample using gas chromatograph.
11. To determine the transmittance of the copper sample using Atomic Absorption Spectrometer.
12. To determine the absorption of the copper sample using Atomic Absorption Spectrometer.
13. To determine the concentration of the copper sample using Atomic Absorption Spectrometer.

Title of the course : **Non-Linear and Discrete Control System**
Subject Code : **IE-614**
Weekly load : **5** **LTP-3 0 0**
Credit : **4**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	State space analysis & design	Review of state space representation for linear continuous time system, solution of linear time invariant state equations, controllability and observability, solution of state equation for discrete system, state space analysis of discrete time systems, pole placement techniques	08
	Non-linear control systems	Introduction to non-linear feedback control system, different types of non linearities, special features of non-linear systems: limit cycles, jump resonance and sub harmonics resonance etc. Definition of describing function.(D.F.), D.F.'s for various non-linearities, D.F. analysis of non-linear control systems, stability analysis using Limit cycles, and jump resonance.	10
	Phase Plane Analysis	Phase-plane analysis for non linear systems. Singular points, Construction of phase-plane plots for non -linear systems.	08
Unit-2	Liapunov's Stability Analysis	Introduction, Concept of local, global and asymptotic stability, Liapunov's Stability criterion, The direct method of Liapunov and the linear systems, Methods of constructing Liapunov function for non-linear system.	12
	Discrete time control systems (Part-I)	Basic elements of a discrete data control system & its advantages over the continuous time systems A/D and D/A conversions, Spectrum analysis of sampling process and signal reconstruction Sample and hold device, Z-transforms, Inverse Z-Transform, Pulse transfer function, Pulse transfer functions of cascaded elements, Pulse transfer function of close loop system	12
	Discrete time control systems (Part-II)	Modified Z-transform, Stability analysis of close loop systems in Z-domain, Stability criterion by Jury's test, schur-cohn method, Stability analysis by bilinear transformation and Routh's stability criterion, state space representation of discrete time systems.	10

Recommended Books-

1. Control Systems Engineering By Nagrath IJ and Gopal M, New Age International Publishers
2. Modern Control Engineering By Ogata K, PHI
3. Digital Control System By Kuo BC, Pearson Education
4. Digital Control Engineering By Gopal M, Willey Eastern

Title of the course : **Industrial Instrumentation-II**
Subject Code : **IE-615**
Weekly load : **5** **LTP-3 0 2**
Credit : **4**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Metrology	Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, - Tool Makers Microscope - interferometry, optical flats, Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: - Sine bar, Sine center, bevel protractor and angle Decker	08
	Motion and Dimensional measurement	Potentiometers, differential transformers, variable inductance & variable reluctance pickups, capacitance pickup, Piezo-electric transducers, digital displacement transducers, Relative velocity Translational and rotational, calibration, velocity by electrical differentiation of displacement voltage signals, average velocity from measure Δx and Δt , mechanical fly ball angular velocity sensor, mechanical revolution counters, tachometer encoder methods, stroboscopic method, translational velocity transducer, eddy current Drag-cup tachometer, Gyroscopic angular displacement and velocity sensors.	10
	Force, Torque, and Shaft power	Basic methods of force measurement; characteristics of elastic force transducer-Bonded strain gauge, differential transformer, Piezo electric transducer, variable reluctance/FM-oscillator, digital systems. Loading effects; Torque measurement on rotating shafts, shaft power measurement (dynamometers).	10
Unit-2	Acoustic and Vibrations	Acoustic: Condenser Microphones, sound pressure level measurement, sound intensity measurement, Vibration: Siesmic transducers, Types of accelerometers, Potentiometer type, LVDT type, Piezoelectric type accelerometers	08
	Miscellaneous Measurement	Viscosity Measurement: capillary, falling ball, oscillating, ultrasonic viscometers pH Measurement: electrochemical and optical method for pH measurement, Density Measurement: buyoncy type, balance type, column type, absorption type, radioactive densitometers, Humidity and moisture measurement: definitions – absolute, specific, relative humidity and dew point, Dry and wet bulb psychrometer, Hair hygrometer, dew point meter, infrared hygrometer conductance and capacitance method. Specific gravity Measurement Conductivity Measurement	12

--	--	--	--

Recommended Books:

1. Jain.R.K,*Mechanical and industrial measurements*, Khanna
2. Patranabis.D, *Principles of industrial instrumentation*,TMH
3. Fribance, *Industrial instrumentation fundamentals*, Mcgraw hill.
4. Birdie G.S. & Birdie J.S., *Water Supply and Sanitary Engineering*, Dhanpat Rai & Sons
5. Andrew and Williams, *Applied instrumentation in process industries*, Gulf pub.Vol- 1,2
6. Jones.E.B, *Instrument technology*, Scientific Pub.
7. Liptak.B.G , *Instrument Engineers H/B Vol- 1*, Chilton book.co.
8. Doebelin.E.O, *Measurement system- Application and design*, Mcgrow hill
9. Trade journals like I&C.S, Intech, Control and instrumentation etc.
10. Fairgeyer & Okun, *Water and Waste Water Technology*, Prentice Hall of India.
11. Mark .J.Hammer& Mark.J.Hammer.jr, *Water and Waste Water Technology*, Prentice Hall of India.

Practicals: IE-615

1. Measurement of Viscosity using viscometer.
2. Measurement of density using densitometer.
3. To Study Characteristics of accelerometer.
4. Measurement of humidity using rotational hygrometer.
5. To Study Characteristics of inductive transducer LVDT.
6. To Study Characteristics of strain gauge for load measurement.
7. To Study Characteristics of hall effect sensor.
8. To Study Characteristics of LDR applied sensor.
9. Study of characteristic of Stroboscope along with its application in speed measurement.
10. Study of pH meter.
11. To Study Characteristics of conductivity meter.
12. To Study Characteristics of Speed measurement- Tachometer.
13. To Study Characteristics of digital RPM counter.
14. To measure the torque with the help of Digital Instrumentation Tutor.
15. To determine the specific gravity of battery acid with the help of Hydrometer.
16. To Study the Characteristics of Piezoelectric Transducer.
17. To Study the Characteristics of Moving coil loudspeaker.
18. To Study the Characteristics of Buzzer.

Title of the course : **Nuclear Instrumentation**
Subject Code : **IE-621A**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Introduction to properties of Nuclear system and Radiation, Interaction of radiation with matter ,General Properties of Nucleus, Radioactivity, Nature of Nuclear Radiations, Characteristic properties of radioactive radiations, Properties of Alpha, Beta, and Gamma rays, Natural and artificial radio-activity. Radioactivity Laws, Half life period, radioactive series, Isotopes and Isobars, Various effects- photoelectric, Compton scattering and pair production, stopping power and range of charged nuclear particles.	08
	Radiation detectors	Techniques for weak signal detection, Detectors for Alpha, beta and gamma rays, Detector classification. Ionization chamber, Regions of multiplicative operation, Proportional counter, Geiger Muller counter-volt ampere characteristics, Designing features, Scintillation detectors (Photomultiplier tube- types, dark currents, scintillators, pulse resolving power) , efficiency of detection, SNR improvement, Solid state detectors (Lithium ion drifted -Si-Li, Ge-Li, Diffused junction, surface barrier)	10
	Electronics and Counting systems	Pre-amp., main amplifiers, Discriminators, Scalars and count rate meters, Pulse shaping, pulse stretchers, Coincidence circuits, photon counting system block diagram, factors influencing resolution of gamma energy spectrum, Energy resolution in radiation detectors, single and multichannel analyzers (MCA),pulse height analyzers (PHA).	06
Unit-2	Applications in Industry	Basic Nuclear Instrumentation system- block diagram, Nuclear Instrumentation for laboratory. Personal monitors like Thermo Luminescence Detectors (TLD), Dosimeters, Tele-detectors, which are used to assess the radiation exposure to the radiation plant workers. Nuclear Instrumentation for power reactor. Nuclear Instrumentation for Toxic fluid tank level measurement, Underground Piping Leak detection, weighing, thickness gauges, water content measurement etc. Agriculture applications like food irradiation.	10
	Applications in Medicines	Gamma camera- design, block diagram, medical usage. Radiation uptake studies- block diagram and design features. Nuclear Instrumentation for health care, Radiation Personnel	08

