CENTRAL INSTITUTE OF TECHNOLOGY
(Centrally Funded Institute Under the Ministry of HRD, Govt. of India)
Bodoland Territorial Council, Kokrajhar, Assam-783370
(B.Tech Syllabus in Instrumentation Engineering)

CONTENTS

STUDY PLANS

Total Credit Requirements : 238
Total Number of Semesters : 8

1st YEAR: 1st SEMESTER (JULY-DEC)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	MA101	Engineering Mathematics -I	3	1	0	4	4
2.	PH101	Engineering Physics	3	1	0	4	4
3.	CS101	Introduction to Computer Programming	3	1	0	4	4
4.	HU101	Communication Skills	3	0	0	3	3
5.	ES101	Environmental Engineering	3	1	0	4	4
Total of theory							19

B. Practicals							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	PH171	Physics Lab	0	0	3	2	2
2.	CE101	Engineering Graphics	0	1	0	1	1
3.	CE171	Engineering Graphics Lab	0	0	3	2	2
4.	WS171	Workshop Practice -I	0	1	3	3	3
5.	CS171	Computing Lab	0	0	3	2	2
Total of practicals							10

Total of 1st Semester: 29

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1st YEAR: 2nd SEMESTER (JAN-JUNE)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	MA201	Engineering Mathematics -II	3	1	0	4	4
2.	CY201	Engineering Chemistry	3	1	0	4	4
3.	ES201	Basic Electrical Engineering	3	1	0	4	4
4.	ME201	Engineering Mechanics	3	1	0	4	4
5.	EC201	Basic Electronics	3	1	0	4	4
6.	HU201	Professional Ethics and Human value	2	0	0	2	2
Total of Theory							22

B. Practicals							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	CY271	Engineering Chemistry Lab	0	0	3	2	2
2.	WS271	Workshop Practice -II	0	1	3	3	3
3.	EE271	Basic Electrical and Electronics Lab	0	0	3	2	2
Total of Practicals							7

Total of 2nd Semester: 29

***** Approved by GU**

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2nd YEAR: 3rd SEMESTER (JULY-DEC)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	EC301	Electronic Devices and Circuits	3	1	0	4	4
2.	IE301	Network Theory	3	1	0	4	4
3.	IE302	Fundamentals of Instrumentation	3	1	0	4	4
4.	IE303	Electrical Engineering Materials & Devices	3	1	0	4	4
5.	MA301	Mathematics-III	3	1	0	4	4
6.	ME301	Basic Thermodynamics	3	1	0	4	4
Total of Theory							24

B. Practicals							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	EC371	Basic Electronics Lab	0	0	3	3	2
2.	IE371	Circuit Simulation Lab	0	0	3	3	2
3.	HU370	Language Lab	0	0	3	3	2
Total of Practicals							6

Total of 3rd Semester: 30

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2nd YEAR: 4th SEMESTER (JAN-JUNE)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	HU401	Engineering Economics	3	0	0	3	3
2.	EC401	Digital Electronics	3	1	0	4	4
3.	IE401	Electrical Machines	3	1	0	4	4
4.	IE402	Electrical Measurements and Instruments	3	0	0	3	3
5.	IE403	Linear Systems and Signals	3	1	0	4	4
6.	MA401	Numerical Methods & Computer Programming	3	1	0	4	4
Total of Theory							22

B. Practicals							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	IE471	Electrical Machines Lab	0	0	3	2	2
2.	IE472	Instrumentation and Measurement Lab	0	0	3	2	2
3.	EC471	Digital Electronics Lab	0	0	3	2	2
4.	MA471	NMCP Lab	0	0	3	2	2
Total of Practicals							8

Total of 4th Semester: 30

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3rd YEAR: 5th SEMESTER (JULY-DEC)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	HU501	Industrial Management and Entrepreneurship	3	0	0	3	3
2.	IE501	Microprocessor and Microcontrollers	3	1	0	4	4
3.	IE502	Transducer Engineering	3	1	0	4	4
4.	IE503	Control System-I	3	1	0	4	4
5.	IE504	Electronic Instrumentation	3	1	0	4	4
6.	IE505	Analytical Instrumentation	3	1	0	4	4
Total of Theory							23

B. Practicals							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	IE571	Microprocessor Lab	0	0	3	2	2
2.	IE573	Control Systems Lab	0	0	3	2	2
3.	IE574	Electronic Instrumentation lab	0	0	3	2	2
Total of Practicals							6

Total of 5th Semester: 29

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3rd YEAR: 6th SEMESTER (JAN-JUNE)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	HU601	Professional Communication	2	0	0	2	2
2.	IE601	Process Control	3	1	0	4	4
3.	IE602	Power Electronics	3	1	0	4	4
4.	IE603	Communication Engineering	3	1	0	4	4
5.	IE604	Control System-II	3	0	0	3	3
6.	EC603	Digital Signal Processing	3	1	0	4	4
Total of Theory							21

B. Practical							
	Code	Subjects	Contacts (periods per week)				Credit Points
			L	T	P	Total	
1.	IE671	Process Control Lab	0	0	3	2	2
2.	IE672	Power Electronics Lab	0	0	3	2	2
3.	EC673	Digital Signal Processing Lab	0	0	3	2	2
Total of Practical							6

Total of 6th Semester: 27

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4th YEAR: 7th SEMESTER (JULY-DEC)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	IE701	Industrial Instrumentation	3	1	0	4	4
2.	IE702	Instrumentation System Components	3	1	0	4	4
3.	IE703	Fiber Optic and Laser Instruments	3	1	0	4	4
4.	IE71*	Elective-I	3	0	0	3	3
5.	IE71*	Elective-II	3	0	0	3	3
Total of Theory							18

B. Sessionals							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	IE791	Major Project –I	0	0	12	12	8
2.	IE792	Report and Presentation on Practical Training – II	-	-	-	-	3
3.	IE793	Seminar	0	0	3	3	2
Total of Practicals							13

Total of 7th Semester: 31

4th YEAR: 8th SEMESTER (JAN-JUNE)

A. Theory							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	IE801	Biomedical Instrumentation	3	0	0	3	3
2.	IE81*	Elective	3	0	0	3	3
3.	IE81*	Elective	3	0	0	3	3
Total of Theory							9