		Health Monitors like neutron monitors, Gamma Monitors, Tritium monitors, Iodine monitors and PARA (particulate activity radiation alarms).	
	Safety	Hazards of ionization radiation, physiological effect of radiation, Dose and Risk, Radiological protection-Shielding material and effectiveness. Operational safety instruments, Emergency schemes, affluent disposal, Applications to medical diagnosis and treatment.	06

Recommended Books-

1. G. F. Knoll, .Radiation Detection & Measurement., 2nd edition, John Wiley & Sons,1998.
2. P.W.NICHOLSON, .Nuclear Electronics., John Wiley, 1998.
3. S. S. Kapoor & V. S. Ramamurthy, .Nuclear Radiation Detectors., Wiley Eastern Limited, 1986.
4. Gaur & Gupta, .Engineering Physics., Danpat Rai & Sons, 2001.
5. Irvin Kaplan, .Nuclear Physics., Narosa, 1987.
6. M.N.Avdhamule & P.G.Kshirsagar, .Engineering Physics. S.Chand & Co., 2001.
7. R. M. Singru, .Introduction to Experimental Nuclear Physics", Wiley Eastern Pvt. Ltd., 1974.
8. Hand Book of Nuclear Medical Instruments, TMH Publishing New Delhi, 1974.
9. Washlete CCH and Hewitt SG, Nuclear Instrumentation, Newnes,1965
10. issue of national research control, "Digital instrumentation and control system in Nuclear Power Plant: Safety and Reliability Issue" National Academy Press, 1977

Title of the course	:	Robotics	
Subject Code	:	IE-621B	
Weekly load	:	3	LTP-3 0 0
Credit	:	3	

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Fundamentals of robot technology	Robots in science fiction – automation and robotics, Asimov’s laws of Robotics Definition of robot, anatomy of a robot, classification (type of control, capability, configuration and mobility), use of robots, robot motions and degrees of freedom, joint notation scheme ,work volume ,speed of motion, load carrying capacity – speed of response and stability, precision of movement.	08
	Actuators & Power Transmission System	Pneumatic – hydraulic – electric – dc servomotor – stepper motor - ac servomotors. Power Transmission Systems: Gears – power screws – pulleys, chains and harmonic drives – horse power – electric motor efficiency.	08
	Transducer and Sensors	Position sensors – potentiometers – resolvers – encoders – velocity sensors – tactile sensors – touch sensors (capacitance, resistance, resistive material, etc.) – force sensors (force sensing resistor, capacitance, force sensing wrist, joint sensing, and tactile array sensors) – proximity sensors – optical proximity sensors/range sensors (two emitter proximity sensor, ranging light based sensor, LIDAR, etc.) – Acoustic sensors – Magnetic	08

		sensors.	
	Machine Vision	Introduction – the sensing and digitalizing function in machine vision – imaging devices – lighting techniques – ADC – image processing and analysis – image data reduction – segmentation feature extraction – object recognition – training the vision system – robotic applications.	08
Unit-2	Robot end effectors	type of end effectors – mechanical grippers – basic definitions and operations – type of gripper mechanism – other types of grippers (vacuum cups, magnetic grippers, adhesive grippers, and hooks and scoops) – tools – the robot to end effector interface – checklist of factors in the selection and design of grippers.	08
	Robot arm kinematics	Construction of manipulator – the direct kinematics problem - the inverse kinematics problem – inverse transform techniques for Euler Angles solution – geometrical approach.	
	Robot arm dynamics & Planning of manipulator trajectories	Lagrange euler formulation – kinetic energy of a robot manipulator – potential energy of robot manipulator – motion equations of a manipulator – Newton euler formulation – rotating coordinate system – moving coordinate system. Joint interpolated trajectory – planning of Cartesian path trajectories – four types of robot controls.	08
	Case Studies	Hill climbing techniques – multiple robots – machine interface – robot cell design –selection of robot.	06

Recommended Books-

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, *Industrial Robotics: Technology, Programming, and Applications*, McGraw-Hill International Edition.
2. K.S.Fu, R.C.Gonzalez and C.S.G.Lee, *Robotics: Control, Sensing, Vision, and Intelligence*, McGraw-Hill International Editions.
3. Ghosh, *Control in Robotics and Automation: Sensor Based Integration*, Allied Publishers.
4. Deb.S.R, *Robotics Technology and Flexible Automation*, John Wiley.
5. Asfaht.C.R, *Robots and Manufacturing Automation*, John Wiley.
6. Klafter.R.D, Chemiclewski.T.A and Negin.M, *Robotics Engineering – An Integrated Approach* Prentice Hall of India.
7. Mc Kerrow.P.J, *Introduction to Robotics*, Addison Wesley.
8. James G. Keramas, *Robot Technology: Fundamentals*, Vikas Publishing House

Title of the course : **Optimal Control System**
Subject Code : **IE-621C**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction and Parametric Optimization	Introduction to optimal control problems, Classification of optimal control problems, performance indices for optimal control and their selection, Dynamic optimization using.	08
	Calculus of variations	Lagrange multiplier, Euler Lagrange's equation for different conditions, Transversality conditions, Dynamic optimization with equality and inequality constraints	08
	Pontryegans Max/min Principle	Optimization using Pontryegans maximum (minimum) principles with special emphasis on Bang-Bang type system	08
Unit-2	Dynamic Programming in Continuous Time	Developments of Hamilton Jacobi equation, Matrix Riccati equation, Optimal control based on quadratic performance indices, Linear regulator and servomechanism problem	08
	Dynamic programming in Discrete System	Dynamic programming multi stage decision processes in continuous time. Principle of causality, Invariant inbedding & optimality	08
	Iterative Method of Optimization and sensitivity analysis	Optimization using gradient methods and interactive techniques (steepest descent), Newton Raphson and Fletcher Powell. Introduction to multivariable system and decoupling, Introduction to Optimal Filters (Kalman Filter)	08

Recommended Books-

1. Modern Control System Theory By Gopal M, Wiley Eastern
2. Optimum Systems Control By Andrew P Sage & C C White-III, PHI
3. Optimum System Control By B D O Anderson & B Moree, PHI

Title of the course : **Environmental Instrumentation**
Subject Code : **IE-621D**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Necessity of instrumentation & control for environment, sensor requirement for environment. Instrumentation methodologies: Ultraviolet analyzers, total hydrocarbon analyzers using flame ionization detector, Gas chromatography in environmental analysis, photo ionization, portable & stationary analytical instruments.	06
	Water Quality	Quality of water: Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity, detectors, Opacity monitors, pH analyzers & their application, conductivity analyzers & their application. Water treatment: Requirement of water treatment facilities, process design.	08
	Water Treatment Techniques	Sedimentation & flotation: General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin, reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation. Ground water monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution	10
Unit-2	Waste Water monitoring	Waste water monitoring: Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. Air pollution: definitions, energy environment relationship, importance of air pollution, air pollution from thermal power plant, their characteristics & control. Air sampling methods & equipments, analytical methods for air pollution studies. Control of air pollution.	10
	Air Monitoring	Air monitoring: measurement of ambient air quality. Flow monitoring: Air flow measurement, gas flow, non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, rate of NGOs municipal corporation, Govt., limitations. Quality	12

		assurance of storage water.	
--	--	-----------------------------	--

Recommended Books-

1. Water treatment technology - Walter J. Weber
2. Air pollution engineering – M. N. Rao & H. V. N. Rao
3. Air pollution control technology – Wark & Warner
4. Environmental Instrumentation & Analysis Handbook- Randy D. Down

Title of the course : **Image processing**
Subject Code : **IE-621E**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Definition of image, generation of image, steps in image processing, elements of digital image processing systems, image enhancements, restoration and analysis	06
	Digital Image Fundamentals	Elements of visible perception, image model, sampling and quantization, relationships between pixels, imaging geometry.	06
	Image Transforms	Introduction to D.F.T., 2-D.F.T., F.F.T., other separable image transforms (walsh, hadamard, discrete cosine, haar, slant, KL)	06
	Image Enhancements	Point operations, histogram modeling, spatial filtering-smoothing, sharpening, low pass, high pass, homomorphic filtering.	06
Unit-2	2-D systems and mathematical preliminaries	Introduction and definitions, matrix theory, random signals, spectral density function, results from estimation and information theory.	06
	Image Restoration	Image observation models, inverse and wiener filtering, F.I.R. wiener filters, filtering using image transforms, least squares filters, generalized inverse, S.V.D. and interactive methods, recursive filtering, causal models, digital processing of speckle images, maximum entropy restoration.	06
	Image Segmentation	Detection of discontinuities, edge linking and boundary detection, thresholding region oriented segmentation, use of motion in segmentation.	06
	Image Data Compression	Introduction, pixel coding, predictive techniques (PCM, DPCM, etc), transform coding theory of images, hybrid coding and vector DPCM	06