B. Sessionals							
	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	IE891	Major Project -II	0	0	18	18	12
2.	IE892	Project Defense	-	-	-	-	4
3.	IE893	Comprehensive Viva Voce	-	-	-	-	8
Total of Practicals							24

Total of 8th Semester: 33

List of Elective Papers:

1. IE710 Instrumentation in Petrochemical Industries 3-0-0: 03
2. IE711 Fluidic Power and Control 3-0-0: 03
3. IE712 Computer Control of Process 3-0-0: 03
4. IE713 Digital Image Processing 3-0-0: 03

5. IE810 Virtual Instrumentation 3-0-0: 03
6. IE811 Operation Research 3-0-0: 03
7. IE812 Instrumentation & Control in Paper Industry 3-0-0: 03
8. IE813 Instrumentation in Aerospace & Navigation 3-0-0: 03

Detail Syllabus of

Under Graduate Programme

B.Tech Degree

CIT Kokrajhar

MANDATORY LEARNING COURSES (MLCs)

ES101: ENVIRONMENTAL AND SAFETY ENGINEERING

Code: ES101
Credit: 04
L-T-P: 3-1-0

Environment: Basic ideas of environment, basic concepts related to environment al perspective, man, Society and environment, their inter relationship. Mathematics of population growth and associated problems, definition of resource, types of resource, renewable, nonrenewable, and potentially renewable. Pollutant and contaminants. Environmental impact assessment.

Ecology: Ecosystem, biotic and a biotic component. Open system, close system, species, population, community. Ecological balance and consequence of change, Effect of a biotic factor on population, flow chart of different cycles with only elementary reaction and food chain [definition and one example of each food chain].

Air Pollution and control: Atmospheric Composition; Troposphere, stratosphere, mesosphere, thermosphere. Energy Balance, Conductive and convective heat transfer, radiation heat transfer, simple global temperature modal

Green-House Effects: Definition, impact of greenhouse gasses on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence. Adiabetic lapse rate, atmospheric stability, temperature inversion, radiation inversion.

Source and Effect of Air Pollutions: Toxic chemicals in the environment, toxic chemicals in air, suspended particulate matter, carbon dioxide, sulphur dioxide, nitric oxide, lead, carbon monoxide. Primary and secondary pollutants, Emission standard, criteria pollutant, oxides of carbon, oxide of nitrogen, oxide of sulphur, particulate, etc.

Depletion Ozone Layer: CFC**,** destruction of ozone layer by CFC, impact of other greenhouse gasses, effect of ozone modification.

Standards and Control Measures: Industrial, commercial and residential air quality standard, Control measure (ESP, Cyclone separator, bag house, catalytic converter, scrubber ventury Statement with brief reference).

Water Pollution and Control: Hydrosphere; Hydrological cycle. Natural water pollutants: their origin and effects Oxygen demanding wastes, pathogens, nutrients, salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/ lake/ ground water pollution. Waste water standard [BOD, COD, Oil, Grease], Water treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening], wastewater treatment, primary treatment, secondary and tertiary treatments.

Waste and Waste Management: Municipal, industrial, commercial, agricultural, hazardous solid wastes. Recovery and conversion method, Land filling, incineration, composting.
Noise Pollution: Definition of noise, effect of noise pollution, noise classification, transport noise occupational noise, neighborhood noise, definition of noise intensity, noise threshold limit value

References Books:

1. *Masters, G.M., "Introduction to Environmental Engineering and Science" Prentice – Hall of India Pvt. Ltd., 1991.*
2. *Basak: Environmental Engineering TMH*
3. *Nebel, B.J., "Environmental Science", Prentice – Hall Inc., 1987*
4. *Odum, E.P., "Ecology: The link between the natural and social Sciences", IBH Publishing Com., Delhi.*
5. *Environmental Management – N.K. Uberoi, EXCELL BOOKS.*
6. *Fundamentals of Environmental Studies by D.K. Sinha, & A.D. Mukherjee.*
7. *Introduction to Environmental Engineering Sc. By G. M. masters.*
8. *Environmental Chemistry by A. K. De, New Age International.*
9. *Environmental Management- Mukherjee, Vikas.*
10. *Water Pollution and Management – Varshney C.K., New Age International.*
11. *Water chemistry – Venkateswarlu K.S., New Age International.*
12. *Water Pollution: Causes, Effects & Control – Goel P.K., New Age International*
13. *Environmental Pollution Control Engineering – Rao C.S., New Age International*
14. *Land Treatment of Waste Water – Goghil M.B., New Age International*
15. *Environmental Pollution Analysis – Khopkar S.M., New Age International*
16. *Soil Erosion & Conservation – Tripathi R.P., New Age International*
17. *Invironmental Impact Assessments – Barthwal R.R., New Age International*

HU201: PROFESSIONAL ETHICS AND HUMAN VALUES

Code: HU201
Credit: 02
L-T-P: 2-0-0

Engineering Ethics

Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – professions and professionalism – professional ideals and virtues – theories about right action – self-interest – customs and religion – uses of ethical theories

Engineering as Social Experimentation

Engineering as experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – the challenger case study

Responsibility for Safety

Safety and risk – assessment of safety and risk – risk benefit analysis – reducing risk.

Responsibilities and Rights

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – intellectual property rights – discrimination

Global Issues

Multinational corporations – environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – sample code of conduct

References:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 1996.
2. Charles D Fleddermann, "Engineering Ethics", prentice Hall, New Mexico, 1999.
3. Laura Schlesinger, "How Could You Do That: The Abdication of Character, Courage, and Conscience", Harper Collins, New York, 1996.
4. Stephen Carter, "Integrity", Basic Books, New York, 1996

BASIC SCIENCE COURSES

MA101: ENGINEERING MATHEMATICS-I

Code: MA101
Credit: 04
L-T-P: 3-1-0

Infinite Series:
Sequence, Convergence and Divergence of Infinite series and typical examples of convergent and divergent series. Comparison test (statement only) and related problems. Ratio test (statement only) and related problems. Cauchy's root test (statement only) and related problems. Alternating series, Leibnitz's theorem (without proof), absolute convergence and related problems.

Differential Calculus:
Successive derivatives, Leibniz's theorem, tangent and normal, derivative of arc length (Cartesian & Polar), Tailor's Series and Maclaurin's Series, expansion of functions, Asymptotes, curvature, curve tracing, Functions of two or more variables, Partial derivatives, Homogeneous function (Definition).