Recommended Books-

1. R. C. Gonzalez, .Image Processing. Pearson Education 2nd edition, 1999.
2. A. K. Jain, .Fundamental of Digital Image Processing., PHI 2nd edition, 1995.
3. W. K. Pratt, .Digital Image Processing., John Wiley and Sons, 1994.
4. C. Phillips, .Image Processing in C., BPB Publication, 1995.
5. B. Chanda, D. Dutta Majumdar, .Digital Image processing., PHI, 2000.
6. Emmanuel C. Ifeachor and Barry W. Jervis, .Digital Signal Processing., Pearso Education, 2nd edition, 2000.
7. Don Pearson, .Image Processing. (The ESSEX series in Telecommunication an information systems, McGraw Hill International ELTL engg. series), 1991.
8. Johnny Johnson, .Introduction to DSP., PHI . 1996.
9. Proakis, .DSP. , PHI 1997.
10. Rabnier Gold, .Theory and Application of DSP., PHI, 1996.
11. Milan Sonka, Vaclav Hlavac, .Image Processing analysis and machine vision., Thomson Learning, 2nd edition, 1999.

Title of the course : **Statistical and Optimization Techniques**
Subject Code : **IE-622**
Weekly load : **5** **LTP-3 2 0**
Credit : **4**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	INTRODUCTION TO OPTIMIZATION	Statement of an optimization problem, Classification of optimization problems, Optimization techniques, Engineering applications of optimization.	06
	CLASSICAL OPTIMIZATION TECHNIQUES	Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with in equality constraints.	06
	LINEAR PROGRAMMING	Standard form of linear programming, Simplex method, Computer implementation of the Simplex method, Duality theory.	06
	TRANSPORTATION PROBLEM	North-West Corner rule, Least cost method, Vogel approximation method, testing for optimality.	06
Unit-2	NON-LINEAR PROGRAMMING: One-Dimensional Minimization Methods	Unimodal function, Dichotomous search, Fibonacci search, Golden Section, Cubic interpolation method, Direct root, Newton Raphson Method	06
	Unconstrained Multivariable Optimization Techniques	Random search method, Steepest descent method, Conjugate gradient method, Newton Raphson Method, Evolutionary search, Hooke-Jeeves Method, Simplex search Method	06
	Constrained Optimization Techniques	Interior Penalty function method, Exterior penalty function method, Method of Multipliers, KKT Conditions	06
	FURTHER TOPICS IN OPTIMIZATION	Critical path method (CPM), Program evaluation and review technique (PERT). Multiobjective Optimization Techniques, Weighting method, ϵ -constraint method. Simulated annealing method	06

Recommended Books-

1. Rao, S.S., 'Optimization : Theory and Application' Wiley Eastern Press, 2nd edition 1984.
2. Deb Kalyanmoy, 'Optimisation for Engineering Design-Algorithms and Examples', Prentice Hall India-1998
3. Taha, H.A., 'Operations Research -An Introduction', Prentice Hall of India, 2003.
4. Fox, R.L., 'Optimization methods for Engineering Design', Addison Welsey, 1971.
5. Ravindran A., Ragsdell K.M. and Reklaitis G.V. , 'Engineering Optimization: Methods And applications , Wiley, 2008
6. Godfrey C. Onwubolu , B. V. Babu , 'New optimization techniques in engineering , Springer, 2004

Title of the course : **DATA COMMUNICATION AND NETWORKING**
Subject Code : **IE-623**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction and network models	An Introduction to data communication and networks, internet, Protocols and standards, layered tasks, OSI model, Layers in OSI model, TCP/IP protocol suite, Addressing	08
	Physical layer and media	Introduction, Analog and digital signals, periodic and non periodic signals, Digital to digital conversion, analog to digital conversion, transmission modes , digital to analog conversion, analog to analog conversion.	08
	Data link layer	Error detection and correction, data link control, multiple access, Ethernet, wireless LAN-IEEE 802.11, Bluetooth	08
Unit-2	Network layer	Need for the network layer, IPv4 and IPv6 addresses, Internet working, address mapping	08
	Transport Layer	Process to process delivery, UDP, TCP and SCTP	08
	Application layer	Domain name system, remote logging , electronic mail and file transfer, www and http	08

Recommended Books-

1. Dcou Reynders, Steve Mackay, Edwin Wright, *Practical Industrial Data Communications*, 1st edition ELSEVIER, 2005.
2. Lawrence M Thompson, *Industrial data Communication*, 2nd edition, 1997.
3. Daniel T Miklovic, *Real time control network*, ISA 1993.
4. Bela G Liptak, *Process software and digital networks*, 3rd edition, 2002.
5. Andrew S. Tanenbaum, *Computer Networks*, 4th Edition, PHI/Pearson Education, 2002.
6. Behrouz A. Forouzan, *Data Communications and Networking*, 2nd update Edition, Tata McGraw Hill Publishing Company, New Delhi, 2000.
7. Douglas E. Comer, *Computer Networks and Internets*, 2nd Edition, Pearson Education Asia, 5th Indian reprint, 2001.

Title of the course : **Data Acquisition System**
Subject Code : **IE-624**
Weekly load : **5** **LTP-3 0 2**
Credit : **4**

Theory:

Unit	Main Topics	Course Outline	Lectures
Unit-1	Data Acquisition Systems	Block diagram of data acquisition System & its applications, Analog& digital acquisition systems, signal conditioning of the inputs, single channel data acquisition, multi-channel DAS, computer based DAS, uses of data acquisition systems, use of recorders in digital systems & block diagram of digital data recording system, data logging system, compact data logger , modem digital data acquisition,digital transducer.	08
	Data Transmission System	Methods of data transmission, transmission channels & media, Modulation & demodulation, amplitude, frequency & phase modulation, Comparison between frequency & amplitude, pulse modulation (PAM, PDM, PFM, POM), delta modulation, adaptive data modulation & Companding, digital data codes, error correcting & error detecting codes, Asynchronous & synchronous data transmission, pulse code formats used in data transmission, radio link, frequency division & time division multiplexing, time division multiplexing using mechanical commutator, electronic time division multiplexing system, block diagram of AM frequency division multiplexing system.	08
	Digital Instruments	digital to analog converters, analog to digital converters, electromechanical ADC, Digital Transducers.	06
Unit-2	Introduction to Telemetry Principles	Definition, generalized block diagram of Telemetry System, Classification of Telemetry system, Working principle, salient features and applications of the following Telemetry System: DC Voltage, current and position telemetry system, Pulse telemetry System, Introduction to Satellite telemetry And Fibre Optic telemetry system	08
	Modems, Transmitters and receivers	Modems Introduction, Transmitters, Transmission Techniques, Inter stage Coupling, Receiver, Introduction to Antennas	08
	Display Systems	Construction, principle of operation and salient features of various kinds of display devices	05
	Recorders	Working principle, Construction, operation and	05

		salient features of Strip Chart Recorder, X-Y strip chart recorder and magnetic recorder	
--	--	--	--

Recommended Books-

1. Sawhney AK, "Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Sons, 1993
2. Patranabis D, "Telemetry Principles", Tata McGraw Hill.
3. Munez-Ruiz, Angel; Vromans, Herman, "Data Acquisition and Measurement Techniques", CRC Press
4. Doebelin EO, "Measurements Systems- Application and Design", Tata McGraw Hill.
5. Gruenberg EL, "Handbook of Telemetry & Remote Control", Tata McGraw Hill.
6. Kalsi HS, "Electronic Instrumentation", Tata McGraw Hill.