Integral Calculus:
Reduction formulae for indefinite integrals involving power of circular functions of x and Product of Sin mx Cos nx; Deduction of;

$$\int_0^{\pi/2} \sin^n x dx \quad ; \quad \int_0^{\pi/2} \cos^n x dx \quad ; \quad \int_0^{\pi/2} \sin^n x \cos^n x dx$$

Length of plane curves (Cartesian & Polar), Areas under Plane curves (Cartesian & Polar), Volume and surface area of solids of revolution of plane curves.

Ordinary differential equations of first order:
Formation of differential equations; Separable equations, equations reducible to separable form, exact equations; integrating factors; linear first order equations; Bernoulli equation; Orthogonal Trajectories.

Ordinary linear differential equations of higher order:
Homogenous linear equations of arbitrary order with constant coefficients – non homogenous linear equations with constant coefficients, Euler and Cauchy's equations. Method of variation of parameters; system of linear differential equations.

Three Dimensional Geometry (Cartesian):
Direction Cosine, Direction Ratio; Equation of a Plane (general form, normal form and intercept form); Equation of a Straight Line passing through one point and two points; Pair of intersecting planes representing a straight line. Elementary ideas of surfaces like sphere, Right Circular Cone and Right Circular Cylinder (through Geometrical configuration) and equations in standard forms.

Texts/ references:

1. *Differential Calculus, B.C. Das & B.N. Mukhejee.*
2. *A Text book of Engineering Maths, N.P Bali, Dr. N. Ch. Narayan Iyenger*
3. *Higher Algebra, Bernard & Child*
4. *Differential Calculus, Maity & Ghosh*
5. *Integral Calculus, Maity & Ghosh*
6. *Calculus of One Vairable – Pandey G.S. (New Age International)*
7. *Differential Calculus – Dhami H.S. (New Age International)*
8. *Integral Calculus – Dhami H.S. (New Age International)*

PH101: ENGINEERING PHYSICS

Code: PH101
Credit: 04
L-T-P: 3-1-0

General Physics: Angular momentum, relation between torque and angular momentum, elasticity, relation between the elastic constants, Energy of strained body, torsional balance, bending of beam and cantilever, Poisseuli's formula, Stokes law, Bernoulli's equation.

Heat and thermodynamics: 1st and 2nd laws of thermodynamics, Isothermal and adiabatic changes, Carnot engine, Otto cycle, Carnot theorem, reversible and irreversible process, entropy, entropy of perfect gas and steam, thermodynamic temperature scale, Black body radiation, Stefan's law, pyrometer.

Optics: Aberration in lenses, spherical aberration, remedy, chromatic aberration, achromatism, interference, Fresnel Bi-prism.

Simple Harmonic Motion: Simple harmonic motion- its expression and differential equation and solution, Superposition of two linear SHMs (with same frequency), Lissajous figures.

Vibration and Wave: Damped vibration-its differential equation and solution, Forced Vibration, Amplitude and Velocity resonance, Sharpness of resonance and quality factor, Progressive wave equation- its differential form, difference between elastic (Mechanical) and electromagnetic waves.

Electricity and magnetism: Gauss's theorem and its application, Poisson's and Laplace's equation, Lorentz force, Biot Savart Law & Ampere's law, their application, L-C-R Circuit, Dia-, Para-, & Ferromagnetism, hysteresis.

Electromagnetism: Faraday's laws of electromagnetic induction in integral form and conversion to differential form, Maxwell's field equations, concept of displacement current, Maxwell's wave equation and its solution for free space.

Laser: Characteristics, Basic Principles, uses.

Mathematical Physics: Vector and Scalar field, grad, divergence, curl, line integral, surface integral, volume integral, physical examples in the context of electricity and magnetism, stokes theorem, gauss theorem(No proof) , Expression of grad, div, curl and Laplacian in spherical and cylindrical coordinates.

Text and Reference Books:

1. *Arthur Beiser, Concepts of Modern Physics (Sixth Edition), Tata McGraw-Hill Publication, New Delhi (1988).*
2. *Kenneth S Krane, Modern Physics (Second Edition), Wiley International Edition (1998).*
3. *B.G. Streetman, Solid state Electronics Devices, Prentice Hall of India Ltd., New Delhi (1981).*
4. *Jacob Phillip-A text Book of Engineering Physics, Educational Publishers and distributors 2002*
5. *A. S. Vasudeva-Modern Engineering Physics, S. Chand & Co.*
6. *M. R. Sreenivasan-Physics for Engineers-New Age International.*

CY201: ENGINEERING CHEMISTRY

Code: CY201
Credit: 04
L-T-P: 3-1-0

General Chemistry: Atomic and molecular structure – chemical bonding; Molecular and Crystal structure-Covalent inorganic and Organic Compounds, ionic solids; hybridization, close packing of atoms and ions. Insulator and conductors-electronic structure and properties of solids.
Acid and bases – pH and pKa; Oxidation and Reduction, standard reduction Potential.
Laws and application of thermodynamics - phase Rule, critical behavior of substances, Chemical kinetics, catalysis, Electrolytic conduction and electrolysis.

Electrochemistry: Electrochemical Cells – EMF of a cell, Electrodes, reference electrodes, ion-selective electrodes, glass electrodes, Commercial electrochemical cells and batteries: batteries-properties, classification, cell reactions and performance. Lead-acid battery, dry cell, Ni-cd battery, lithium battery, alkaline battery, Fuel cell.
Corrosion and material oxidation – Chemical and electrochemical corrosion, pitting and water line corrosion, passivation of surfaces, protective measures against corrosion- anodizing, galvanizing. Corrosion inhibition.

Instrumental Methods of Analysis: Introduction to instrumental metals such as IR, UV,-Vis, NMR and Mass spectrometry.

Reaction Dynamics: Reaction laws: rate and order; molecularity; first and second order kinetics; mechanism and theories of reaction rates (Transition state theory, Arrhenius equation).

Structure and Reactivity of Organic Molecule: Inductive effect; resonance; hyperconjugatin; electrometric effect; carbanion and free radicals; brief study of some addition, elimination and substitution reactions

Polymerization: Concepts, classifications and industrial applications; polymerization processes, degree of polymerization (addition and condensation polymerization); preparation, structure and use of some common polymers: plastic (PE, PP, PVC bakelite), rubber (natural rubber, SBR, NBR), fibre (nylon 6, 6, polyester); conducting and semiconducting polymers.

Industrial Chemistry: Solid, liquid and gaseous fuels; constituents of coal, carbonization of coal, coal analysis, proximate and ultimate analysis; classification of coal Petroleum, gasoline, octane number, aviation fuel, diesel, cetane number; natural gas, water gas.

Text and Reference Books:

1. *Rakshit P. C. Physical Chemistry*
2. *Dutta R. L. Inorganic Chemistry*
3. *Levine Physical Chemistry*

MA201: ENGINEERING MATHEMATICS – II

Code: MA201
Credit: 04
L-T-P: 3-1-0

Vector Calculus

Differentiation of vector functions, scalar and vector fields, gradient of a Scales functions, directional derivative, Divergence and curl of a vector point function, physical interpretation of gradient, divergence and curl, properties of grad, div & curl; Repeated operation by ∇; Integrations of vector functions, Line, surface and Volume integrals, Theorems of Gauss, Stokes and Green.

Linear Algebra

Some special type of matrices like Symmetric and skew-Symmetric, Hermitian and skew-Hermitian, Idempotent, Nilpotent, Involuntary, Orthogonal, Unitary and their properties. Triangular and Echelon form. Inverse of a matrix. Elementary operations and elementary matrices, equivalent matrices, computation of inverse by elementary transformation. Reduction of matrices to triangular form and normal form. Inverse by partitioning. Rank of a matrix, evaluation of rank.

Probability & Statistics

Measures of Central Tendency and measures of Dispersion. Probability: Definition of probability. Laws of probability, Baye's theorem. Random variables. Probability distributions of a distcrete random variable, Mean and Variance of a discrete random variable. Probability distribution of a continuous random variable. Expectation and moments. Binomial distribution, Poisson's distribution and Normal distribution.

Fourier series

Fourier series expansion of $f(x)\, in\ \ c < x < c + 2\pi$, Dirichlet's conditions, Fourier series for discontinuous functions, change of intervals, half range series.

Integral Calculus:

Jacobians. Beta and Gamma functions.

Texts/ References:

1. *Murray R. Spiegel: Vector Calculus, Schaum Pub.*
2. *Erwin Kreyszig: Advanced Engg. Mathematics, Wiley Eastern*
3. *B.S.Grewal: Higher Engg. Mathematics, Khanna Publishers*
4. *Shanti Narayan: Integral Calculus, Sultan Chand & Co., Delhi*

MA301: ENGINEERING MATHEMATICS –III

Code: MA301
Credit: 04
L-T-P: 3-1-0

Partial Differential Equations

Basic concepts, formation of partial differential equations, equation solvable by direct integration, linear and non-linear equations of first order. Homogenous linear equations with constant coefficients, solutions of heat equations, wave equations, transmission line equations and Laplace equations.

Tensor Analysis

Curvilinear coordinates, unit vectors in curvilinear system, representation of a vector in terms of unit base vectors, contravariant and covariant components of F, arc length and volume element in orthogonal curvilinear coordinates. Transformations of coordinates. Definition of tensors, fundamental operations with tensors, Symmetric and skew-Symmetric tensors, Riemannian space and metric tensor, Conjugate tensor, Christoffel symbols.

Calculus of Complex Variables

Analytic functions, C-R equations, conjugate functions, Harmonic functions, orthogonal systems. Formation of analytic functions, conformal mapping, integration of a complex functions, Cauchy's Integral Theorem, power series representation of complex functions, Laurent's Series, singularities, Residue Theorem.

Transformations

Laplace transformation of elementary functions, inverse Laplace transform, Linearity, Laplace transform of derivatives and integrals, shifting Theorems, Laplace transform of unit step function, Dirac-delta function, Differentiation and integration of transforms, convolution, Application to differential equations.
Definition, properties, Z-transform of some basic sequences, Z-transforms of some basic discrete functions, Shifting theorems.

Texts / References:

1. *B.S. Grewal: Higher Engg. Mathematics, Khanna Publishers*
2. *Gilbert Strang: Linear Algebra and applications, Thomson Books*
3. *P.L. Meyer: Introduction to Probability & Statistics*
4. *Shanti Narayan: Functions of Complex Variables, S. Chand & Co.*
5. *Murray R. Spiegel: Laplace Transforms, Thomson Books*
6. *I.M. Snedon: Elements of Partial Differential Equations, S. Chand & Co.*

MA401: NUMERICAL METHODS & COMPUTER PROGRAMMING

Code: MA401
Credit: 04
L-T-P: 3-1-0

Computer Arithmetic

Floating point Arithmetic, Normalization, Approximations and errors, types of errors in computations

Transcendental and Polynomial Equations

Methods of iteration for finding solution of transcendental and equations: Newton Raphson Method, Regula-Falsi Method, Bisection Method, Secant Method.
Solution of linear simultaneous equations by Gauss Elimination Method & Gauss Siedal Method.

Curve Fitting and Interpolation

Linear and non-linear Regression Analysis. Difference table, Newton's Forward and Backward interpolation formulae, Lagrange's Interpolation Formula, Divided differences and Newton's general formula.

Numerical Differentiation & Integration

Numerical differentiation, Numerical Integration: Trapezoidal and Simpson's Rules. Gaussian Quadrature Formula.

Numerical Solution of Ordinary Differential Equations

Euler method, Modified Euler Method, Taylor Series Method, Runge - Kutta Method and Predictor – Corrector Method.

Labs: Developing C programs for the following methods:

1. Numerical integration by Trapezoidal & Simpson's Rules
2. Various iteration methods for solving transcendental and algebraic equations: viz. Newton Raphson Method, Bisection Method, Regula – Falsi Method, Secant Method
3. Gauss – Siedal Iteration Method
4. Various matrix operations and their uses as sub – routines
5. Use of pointers, data structures, loops, arrays

Texts / References:

1. *E. Balaguruswamy: Numerical Methods, Tata McGraw Hill*
2. *Jain, Iyengar and Jain: Numerical Methods for Scientific and Engineering Computations, New Age International, New Delhi*
3. *Sastry, S.S.: Introductory Methods of Numerical Analysis, PHI*
4. *B.S. Grewal: Numerical Methods for Engineering and Science, Khanna Publishers*
5. *Schaum's Outlines: Numerical Analysis, Tata McGraw Hill*

HUMANITIES & SOCIAL SCIENCE COURSES

HU101: COMMUNICATION SKILLS

Code: HU101
Credit: 03
L-T-P: 3-0-0

Grammar:
Correction of sentence, Vocabulary / word formation, Single word for a group of words, Fill in the blank, transformation of sentences, Structure of sentences – Active / Passive Voice – Direct / Indirect.