Practicals: IE-624

1. Measurement of Temperature Using RTD/ Thermister and amplification to an appropriate level suitable for Tele transmission.
2. Sampling through a S/H Circuit and reconstruction of the sampled signal. Observe the effect of sampling rate & the width of the sampling pulses.
3. Realization of PCM signal using ADC and reconstruction using DAC using 4-bit/8 bit systems. Observe the Quantization noise in each case.
5. Realization of data in different formats such as NRZ-L, NRZ-M and NRZ-S.
6. Clock recovery circuit from NRZ-L data using PLL.
7. Manchester coding & decoding (Biphase L) of NRZ-L Data.
8. Coding and decoding NRZ-L into URL-L (Unipolar return to Zero coding).
9. ASK – Modulation and Detection
10. FSK – Modulation and Detection
11. PSK - Modulation and Detection.
12. Error introduction, Error Detection & Correction using Hamming Code.
13. Amplitude modulation and Detection of signal obtained from experiment no.1.

Title of the course : **Biomedical Instrumentation**
Subject Code : **IE-625**
Weekly load : **5**
Credit : **4**

LTP-3 0 2

Theory

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Physiological systems of body	Brief description of nervous, circulatory and respiratory systems, the body as a control system, the nature of bioelectricity, the origin of biopotentials.	06
	Bio electric Signals And Electrodes	Electro conduction system of the heart, the ECG Waveform, Neuron potential, muscle potential, electrodes for biophysical sensing, Skin-contact-impedance, electrodes for EEG,EMG and ECG, electrical conductivity of electrode jellies and creams.	06
	Cardiovascular measurements	The standard lead system, the ECG preamplifier; ECG machines, Cardiac monitors, , blood pressure measurements, direct and indirect, blood flow measurements, phonocardiography, defibrillators, pacemakers	06
	Measurements of Electrical Activity in Brain	Anatomy of Human Brain and Nerve Cell, EEG electrodes and the 10-20 system, EEG amplitude and frequency bands, simplified block diagram, preamplifiers and EEG system specifications, EEG diagnostic uses and sleep patterns, visual and auditory evoked potential recordings, EEG system artifacts.	06
Unit-2	EMG	Muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, electrodes, signal conditioning and processing, Block diagram & description of Electromyography (EMG).	04
	Respiratory System Measurements	Respiratory anatomy,parameters of respiration, regulation of respiration, respiratory system measurements, respiratory transducers and instruments, spirometry.	08
	Medical Imaging	Introduction to Medical Imaging, Computers in Medical Imaging, Computerized Ultrasonic Diagonosis and types, X-Rays, Computerized Tomography, Computerized Emission Tomography	08
	Biotelemetry	Physiological parameters adaptable to bio-telemetry, Components of a biotelemetry system, Implantable units, Applications of telemetry system in patient care.	04

Recommended Books:

Title	Author	Publisher
Handbook of biomedical instrumentation	R S Khandpur	TMH

Biomedical instrumentation and measurement	L Cromwell	PHI
Introduction to Biomedical Equipment Technology	Joseph J Carr John M.Brown	PE
Medical Instrumentation	John G.Webster	WSE

Practicals: IE-625

1. To measure the respiration rate of human body with the help of Thermistor as a transducer.
2. To measure the pulse rate of human body with the help of physiopac .
3. To measure the GSR of human body using Biofeed back kit.
4. To measure the blood pressure using sphygmomanometer and Stethoscope.
5. To measure the blood pressure using OMRON kit.
6. To study the Blood sugar device.
7. Record ECG using student physiograph and identify P, Q, R, S and T components on the graph.
8. To study the QRS detection circuit and find out heart rate using R-R interval.
9. Compare the EMG signal obtained from unipolar and bipolar electrodes.
10. To study the characteristics of EEG signal.
11. Analyze the rest ECG and exercise ECG on TMT machine.
12. To Study the health of lungs with the help of spirometer.

Title of the course : **Computer Control of Processes**
Subject Code : **IE-626**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Hierarchical computer control system – data acquisition system – stand alone data acquisition – PC based data acquisition – analog signal conditioning – analog isolation – surge protection – digital signal conditioning – digital isolation – analog multiplexer – data loggers – supervisory control – computer based controllers (DDC) – SMART transducers and transmitters – SMART pressure transmitter – SMART temperature transmitter – SMART control valve – capabilities of SMART transducer.	12
	Programmable Logic Controller	PLC versus relay – characteristic functions of a PLC – PLC versus PC – PLC block diagram – I/O configuration – direct I/O – Parallel I/O – Serial I/O – slice I/O – input and output module (discrete and analog) – input and output devices – RS 232, 488 & 485 – CPU – memory unit – input image file – output image file – power supply – program loaders – hand held and computer based loaders – types of PLC software – programming languages – ladder programming – file organizing and addressing – instruction set – timers and counters instructions – communication instructions – i/o and interrupt instructions – math instruction – logical instruction – complete scan cycle – program execution – different types of PLC – system installation recommendations.	12
	Distributed control systems:	PLC versus DCS – DCS configuration – control room for DCS – the control console equipment – displays – software configurations – relay rack mounted equipment – local control units – communication between components – data highway design – highway compatibility – data highway communications – network access methods.	12
Unit-2	Introduction to SCADA system	Definition of SCADA – elements of SCADA system block diagram, – communication in SCADA – SCADA hardware and Software, applications –	12

Title of the course : **Microcontroller and Embedded System**
Subject Code : **IE-627**
Weekly load : **5** **LTP-3 0 2**
Credit : **4**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction	Microprocessor, Micro-controllers and their comparison. The 8051 Architecture: Introduction, 8051 micro-controller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts	12
	8051 Assembly Language Programming	Instruction format and addressing techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions), The mechanics of programming, assembly language programming process, programming tools and techniques,	12
Unit-2	8051 Microcontroller Design	Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding I/O, memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission	12
	Microcontroller Applications	Interfacing keyboards, displays, D/A and A/D, multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems: Introduction to PLDs and FPGA- architecture, technology and design issues, implementation of 8051 core.	12

Recommended Books-

1. Kenneth J Ayola, *The 8051 Micro Controller- Architecture, Programming and Application*, Penram International Publication
2. John B Peatman, *Design with Micro Controller*, Tata McGraw Hill
3. Ray A. K. and Bhurchandi K. M., *Advanced Microprocessors & Peripherals; Architecture, Programming & Interfacing*, Tata McGraw Hill
4. Mazidi M. A. and Mazidi J. G., *The 8051 Micro-controller & Embedded System*, Pearson Education.
5. Surekha Bhanot, *Process Control*, Oxford Higher Education.
6. Otter, Job Dan, *Programmable Logic Controller*, P.H. International, Inc, USA
7. Dunning Gary, *Introduction to PLCs*, Tata McGraw Hill
8. Kumar Rajesh, *Module on PLCs and their Applications*, NITTTR Chandigarh

Practical: IE-627

1. Study of 8051 Microcontroller, Architecture & command.
2. Write an ALP for the Addition & Subtraction of 8 bit no's.
3. Write an ALP for multiplication of Two 8 bit no's.
4. Write an ALP for Division of Two 8 bit no's.
5. Write an ALP to find smallest & largest no in a given array.
6. Write an ALP to generate 10 KHz frequency using interrupt.
7. Write an ALP to interface intelligent LCD display with m C.
8. Write an ALP for m C & HLL for PC (VB/C++/VC++) to demonstrate/implement serial Interfacing.
9. Write an ALP to interface LED display.
10. Write an ALP to interface one m C with other using serial/parallel communication.
11. Write an ALP to switch ON alarm when m C receive interrupt

Title of the course : **Machine Vision**

Subject Code : **IE-711A**

Weekly load : **3**

LTP-3 0 0

Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Fundamentals of Machine vision	Machine vision, grey scale vs color image, basic image processing operations, basic image filtering techniques, thresholding techniques	08
	Edge detection	Basic theory of edge detection, template matching approach, Differential gradient operators, circular operators	08
	Morphological operations	Dilation, erosion and their properties, closing and opening, Hit and miss transform	08
Unit-2	Edge detection	Basic theory of edge detection, template matching approach, Differential gradient operators, circular operators	08
	Line and Circle detection	Hough transform for line detection, Foot of normal method, Longitudinal line localization, Hough based schemes for circular object detection	08
	Pattern matching techniques	Graphical approach to object location, maximum clique and other approaches, relational descriptors	08

Recommended Books-

[1] **Machine Vision: Theory, Algorithms, Practicalities**

By E. R. Davies

[2] Handbook of machine vision by Alexander Hornberg

[3] Fundamentals of Machine Vision By Harley R. Myler

Title of the course : **Renewable Energy Resources**
Subject Code : **IE-711B**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	PRINCIPLES OF SOLAR RADIATION	Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.	08
	SOLAR ENERGY COLLECTION	Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.	06
	SOLAR ENERGY STORAGE AND APPLICATIONS	Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.	06
	WIND ENERGY	Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria	04
Unit-2	BIO-MASS	Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.	10
	GEOTHERMAL ENERGY	Resources, types of wells, methods of harnessing the energy, potential in India.	04
	OCEAN ENERGY	OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.	06
	DIRECT ENERGY CONVERSION	Need for DEC, Carnot cycle, limitations, principles of DEC.	04

Recommended Books-

1. Non-Conventional Energy Sources /G.D. Rai, Khanna Publishers
2. Renewable Energy Resources – Twidell & Wier, CRC Press(Taylor & Francis)
3. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa
5. Non-Conventional Energy Systems / K Mittal /Wheeler
6. Renewable energy sources and emerging technologies by D.P.Kothari,K.C.Singhal, P.H.I.

Title of the course : **Reliability Engineering**
Subject Code : **IE-711C**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Introduction, Importance of reliability, Reliability functions, Failure and Failure Modes, causes of failure, Instantaneous failure rate, General reliability Function.	08
	Component Reliability and Hazard Model	Component reliability from Test data, failure data (Failure density, failure rate, reliability, probability of failure) mean failure rate MTTF, MTBF. Hazard Models (Time dependent Hazard models, Constant Hazard model, Linear Hazard model, on-linear hazard model	08
	System Reliability	Reliability evaluation of non-maintained systems, series, parallel, series- parallel, non-series, standby configuration, k out of n configuration, complex system, Markov's Method, Fault tree technique, Event space, path Tracing methods, cut-set and tie set method	08
Unit-2	Reliability Improvement	Introduction, Improvement of components, redundancy: standby with perfect and imperfect switching .Comparison of component redundancy to system/unit redundancy, mixed redundancy, stand by redundancy	08
	Reliability Allocation	Introduction, Redundancy allocation and techniques for reliability allocation	06
	Availability and Maintainability	Concepts of reliability ,availability and maintainability, types of availability, objectives of maintenance, classification and factor effecting maintenance, maintenance levels, Inventory control of spare parts, Preventive maintenance of some electrical appliances	10

Recommended Books-

1. Reliability Engineering By L S Srinath, Affiliated East-West Press
2. Reliability Engineering By E. Balagurusamy, Tata McGraw Hill
3. Reliability Engineering By KK agarwal, academic Press
4. Reliability Engineering By AK Govil, Tata McGraw Hill

Title of the course : **Building Automation**
Subject Code : **IE-711D**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Fire Alarm System	Fundamentals: What is Fire? Fire modes, History, Components, and Principles of Operation FAS Components: Field Components, Panel Components, Applications. FAS Architectures: Types of Architectures, Examples FAS loops: Classification of loops, Examples. Power Supply design for FAS. Cause & effect matrix: Examples Fire Standards: FAS Design procedure in brief, NFPA 72A, BS 5839, IS	10
	Security Systems	Fundamentals: Introduction to Security Systems, Concepts, Access Control System: Access Components, Access control system Design., CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR, Based system, DVM, Network design, Storage design, CCTV Applications: CCTV Applications Perimeter Intrusion: Concept, Components, Technology, Advanced Applications Security Design: Security system design for verticals	08
	Introduction to HVAC System	Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating, Cooling etc) Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms, Examples. Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heat loss Processes: Heating Process & Applications (I.e. Boiler, Heater), Cooling Process & Applications (I.e. Chiller), Ventilation Process & Applications (I.e. Central Fan System, AHU, Exhaust Fans), Unitary Systems (VAV, FCU etc).	08
Unit-2	Control Theory	Control Theory: Instrumentation Basics, Field components & use, DDC & applications Architecture: Honeywell Architecture, BMS Components Control Panel: HVAC Control Panel, MCC Basics, Panel Components Communication: Communication Basics, Networks, BACNet, Modbus, LON	08
	Energy Management	ASHRAE Symbols Energy Management: Advantages of BMS, Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples	08
	Applications	Project Life Cycle: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS Verticals:	06

		Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation	
--	--	---	--

Recommended Books-

1. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) (Hardcover) by Reinhold A. Carlson (Author), Robert A. Di Giandomenico
2. Building Automation: Control Devices and Applications by In Partnership with NJATC (2008)
3. Building Control Systems, Applications Guide (CIBSE Guide) by The CIBSE (2000)
4. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon (2007)
5. Security/Fire Alarm Systems: Design, Installation, and Maintenance by John E. Traister (1995)
6. Building Automation Online by McGowan; McGowan, John J.; ISBN: 0824746155
7. HVAC Control in the New Millennium by Hordeski; Hordeski, Michael F.; Marcel Dekker, ISBN: 0824709152 EAN: 9780824709150 Publisher: Fairmont Press (2001) 16
8. HVAC Control System Design Diagrams by Levenhagen, John I.; ISBN: 0070381291 EAN: 9780070381292 Publisher: McGraw-Hill Professional Publishing (1998)
9. HVAC Controls and Systems by Levenhagen, John I. Spethmann, Donald H. ISBN: 0070375097 EAN: 9780070375093 Publisher: McGraw-Hill Professional Publishing

Title of the course : **Modelling and Simulation**
Subject Code : **IE-711E**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Introduction - systems and models - computer simulation and its applications -	04
	System Simulation	Continuous system simulation - modeling continuous systems - simulation of continuous systems - discrete system simulation - methodology – event scheduling and process interaction approaches - random number generation -testing of randomness - generation of stochastic variates - random samples from continuous distributions - uniform distribution – exponential distribution m-Erlang distribution - gamma distribution - normal distribution – beta distribution - random samples from discrete distributions - Bernoulli - discrete uniform - binomial - geometric and poisson	10
	Evaluation and Validation	Evaluation of simulation experiments - verification and validation of simulation experiments - statistical reliability in evaluating simulation experiments -confidence intervals for terminating simulation runs	10
	Simulation Languages	simulation languages -programming considerations – general features of GPSS - SIM SCRIPT and SIMULA. Simulation of queueing systems - parameters of queue - formulation of queueing problems - generation of arrival pattern - generation of service patterns -Simulation of single server queues - simulation of multi-server queues - simulation of tandom queues.	08
Unit-2	Simulation of Various Networks	Simulation of stochastic network - simulation of PERT network - definition of network diagrams - forward pass computation - simulation of forward pass -backward pass computations - simulation of backward pass - determination of float and slack times determination of critical path - simulation of complete network - merits of simulation of stochastic networks.	12

Recommended Books-

1. C. Deo N., *System Simulation And Digital Computer*, Prentice Hall of India.
2. Gordan G., *System Simulation*, Prentice Hall of India.
3. Law A.M. & Ketton W.D., *Simulation Modelling and Analysis*, McGraw Hill.

Title of the course : **Introduction to Soft Computing**
Subject Code : **IE-712**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Fuzzy Logic-I (Introduction)	Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.	08
	Fuzzy Logic –II (Fuzzy Membership, Rules)	Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfication & Defuzzification, Fuzzy Controller, Industrial applications.	08
	Genetic Algorithm(GA)	Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.	08
Unit-2	Neural Networks-1(Introduction & Architecture)	Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetero-associative memory.	08
	Neural Networks-II (Back propagation networks)	Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propagation learning methods, effect of learning rule coefficient; back propagation algorithm, factors affecting backpropagation training, applications.	08
	NEURO FUZZY MODELING	Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.	08

Recommended Books-

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.
3. Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
5. R.Eberhart, P.Simpson and R.Dobbins, “Computational Intelligence - PC Tools”, AP Professional, Boston, 1996.