Narration:
Essay – Descriptive – Comparative – Argumentative – Thesis statement- Structure of opening / concluding paragraphs – Body of the essay.

Reading Comprehension:
Global – Contextual – Inferential – Select passages from recommended text.

Business Correspondence:
Letter Writing – Formal. Drafting. Bio-data- Resume - Curriculum Vitae.

Report Writing:
Structure , Types of report – Practice Writing.

Communication and Public Speaking Skills: Communication Process-meaning, principles of effective communication (barriers and solutions), Introduction to the sounds of English, Features of effective speech, verbal-nonverbal.

Group Discussion:
Principle – practice.

References / Books:

1. *S R Inthira & V Saraswathi " Enrich your English – a) Communication skills b) Academic skills " Publisher CIEFL & OUP*
2. *R.C. Sharma and K.Mohan , "Business Correspondence and Report Writing", Tata McGraw Hill , New Delhi , 1994*
3. *L.Gartside , "Model Business Letters" , Pitman , London , 1992*
4. *Longman , "Longman Dictionary of Contemporary English" (or 'Oxford Advanced Learner's Dictionary of Current English' , OUP , 1998.*
5. *Maxwell Nurnberg and Rosenblum Morris , "All About Words" , General Book Depot, New Delhi , 1995*
6. *Written Communication in English by Sara-Freeman – Orient Longman*

7. English skills for Technical Students by British Council
8. Communicating at Work by Alder & Elmhorst – McGraw-Hills International
9. Art of Effective Communication – Charles J Margerison, EXCEL BOOKS
10. Communication Skill For Effective Management – A.Ghanekar.EPH
11. Communication Skill for Technical Students – Faratullah, Orient Longman
12. English Online – Jayasree Mohan Raj, Orient Longman

HU401: ENGINEERING ECONOMICS

Code: HU401
Credit: 03
L-T-P: 3-0-0

Definition of Economics, Consumer behaviour, Utility analysis and demand analysis, Kinds of Demand, Law of Demand and Law of Supply, Elasticity of Demand: Types and Measurement, Scope of Economics including economics of environment and e-commerce.

Market forms-Perfect and Imperfect markets, Features of Perfect competition, Monopoly and Monopolistic competition. Price and output determination under Perfect Competition, Monopoly, Monopolistic and Oligopoly etc., Concept of Production function, Cost Analysis, Estimation of cost function-Profit and Break Even Analysis.

National Income, GNP and NNP, Per-Capita Income, Source of Public Revenue-Tax Revenue and Non-Tax Revenue, Direct and Indirect Tax. Inflation and Deflation. Banking-Definition - Types of Banks. Concept of Investment Analysis

Features of Indian Economy, Planning in India, Objectives. Economic Reforms in India-Concept of Economic Liberalization, Privatization and Globalization. Unemployment Problem in India-Types, Causes and remedial measures.

International Trade, Gains from International Trade, The World Trading Environment and Multinational Corporations, BPO etc., Function and Role of IMF, World Bank and WTO. Concept of Stock Exchange Market and Market for Securities.

Reference Book:

1. *M.L. Jhingan—Micro Economic Theory*

2. *Sumitra Paul-Managerial Economics*
3. *Joel Dean—Managerial Economics*

HU501: INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Code: HU501
Credit: 03
L-T-P: 3-0-0

Meaning and Concept of Management, Principles and function of Management, Concept of Organizational Behaviour, Function of a Manager—Planning, Organizing, Coordinating and Controlling. Motivation—implication of Managers and application. Leadership and Decision Making : Qualities and Styles of Leadership, Decision making process.

Individual Process in Organizations-Perception, attitude and personality, Factors that affect them, How they influence people. Group Process in Organizations, Group formation, Group effectiveness, Group Conflict.

Evolution, Role and Status of Human Resource Management in India. Recruitment and Selection Process in Organization, Job Analysis, Job Specification, Selection Process-Test and Interview. Trade Union and Collective Bargaining

Entrepreneurship-Meaning, Types of entrepreneur, Qualities of an entrepreneur, Role of Entrepreneur, Factors affecting entrepreneurial growth. Entrepreneurship Development Programme-Concept, Objective and Importance, Engineer Entrepreneurship Training Programme Scheme

Small Scale Industry-Definition, Types of Small Scale Industry, How to Set up Small Scale Industry, Role and Problem of Small Scale Industry. Concept of Joint Stock Company, Private and Public Limited Company. Source of Finance for Entrepreneur-Bank, Government and Financial Institutions etc.

Reference Books:

1. *S.S. Khanka-Organisational Behaviour.*

2. *S.S. Sarkar, R.K.Sharma and S.K.Gupta – Business Organisation and Entrepreneurship Development.*
3. *Cynthia L. Greene – Entrepreneurship.*

HU601: PROFESSIONAL COMMUNICATION

Code: HU601
Credit: 02
L-T-P: 2-0-0

Oral Communication: Aims at improving the oral communication skills. Public speaking skills, features of effective speech – verbal – non-verbal, Presentation skills, Group discussion. Mock Interviews.

Written Communication: Focuses on improving the writing skills. A review of grammar, transformation of sentences; reading comprehension; Precis-writing, skills to express ideas through various kinds of essays; business administrative and E-correspondence, business reports, technical documentation & project proposal writing and CVs/ resumes; Application letters, Notices, Agenda, Minutes & Memos. Case Analysis.

Organization Communication: Attempts to acquaint students with the process and requirements of communication in organizations. It includes the objectives of communication, Channels of communication, Barriers in Communication, Non-verbal & Cross-cultural communication, Meetings, Conferences, Press Conference and Press release. Business Communication Technology: Audio-Visual aids, Internet, e-mail. Creative Communication: Slogan-writing, Advertisement.

Texts / References:

1. *Wren & Martin., English Grammar*
2. *John Metchell., How to write Reports*
3. *Mark McCormack., Communication*
4. *Rajendra Pal & J.S. Korlahalli, Essentials of Business Communication*

ENGINEERING SCIENCES CORE COURSES

CS101: INTRODUCTION TO COMPUTER PROGRAMMING

Code: CS101
Credit: 04
L-T-P: 3-1-0

Fundamentals of Computer:

History of Computer, Generation of Computer, Classification of Computers, Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.

Binary & Allied number systems representation of signed and unsigned numbers, BCD, ASCII, Binary. Arithmetic & logic gates.

Assembly language, High level language, compiler and assembler (basic concepts)

Basic concepts of operating systems like MS DOS, MS WINDOW, UNIX, Algorithm & flow chart.

C Fundamentals:

The C character set, identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions:

Arithmetic operators, relational and logical operators, type conversion, increment and decrement operators, bitwise operators, assignment operators and expressions, precedence and order of evaluation.

Input and Output: Standard input and output, formatted output – printf, formatted input scanf.

Flow of Control:

Statement and blocks, if-else, switch, loops – while, for, do while, break and continue, goto and labels.

Fundamentals and Program Structures:

Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register variables, scope rules, recursion, function prototypes, C preprocessor, command line arguments.

Arrays and Pointers:

One dimensional arrays, pointers and functions, multidimensional arrays.

Structures, Unions and Files:

Basic of structure, structures and functions, arrays of structures, bit fields, formatted and unformatted files.

Recommended reference Books:

1. *Kerninghan, B.W. The Elements of Programming Style.*
2. *Yourdon, E. Techniques of Program Structures and Design.*
3. *Schied F.S. Theory and Problems of Computers and Programming.*
4. *Gottfried. Programming with C. Schaum.*
5. *Kerninghan B.W. & Ritchie D.M. The C Programming Language*
6. *Rajaraman V. Fundamental of Computers.*
7. *Balaguruswamy. Programming in C.*
8. *Kanetkar Y. Let us C.*
9. *M.M. Oka. Computer Fundamentals, EPH*
10. *Leon. Introduction to Computers, Vikas*
11. *Leon. Fundamental of Information Technology, Vikas*
12. *Ram B. Computer Fundamentals, New Age International*
13. *Ravichandran D. Programming in C, New Age International*

EE201: BASIC ELECTRICAL ENGINEERING

Code: EE201
Credit: 04
L-T-P: 3-1-0

Introduction to circuit elements-resistance, capacitance & Inductance their behavior with ac and dc, different types of sources and equivalent conversions, test signal assumption for circuit analysis, classification of elements.

AC machines, attenuator, three phase induction motor, starting single phase motor, power factor improvements, principles, construction and application of transformers.

Electro mechanical energy conversion, Torque, rotating magnetic fields, dc machines, types, construction, motor generator actions, voltage and speed regulation.

Measuring instruments, moving iron and moving coil meter, voltmeter, ammeter, principles of operation, construction, extension of range, wattmeter, energy meter.

Batteries, construction and maintenance, electrical heating principle, operation & comparison of various heating system.

Text / References:

1. *Fitzgerald, D.E; A Grabel: Basic Electrical Engineering, McGraw Hill*
2. *Edward Hughes: Electrical Technology, Longman*
3. *S.K. Bhattacharjee: Experiments in Basic Electrical Engineering*
4. *Thereja B.L.: A Text Book of Electrical Technology, S. Chand & Co., New Delhi*
5. *Dobey: Fundamentals of Electrical Machines, Narosa Publishing House, 2nd Ed.*
6. *H. Cotton: Advanced Electrical Technology, Wheeler Publishing, Alahabad, 1999*

ME201: ENGINEERING MECHANICS

Code: ME201
Credit: 04
L-T-P: 3-1-0

Forces and Moments

Force, Moment and Couple, Resultant of forces, Forces in space. Equilibrium, FBD, General equations of equilibrium, Analysis of forces in perfect frames. Brief introduction to vector approach.

Center of gravity and moment of inertia

Center of gravity of axes, volume and composite bodies: Area moment of inertia and mass moment of inertia for plane figures and bodies.

Introduction to dry friction. Laws of friction, friction of simple machines- inclined planes, Screw jacks.

Kinetics of rigid bodies

Plane motion, force, mass, acceleration, work and energy. Impulse and momentum, rotational motion, centrifugal force, torque, angular motion and acceleration, angular momentum, Virtual work.

Reference books:

1. *Engineering Mechanics: S Timoshenko & D H Young. McGrow Hill Int.*
2. *Engineering Mechanics: R S Khurmi. S Chand & Co.*
3. *Engineering Mechanics: R K Bansal. Laxmi Publication (P) Ltd*
4. *Engineering Mechanics: K L Kumar. McGrow Hill Publishing Co.*
5. *Engineering Mechanics: Hibbler*

ME301: BASIC THERMODYNAMICS

Code: ME301
Credit: 04
L-T-P: 3-1-0

Fundamental Concepts and Definitions: Definition of thermodynamics, system, surrounding and universe, phase, concept of continuum, macroscopic & microscopic point of view. Density, specific volume, pressure, temperature. Thermodynamic equilibrium, property, state, path, process, cyclic process, Energy and its form, work and heat, Enthalpy.

Laws of thermodynamics

Zeroth law: Concepts of Temperature, zeroth law.

First law: First law of thermodynamics. Concept of processes, flow processes and control volume, Flow work, steady flow energy equation, Mechanical work in a steady flow of process.

Second law: Essence of second law, Thermal reservoir, Heat engines. COP of heat pump and refrigerator. Statements of second law. Carnot cycle, Clausius inequality. Concept of Entropy.

Properties of steam and thermodynamics cycles: Properties of steam, use of property diagram, Steam-Tables, processes involving steam in closed and open systems. Rankine cycle. Introduction to I.C. Engines-two & four stoke S.I. and C.I. engines. Otto cycle, Diesel cycle.

Reference:

1. Van Wylen G.J. & Sonnlog R.E. : Fundamentals of classical thermodynamics, John Wiley & Sons, Inc. NY.
2. Wark Wenneth : Thermodynamics (2nd edition), Mc Graw Hill book Co. NY.
3. Holman, J.P. : Thermodynamics, MC Graw Hill book Co. NY.
4. Yadav R. : Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad.
5. Yadav R. : Steam & Gas Turbines.
6. Kshitish Chandra Pal : Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta.
7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi.