Title of the course : **Virtual Instrumentation**
Subject Code : **IE-713**
Weekly load : **4** **LTP-2 0 2**
Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction	Virtual instrumentation, Role of virtual instrumentation , Hardware and software in virtual instrumentation, LabVIEW, LabVIEW environment, Palettes, Front panel, Block Diagram, Data types, Data flow programming, Debugging .	04
	Programming Techniques	Vis & Sub VIs, while & for loops & charts, arrays, array functions, cluster , cluster functions , graphs and chart for plotting data , case & sequence structures, formula modes, local & global variables, string & file I/O.	04
	Data Acquisition and Waveforms	Overview and Configuration, Analog and Digital I/O Inputs , signal classification , Data Acquisition in LabVIEW, Hardware configuration and selection , Data Logging, Analog Output, Counters.	04
Unit-2	Instrument Control	Instrument Control Overview, GPIB Communication and Configuration, Using the Instrument I/O Assistant, VISA , Instrument Drivers, Instrument Driver VIs, Serial Port Communication, Waveform Transfers	06
	Labview Signal Processing	Introduction to signal processing and analysis in Labview, signal generation, digital filtering, frequency analysis , Discrete Fourier transform ,Fast Fourier transform, Power spectrum, windowing etc.	06
	Advanced Labview features	Local, global and shared variables, property nodes, invoke nodes, event driven programming , introduction to the toolkits	06

Recommended Books-

1. Gary Johnson, Labview Graphical Programming second edition, McGraw Hill, NewYork, 1997.
2. Lisa K.Wells & Jeffrey Travis, Labview for everyone, Prentice Hall, New Jersey, 1997.
3. Jovitha Jerome, Virtual instrumentation using labview , Prentice Hall.

Practicals: IE-713

- 1) Getting started with LabView. Basic operations, controls, and indicators, simple programming structures.
- 2) LabView: Debugging a VI and Sub VI.
- 3) LabView: Traffic light programming.
- 4) Basics of GPIB. Setting up GPIB, address, simple read/write.
- 5) Communication via RS-232/serial port.
- 6) LabView: Incorporating user written C routine.

Title of the course : **Digital Signal Processing**
Subject Code : **IE-714**
Weekly load : **7** **LTP-3 2 2**
Credit : **5**

Theory

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	The discrete Fourier Transform	Definition of DFT and relation to Z-transform, Properties of the DFT, Linear and periodic convolution using the DFT, Zero padding, spectral leakage, Resolution and windowing in the DFT.	08
	The Fast Fourier transform	Decimation in time FFT, Decimation in frequency FFT. Positive Displacement	08
	Finite Impulse Response (FIR) filters	Window design techniques, Kaiser window design technique, Equiripple approximations.	08
Unit-2	Infinite impulse response (IIR) filters`	Bilinear transform method, Examples of bilinear transform method.	08
	Structures and Properties of FIR and IIR filters and review	IIR - Direct, parallel and cascaded realizations.,FIR – Direct and cascaded realizations, Coefficient quantization effects in digital filters	08
	Introduction to DSP Processor Architecture	Basic architectural features, DSP processor computational building blocks, Bus architecture and memory, Data addressing capabilities, Adress generation unit	08

Recommended Books:

- [1] Schaum's Outline of Digital Signal Processing, M. Hays, McGraw-Hill
- [2] Discrete-Time Signal Processing, A. Oppenheim and R. Schaffer, Prentice Hall, Second edition
- [3] MATLAB Reference Guide: High-Performance Numeric Computation and Visualization Software, The MathWorks, Inc., South Natick, MA, 1984-92.
- [4] Computer-Based Exercises for Signal Processing Using MATLAB 5, J. McClellan (Ed.), Prentice Hall, 1997.
- [5] Digital Signal Processing Using MATLAB (r), V. Ingle, J. Proakis, Brooks/Cole Pub. Co., 1999.
- [6] A Course in Digital Signal Processing, B. Porat, J. Wiley and Sons
- [7] Understanding Digital Signal Processing, R. Lyons, Prentice-Hall,
- [8] Digital Signal Processing: Principles, Algorithms and Applications, J. Proakis, D. Manolakis, Prentice-Hall, 2006 (4-th edition):
- [9] Digital Filter Design, T. W. Parks and C. S. Burras, J. Wiley & Sons, 1987
- [10] The Fast Fourier Transform and its Applications, E. O. Brigham, Prentice-Hall

Practicals: IE-714

1. With the help of Fourier series, make a square wave from sine wave and cosine waves. Find out coefficient values.
2. Evaluate 4 point DFT of and IDFT of $x(n) = 1, 0 \leq n \leq 3; 0$ elsewhere.
3. Implement the FIR Filters for 2 KHz cutoff frequency and 2 KHz bandwidth for band pass filter.
4. Design FIR filter using Fourier series expansion method.

5. Implement IIR low pass filter for a 4 KHz cutoff frequency and compare it the FIR filter with the same type use chirp as input signal.
6. Verify Blackman and Hamming windowing techniques for square wave as an input which window will give good results.
7. Implement the filter functions.
8. Generate DTMF sequence 1234567890*# and observe its spectrogram.
9. Generate an Amplitude Modulation having side low frequencies 1200 Hz and 800 Hz. Observe and verify the theoretical FFT characteristics with the observed ones.
10. Generate Frequency Modulation having carrier frequencies 1 KHz and modulating frequency 200 Hz with the modulation index of 0.7. Observe and verify the theoretical FFT characteristics with the observed ones.
11. Generate an FSK wave form for transmitting the digital data of the given bit sequence. Predict and verify the FFT for the same one.
12. To study the circular convolution.

Title of the course : **Process Plant Instrumentation**
Subject Code : **IE-716**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outline	Lectures
Unit-1	P& I diagrams	Reading and drawing of instrumentation diagrams. Flow sheet symbols-ANSI symbols for 1) lines,2) Valves, 3) heat transfer, 4) dryer, 5) material handling equipment, 6)storage vessel, 7)turbine/compressor, 8) flowsheet codes and lines, 9)graphical symbols for pipe fittings, valves and piping. Instrumentation symbols, standards, specifications-one line diagram of typical measurement and control schemes for flow, temperature, pressure and other process variables. One line diagram of typical pneumatic, hydraulic & electrical instrumentation systems.	20
	Process Flow Diagrams of Industries	cement, steel, chemical, petrochemical, food,paper textile etc.	10
	Instrumentation and control	boiler, chiller, distillation column, compressor, cooling tower, heat exchanger, steam turbine control water treatment , effluent and waste water treatment etc.	18

Recommended Books-

1. A text book of Chemical technology, Vol-I & Vol-II by G N Pandey, Vikas Publishing House
2. Applied Instrumentation in process Industries by W G Andrew, TMH
3. Handbook of Process Instrumentation by Considine, TMH
4. Handbook of Instrumentation : Process control : B.G.Liptak, Chilton

Title of the course : **Technical Communication & Soft Skills**
 Subject Code : HU-711/ HU-721
 Weekly load : 4 LTP 2-0-2
 Credit : 0 (Lecture 0; Practical 0)

Course Description	Lecture(s)
Unit- I	
Speech Mechanism	
Introduction to English Speech Sounds: Consonants and Vowels (basics only), Organs of Speech, Description & Classification of Consonant Sounds, Cardinal Vowel Scale	08
Oral Presentation and Professional Speaking	
Elements of effective presentation, Body language and use of Audio-Visual Aids during presentation, Planning and preparing a model presentation, Organizing the presentation to suit the audience and context	08
Unit- II	
Business Communication	
Business Letters-Placing, Cancelling, Complaints, Reply to Complaints, Notices, Agendas; Minutes of Meetings, Memorandums	08
Career-Oriented Communication	
Resume and Bio-data- Design and style, Applying for a job, Language and format of a job application, Job Interview- Purpose and process, How to prepare for an interview, Language and style to be used in an interview, Types of interview questions and how to answer them	08

Total=32

Recommended Books:

1. Mishra, Sunita & C. Muralikrishna. *Communication Skills for Engineers*. Pearson.
2. Gimson, A.C. *An Introduction to Pronunciation of English*. ELBS.
3. Jones, Daniel. *English Pronouncing Dictionary*. ELBS.
4. Bhattacharya, Indrajit. *An Approach to Communication Skills*. Dhanpat Rai & Co.
5. Sharma, R.C. & Krishna Mohan. *Business Correspondence and Report Writing*. Tata McGraw-Hill.