PROGRAM CORE COURSES

IE201: MECHANICS OF FLUIDS

Code: IE201
Credit: 04
L-T-P: 3-1-0

Fluid Properties and Flow Characteristics

Surface tension – Capillarity – Viscosity – Newton's law – Fluid pressure and pressure head - Fluid velocity and acceleration – Uniform and steady flow – Stream lines and path lines – Reynold's number – Classification as laminar and turbulent flow – Continuity equation – Potential and stream functions.

Flow Dynamics

Euler's and Bernoulli's equations – Pressure losses along the flow – Categorisation into major and minor losses - Flow through circular pipes – Poisseule's equation – Statement of Darcy – Weisbach equation – Friction factor – Hydraulic grade line.

Flow Measurement and Pipe Networks

Manometer - Venturi and orifice meters – Flow through weirs - Principles of open channel flow – Pipes in series and parallel – Kirchoff's Laws.

Turbines

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction.

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines**.**

Pumps

Definition and classifications - Centrifugal pump: classifications, working principle, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principle, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps: working principles of gear and vane pumps.

Text Books:

1. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New Delhi (7th edition), 1995.

2. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi publications (P) Ltd, New Delhi, 1995.

EC301: ELECTRONICS CIRCUITS AND DEVICES

Code: EC301
Credit: 04
L-T-P: 3-1-0

Elementary ideas of Op-amps, Introduction to op-amps, uses of op-amps, types of op-amps, Inverting and noninverting amplifiers, subtractor, adder, integrator, differentiator.

Introduction to class A, B and C amplifier circuits, Simple calculation of voltage/current Gain, input/output impedence, power amplifier, elementary idea on feedback amplifier

Basic theory of oscillators: operation of Colpitt and Hartley oscillators, other oscillators Configurations and their specific applications. Introductory idea and uses of Multi-Vibrators: A stable, Mono stable and Bi stable.

FET: JFET introductory ideas, MOSFET: structure, physical behavior, I/V Characteristic, NMOS, PMOS, CMOS, MOS amplifiers and logic gates.

Multivibrators: A stable, Mono stable and Bi stable circuits. Detailed analysis and design with discrete components. Designing with ICs with logic gates.

Texts / References:

1. *A.K. Gayabad: Analog Circuits and OP-Amps*
2. *P. C. Rakshit: Fundamentals of Electronics Engineering*

IE301: NETWORK THEORY

Code: IE301
Credit: 04
L-T-P: 3-1-0

Basic Circuit Concepts

Lumped circuits – circuit elements, ideal sources (independent and dependent), linear passive parameters R, L and C, V-I relationship of circuit elements – Sinusoidal voltage and current: RMS value, form factor – Kirchoff's Laws – analysis of series and parallel circuits – network reduction: voltage and current division, source transformation, star/delta transformation

Transient Analysis of First & Second Order Circuits

Source free response of RL and RC circuits – forced (step) response of RL and RC circuits – source free response of RLC series circuit – forced (step) response of RLC series circuit – forced response of RL, RC and RLC series circuit to sinusoidal excitation – Time constant and natural frequency of oscillation of circuits – Laplace Transform application to the solution of RL, RC & RLC circuits – Initial and final value theorems and applications – concept of complex frequency – driving point and transfer impedance – poles and zeros of network function.

Sinusoidal Steady State Analysis

Concept of phasor and complex Impedance / Admittance – Analysis of simple series and parallel circuits – active power, reactive power, apparent power (voltampere), power factor and energy associated with these circuits – concept of complex power – phasor diagram, impedance triangle and power triangle associated with these circuits – resonance in series and parallel circuits – Q factor, half-power frequencies and bandwidth of resonant circuits.

Multi Dimensional Circuit Analysis & Network Theorems

Node–voltage analysis of multi node circuit with current sources – rules for constructing nodal admittance matrix [Y] for solving matrix equation [Y]V=I - Mesh-current analysis of multi node circuits with voltage sources – rules for constructing mesh impedance matrix[Z] for solving matrix equation [Z]I=V – Super position theorem – Thevenin's theorem – Norton's theorem – Reciprocity theorem – Compensation theorem – Tellegen's theorem – Millman's theorem – maximum power transfer theorem for variable resistance load, variable impedance load and variable resistance and fixed reactance load.

Coupled Circuits and Three Phase Circuits

Coupled circuits: mutual inductance – coefficient of coupling – dot convention – analysis of simple coupled circuits – Three phase circuits: three phase balanced/ unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages & currents – power and power factor measurements in three phase circuits.

REFERENCES:

1. Joseph edminister : Electric circuits, Schaums Outline Series
2. M.L.Soni and J.C Gupta : Electrical Circuit Analysis,Dhanpat Rai and Sons, New Delhi
3. W.H.hayt and J.E.Kemmerly , Engineering Circuit analysis, McGraw-Hill, New york
4. Theodre F.Bogrart, Jr.Electric circuits, Macmillan /McGraw-Hil

IE302: FUNDAMENTALS OF INSTRUMENTATION

Code: IE302
Credits: 04
L-T-P: 3-1-0

Introduction to instruments and their representation. Typical application of instrumentation systems. Functional elements of a measurement system. Classification of instruments.

Introduction to measurements. Physical measurement. Forms and methods of measurements. Fundamental SI Units. Derived Units. Definition of standards. International standards. Primary standards. Secondary standards. Working standards. Current standard. Voltage standard. Resistance standard. Capacitance standard. Time and frequency standards. Introduction to Transducers – Classification and Selection Criteria.

Measurement Errors. Human Error. Systematic Error. Limiting and Random Errors. Statistical analysis of measurement data. Probability of Errors. Error estimates from the Normal Distribution. Curve Fitting – Method of Least Squares. Chi-Square test. Notion of Signal conditioning.

Static characteristics of measurement system – Range, Span, Linearity, Non-linearity, Sensitivity,

Dependence on environmental effects, Hysteresis, Resolution, Wear and ageing, Accuracy, Precision,

Repeatability, Reproducibility, Tolerance, Bias, Threshold and Loading Effect. Dynamic characteristics of measurement system: Step-response – rise time. Frequency response – bandwidth. Time lag (dead-time)

Testing and calibration: Traceability. Measurement reliability. Calibration experiment and evaluation of results. Primary calibration. Secondary calibration. Direct calibration. Indirect calibration. Routine calibration. Calibration of a voltmeter, ammeter and an oscilloscope.