List of Experiments (10-14):

1. Self Description, Analysis and Interaction.
2. Oral Presentation on a Given Topic.
3. Group Discussion/ Debate on a Given Topic.
4. Reading a Literary Text and Preparing a Summary.
5. Learning Etiquettes in Communication: accepting/ arguing against others' views/ ideas, interrupting others' talks, addressing higher officials, colleagues, sub-ordinates.
6. Individual Power Point Presentations.
7. Team Project Work: Selecting a Survey Topic and collecting relevant material from the Library/ Internet Sources.
8. Designing a Questionnaire and Conducting the Survey.

9. Presenting the survey results and compiling the project report.
10. Visual Comprehension: Movies, Documentaries, Video Lectures and Summarizing.
11. Pronunciation Improvement Exercises.
12. Role Plays.
13. Mock Interviews.
14. Creative Writing: Poems, Articles, Stories etc.

Title of the course : **Switchgear and Protection**
Subject Code : **IE-721A**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	INTRODUCTION	Classification of substations, graphical symbols of substation components, Key diagram, substation equipments and auxiliaries	06
	CONVENTIONAL RELAYS	Introduction, classification, constructional features; and principle of operation of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Translay,	06
	CIRCUIT BREAKERS	Classification of circuit breakers, circuit breaker ratings, restriking voltage, current chopping, duties of switch gear, automatic switch, air circuit breaker, bulk oil CB, minimum oil CB, air blast CB, SF6 CB, vacuum and DC circuit breakers	06
	PROTECTION OF FEEDERS	Time graded protection, Differential and Distance protection of feeders, Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines.	06
Unit-2	PROTECTION OF ALTERNATORS	Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection..	06
	PROTECTION OF TRANSFORMERS	Types of fault on transformers, Protection schemes of transformer, percentage differential protection, BuchSulz relay	06
	PROTECTION AGAINST OVER-VOLTAGES	Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.	06
	STATIC RELAYS	Classification of static relays, amplitude and phase comparators, block-spike and block-average comparators, rectifier type relays, Introduction to digital relay: basic principles, Application of microprocessors and computers	06

Recommended Books-

1. Elgerd O.L., *Electrical Energy System Theory - An introduction*, Tata McGraw-Hill Publication
2. Gupta B.R., *Power System Analysis & Design*, Wheeler Publishing.
3. Nagrath I.J. and Kothari D.P., *Power System Analysis* Tata McGraw-Hill Publication
4. Stevenson Jr. W.D., *Elements of Power System Analysis*, Tata McGraw-Hill Publication
5. Wadhwa C.L., *Course in Electrical Power*, New Age International (P)Ltd.
6. Uppal S.L., *Electric Power*, Khanna Pub.
7. Gupta J.B., *Electrical Power*, S.K. Kataria & Sons
8. Weedy B.M., *Wiley John & Sons Electric Power System*.
9. Cotton H., *Transmission & Distribution of Electrical Engineering*:
10. *Transmission & Distribution of Electrical Engineering*: Westing House & Oxford Univ. Press, New Delhi.

Title of the course : **Industrial Safety Engineering**
Subject Code : **IE-721B**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**
Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Introduction to the concept of safety-Need-safety provisions in the factory Act-Laws related to the industrial safety-Measurement of safety performance, Safety Audit, Work permit system, injury and accidents-Definitions-Unsafe act –unsafe condition- causes, investigations and prevention of accidents, hazards, type of industrial hazards-nature, causes and control measures, hazard identifications and control techniques-HAZOP, FMEA,FMECA etc.	10
	Concept of Industrial hygiene, programmes	Recognition –Evaluation- Control, Noise- source – effects and noise control, exposure limits – standards, Hearing conservation programmes, Fire –fire load-control and industrial fire protection systems, Fire Hydrant and extinguishers,Electrical Hazards, protection and interlock-Discharge rod and earthing device, safety in the use of portable tools.	12
	Logics of consequence analysis	Estimation-Toxic release and toxic effects-Threshold limit values, Emergency planning and preparedness, Air pollution-classification-Dispersion modeling -pollution source and effects- - control method and equipments-Gravitational settling chambers-cyclone separators-Fabric filter systems-scrubbers etc.	12
Unit-2	Concept of reliability	Definition-Failure rate and Hazard function, System reliability modelseries, parallel systems, reliability hazard function for distribution functions-exponentialnormal –lognormal-weibull and gamma distribution.	12

Recommended Books-

1. Thomas J. Anton, *Occupational Safety and Health Management*, McGraw Hill
2. Ian T.Cameron & Raghu Raman, *Process Systems Risk Management*, ELSEVIER Academic press.
3. C.S.Rao, *Environmental Pollution Control Engineering*, New Age International Limited

Title of the course : **Advance Digital Signal Processing**
Subject Code : **IE-721C**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Multirate Signal Processing	The sampling theorem: sampling at subnyquist rate - Basic Formulations and schemes. Basic Multirate operations: Decimation and Interpolation - Digital Filter Banks- DFT Filter, Bank- Identities- Polyphase representation Maximally decimated filter banks: Polyphase representation - Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank	12
	Adaptive Digital Filters	Concepts -Wiener filter-LMS adaptive algorithm-Recursive least squares algorithm-Lattice Ladder filters. Application of Adaptive filters.	10
Unit-2	Wavelet Transform	Wavelets: The basic functions, Specifications, Admissibility conditions, Continuous wavelet transform (CWT), Discrete wavelet transform (DWT). The multiresolution analysis (MRA) of L2R): The MRA axioms, Construction of an MRA from scaling functions - The dilation equation and the wavelet equation, Compactly supported orthonormal wavelet bases - Necessary and sufficient conditions for orthonormality.	12
	DSP Processor Architecture	Basic Architectural Features, DSP computational Building Blocks, Bus architecture and memory, Data addressing capabilities, Adress generation units, Programmability and program execution, speed issues, features for external interfacing	12

Recommended Books-

- [1]. Alan V. Oppenheim, Ronald W. Schaffer & Hohn. R. Back, "Discrete Time Signal Processing", Pearson Education, 2nd edition, 2005.
- [2] J.G. Proakis. D.G. Manolakis, *Digital Signal Processing: Principles. Algorithms and Applications*, 3rd Edn. Prentice Hall India, 1999.
- [3] R.E. Crochiere. L. R., *Multirate Digital Signal Processing*, Prentice Hall.
- [4] DSP process fundamentals, Architecture and features-Lapseley, S.Chand
- [5] R. M. Rao and A. Bopardikar, "Wavelet transforms: Introduction to theory and applications" Addison-Wesley, 1998.
- [6] Ingrid Daubechies, "Ten lectures on wavelets", SIAM, 1990.

Title of the course : **Introduction to MEMS**
Subject Code : **IE-721D**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Historical Background: Silicon Pressure sensors, Micromachining, Micro Electro Mechanical Systems. Microfabrication and Micromachining: Integrated Circuit Processes. Potential of MEMS in industry.	06
	Bulk Micromachining	Bulk Micromachining : Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA)	06
	Physical Microsensors	Physical Microsensors: Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor Principles and Examples: Thermal sensors, Electrical Sensors, Mechanical Sensors, Chemical and Biosensors. Microactuators: Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors Microactuator systems: Success Stories, Ink-Jet printer heads, Micro-mirror TV Projector.	12
Unit-2	Fabrication Techniques-I	Microstereolithography (MSL) for 3D fabrication, Two photon MSL, Dynamic mask MSL, scanning systems, Optomechatronics system for MSL. Ceramic and Metal Microstereolithography.	08
	Fabrication Techniques-II	Ceramic and Metal Microstereolithography. Scattering of light by small particles. Effect of particle properties on accuracy and resolution of component in Ceramic and Metal MSL. Monte carlo ray tracing method. Nanolithography.	08
	Surface Micromachining	Surface Micromachining: One or two sacrificial layer processes, Surface micromachining requirements, Polysilicon surface micromachining, Other compatible materials, Silicon Dioxide, Silicon, Micromotors, Gear trains, Mechanisms. Characterisation of MEMS devices	08

Recommended Books-

1. MEMS, Vijay Vardan, *Wiley Publication*
2. MEMS and Microsystems Design and Manufacture, Tai- Ran Hsu, *Tata McGraw Hill*
3. MEMS, Nitaigour Mahalik, *Tata McGraw Hill*
4. MEMS and MOEMS Technology and Applications, Rai Chaoudhary, *PHI Learning*
5. Stephen D. Senturia, *Microsystem Design, Kluwer Academic Publishers,*
6. Marc Madou, *Fundamentals of Microfabrication, CRC Press*
7. Kovacs, *Micromachined Transducers Sourcebook, WCB McGraw-Hill, Boston*
8. M-H. Bao, Elsevier, *Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes,* New York, 2000.

Title of the course : **Biomedical Signal Processing**
Subject Code : **IE-721E**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Bio electric Amplifiers	Bioelectric Amplifiers, Operational Amplifiers, Basic Amplifier Configurations, Multiple-Input Circuits, Differential Amplifiers, Signal Processing Circuits, isolation Amplifiers, Chopper Stabilized Amplifiers, Input grounding.	08
	Bio potentials	ENG, EMG, ECG, ERG, EEG, MEG and EOG.	06
	Cardiovascular measurements	Hemodialysis, Lithotripsy, Ventilators, Infant Incubators, Drug Delivery Devices, Surgical Instruments, Therapeutic Applications of the Laser.	08
Unit-2	Aids for Handicapped	Computer aids for blind and visually handicapped and deaf.	06
	Introduction to Telemedicine	Telemedicine System's classification, input and output peripherals, Characteristic of available transmission media, introduction to communication system for telemedicine. Medical image format standards, introduction to DICOM and PACs technologies various image compression techniques, loss less and lossy image compression for biomedical application. Telemedicine and law, confidentiality of telemedicine records, security in medical methods.	08
	Hospital Data Management	Hospital Information System, Functional capabilities of Computerized Hospital Information System, Efficiency, Security and Cost Effectiveness of Computer Records, Computerized Patient Data Management.	08

Recommended Books:

Title	Author	Publisher
Handbook of biomedical instrumentation	R S Khandpur	TMH
Biomedical instrumentation and measurement	L Cromwell	PHI
Introduction to Biomedical Equipment Technology	Joseph J Carr John M. Brown	PE
Medical Instrumentation	John G. Webster	WSE

Title of the course : **Advance Sensors**
Subject Code : **IE-722**
Weekly load : **3** **LTP-3 0 0**
Credit : **3**

Theory

Unit	Main Topics	Course Outline	Lectures
Unit-1	Introduction	Introduction to Sensors, Sensor Characteristics, Physical principles of Sensing.	04
	Bio Sensors	Introduction – microbial sensors for process control – acetic acid sensor – alcohol sensor – glutamic acid sensor – carbon dioxide sensor –microbial sensors for environmental control – ammonia sensor – nitrogen dioxide sensor – BOD sensor. Types of biosensors – first generation, biosensors – molecular recognition by higher integrated biocatalytic systems in biosensors –artificially coupled enzymes reactions in biosensors – lactate monooxygenase based sequence and amplification sensors – substrate recycling by Lactate Oxidase and Lactate – Dehydrogenase –Glutamate Oxidase based sensors – Glucose Oxidase Glucose Dehydrogenase sensor – anti interference principle	10
	Optical Fibre Sensors	Multimode fiber Sensors-Displacement, pressure, stress, strain. Intensity modulated sensors, Active multimode FO sensors, Micro-bend optical fiber sensor, Current sensors, Magnetic sensors, Single mode FO sensors, Phase modulated, Polarization modulated, Fibre Optic Gyroscope.	08
Unit-2	Occupancy and Motion Detectors	Working principle, Construction and Characteristics of following Sensors: Ultrasonic Sensors, Microwave Motion Detectors, Capacitive Occupancy Detectors, Optoelectronic Motion Detectors	08
	Chemical Sensors	Chemical Sensor Characteristics, Classification of Chemical-Sensing Mechanisms, Direct Sensors, Metal-Oxide Chemical Sensors, ChemFET, Electrochemical Sensors, Potentiometric Sensors, Conductometric Sensors, Amperometric Sensors, Enhanced Catalytic Gas Sensors, Elastomer Chemiresistors, Complex Sensors	08
	Miscellaneous Miniature Sensors	Magnetic Sensor, SAW micro sensors, resonant micro sensors, micro accelerometers, micro actuators and micro motors.	08
	Sensor Fusion	Introduction to Sensor Fusion and sensor selection, Bayesian theory of sensor fusion and its application	04

Recommended Books-

1. Fraden Jacob, "Handbook of Modern sensors, Physics, Design and Applications", 3rd ed., Springer.
2. Khazan AD, " Transducers and their Elements- Design and Applications". PTR Prentice hall, Englewood Cliff, NJ07632,1994.
3. Middlehoek S and Audet SA, "Silicon Sensors" , Academic Press, London, 1989.
4. Edmonds TE, " Chemical Sensors", Blackie, London, 1988.

Title of the course : **Power Electronics and Drives**
Subject Code : **IE-724**
Weekly load : **5** **L T P-3 0 2**
Credit : **4**

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Basics Concepts	Need of switching and role of power electronic switches, properties and characteristics of various power Electronic switches i.e. power Diode, Thyristor, GTO, Power transistor, Power MOSFET, IGBT, MOS controlled Thyristor, Static Induction Devices, their firing and protection circuits, selection criteria of these switches for various applications, Basic concept of Phase control, Power quality indices.	09
	AC-DC Converters	Analysis and design of Converters : Un-controlled and controlled, Half wave and Full wave, Half controlled and full controlled, Single Phase and three phase, with R, RL and RLC Load, with and without Free wheeling Diode, Effect of Source Impedance on Converters, Dual converters.	09
	AC-AC Converters	Analysis and design of AC controllers: single phase and three phase; Cyclo-converters: Single phase and three phase, Matrix converters.	06
Unit-2	DC-DC Converters	Analysis and design of DC-DC converters i.e. Buck, Boost, Buck-Boost; Isolated and non-isolated; push-pull, half bridge, full bridge, Flyback, Cuk, SEPIC, Zeta and Luo, in continuous conduction and discontinuous conduction modes of operation, review of choppers.	09
	DC-AC Converters (Inverters)	Analysis and design of Inverters: Voltage source and current source, single phase and three phase, Half Bridge and Full Bridge; Line Commutated & Forced Commutated; Series and Parallel; for square wave and Pulse Width Modulation (PWM) controlled outputs, Topologies for Harmonic Reduction or true sine wave Inverters	06
	Electric Drives	Introduction to Drives, Rectifier and Chopper fed DC motor Drives, Converters-Inverter fed Wound Field Synchronous Motor Drives, Converters-Inverter fed Induction Motor Drives, Closed loop control of these drives, Power Quality problems generated by various electric drives, Harmonic Mitigation techniques and Energy Efficiency Improvements in Electric Motor Drives through Solid State Controllers.	09

Recommended Books:

Title	Author	Publisher
Power Electronics: Converters, Applications and Design	Ned Mohan, Undeland & Robbins	John Wiley and Sons
Power Electronics Handbook	M H Rashid	Academic Press
Fundamentals of Power Electronics	R. W. Erickson	Kluwer Academic Publishers
Power Electronics design handbook	Nihal Kularatna	Newnes Publishers
Power Electronics and Variable Frequency Drives, Technology and Applications	B K Bose	IEEE Press

Practicals: IE-716

1. To plot and comment on V-I Characteristics of Diode and Diac.
2. To plot and comment on V-I Characteristics of Thyristor and Triac.
3. To study various turn on methods of Thyristor.
4. To study various commutation methods of Thyristor.
5. To study various protection circuits of Thyristor.

6. To observe and comment on the waveforms of a single phase Full Wave Thyristor converter with R, RL and RLC load. Also comment on the operation with and without free wheeling diode.
7. To observe and comment on the waveforms of a single phase Half controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without free wheeling diode.
8. To observe and comment on the waveforms of a single phase full controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without free wheeling diode.
9. To observe and comment on the waveforms of a three phase half controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without free wheeling diode.
10. To observe and comment on the waveforms of a three phase full controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without free wheeling diode.
11. To observe and comment on the waveforms of a single phase Bridge inverter with PWM controlled output. Also comment on its operation for true sine wave output.
12. To observe and comment on the waveforms of Isolated/non-isolated DC-DC converter in buck/boost mode under CCM and DCM operation.
13. To observe and comment on the waveforms of An Induction Motor Drive.
14. To observe and comment on the waveforms of A DC Motor Drive.