TEXT 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
Raj & Co, 2005
3. D Patranabis: Principle of Industrial Instrumentation, Tata McGraw-Hill, New Delhi 2004
4. John P.Bentley: Principles of measurement systems, 3rd edition, Addison Wesley Longman, 2000.

5. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India
6. M.M.S.Anand: Electronic instruments and instrumentation Technology, Prentice-Hall of India, 2004.

IE303: ELECTRICAL ENGINEERING MATERIALS AND DEVICES

Code: IE303
Credits: 04
L-T-P: 3-1-0

Structure of solids: Crystalline state of solids, systems & classes, unit cell and space lattice, BCC, DC structure, Bragg's law, Miller indices, Crystal imperfections, grain boundaries.

Dielectrics : (I): Properties of static field. Static dielectric constant, polarization, dielectric constant of mono atomic gases & poly atomic molecules, internal fields in solids & liquids, ferroelectric materials, spontaneous polarization, piezo electricity.

(II) Properties in alternating fields: Frequency dependence of electronic, ionic polarizability, complex dielectric constant, dielectric loss, dipolar relaxation, breakdown in dielectrics. General properties of common dielectrics (Electrical, mechanical chemical and thermal). Gaseous dielectrics, liquid insulating materials, solid insulating materials, films.

Magnetic properties of materials: Magnetization, origin of permanent magnetic dipole moment, classification of Magnetic of materials, dia, para, ferro, antiferro & ferromagnetism, magnetic anisotropy, magnetostriction, soft & hard magnetic materials for electrical applications.

Conductors: Electron gas model of a metal, Relaxation time, collision time, mean free path, electron scattering & resistivity, heating effect of current, thermal conductivity, superconductivity, electrical conducting materials (Cu, Al) & their application. Mechanical properties like corrosion, solid curability, contact resistance.

Semiconductors and Devices: Density of carriers in intrinsic semiconductor & in n-type & p-type semiconductor, conductivity, Hall effect, drift & diffusion current, Einstein relation.

Semiconductor Device Fabrication:

Books:

1. Dekker A.J. 'Electrical Engineering Materials -PHI
2. Seth & Gupta 'A course in Electrical Engineering Material' — Dahnpat Rai & Sons
3. Rajput A.K. 'Electrical Engineering Materials' New age international
4. C.S. Indulkar & S. Thiruvengadam 'Electrical Engineering Materials'.
5. S.K. Bhattacharya 'Electrical & Electronic Engineering Materials and Components' Kahnna Publishers.

ECE401: DIGITAL ELECTRONICS

Code: EC301
Credit: 04
L-T-P: 3-1-0

Number systems and codes, Combinational logic analysis and design: Switching algebra, minimization methods- Combinational design using MSI, LSI and PLDs, Sequential logic design: latches and flip-flops

Finite state machine design, ASM charts, state minimization, state assignment, synthesis using D-FF and JK-FF, counters, shift registers, MSI devices as state machines, asynchronous finite state machines.

Texts / References:

J.F.Wakerly, Digital Design Principles and Practices, PH, 1999.
W. I. Fletcher, An Engineering Approach to Digital Design, PHI, 1999. D.D. Givone, Digital Principles and Design, TMH, 2002.

IE401: ELECTRICAL MACHINES

Code: IE401
Credit: 04
L-T-P: 3-1-0

Basic concept of rotating machines:
General working principle and constructional features. - Type of windings- generation of voltage, production of torque

D.C. Machines
Constructional details – emf equation – Methods of excitation – Self and separately excited generators – Characteristics of series, shunt and compound generators –Principle of operation of D.C. motor – Back emf and torque equation – Characteristics of series, shunt and compound motors - Starting of D.C. motors – Types of starters -Testing, brake test and Swinburne's test – Speed control of D.C. shunt motors.

Transformers:
Constructional details – Principle of operation – emf equation – Transformation ratio – Transformer on no load – Parameters referred to HV/LV windings – Equivalent circuit – Transformer on load – Regulation - Testing – Load test, open circuit and short circuit tests.

Single phase motors:
Principle of working-double revolving theory, starting characteristics and application of single phase motor and universal motor.

Induction Motors
Construction – Types – Principle of operation of three phase induction motors – Equivalent circuit – Performance calculation – Starting and speed control –Single phase induction motors.

Synchronous and Special Machines
Salient pole and cylindrical rotor machines. Synchronous generator, distribution and coil span factors, E.M.F. equation. Salient pole generator phase diagram. Synchronous motor – principle of working, phasor diagram, v-curves, starting. Synchronous condenser and power factor improvement. – Reluctance motor – Hysteresis motor – stepper motor.

TEXT/REFERENCE BOOKS
1. S.K.Bhattacharya, 'Electrical Machines', Tata McGraw Hill Publishing company ltd, second edition, 1998.
2. V.K.Mehta and Rohit Mehta, 'Principles of Power System', S.Chand and Company Ltd, third edition, 2003.
3. D.P.Kothari and I.J.Nagrath, 'Basic Electrical Engineering', Tata McGraw Hill publishing company ltd, second edition, 2002.
*4. C.L. Wadhwa, 'Electrical Power Systems' Wiley eastern ltd India, 1985***.**

IE402: ELECTRICAL MEASUREMENTS AND INSTRUMENTS

Code: IE402
Credit: 03
L-T-P: 3-0-0

Measurement of Voltage and Current

Galvanometers – Ballistic, D'Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

Measurement of Power And Energy

Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter – Phantom loading – Induction type KWH meter – Calibration of wattmeter, energy meter.

Potentiometers & Instrument Transformers

DC potentiometer – Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer – Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – C.T and V.T construction, theory, operation, phasor diagram, characteristics, testing, error elimination – Applications.

Resistance Measurement

Measurement of low, medium & high resistance – Ammeter, voltmeter method – Wheatstone bridge – Kelvin double bridge – Ductor ohmmeter – Series and shunt type ohmmeter – High resistance measurement – Megger – Direct deflection methods – Price's guard-wire method – Loss of charge method – Earth resistance measurement.

Impedance Measurement

A.C bridges – Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Hey's bridge – Schering bridge – Anderson bridge – Campbell bridge to measure mutual inductance – Errors in A.C. bridge methods and their compensation – Detectors – Excited field – A.C. galvanometer – Vibration galvanometer – Introduction to cable fault and eddy current measurement.

TEXT BOOKS

1. E.W.Golding & F.C.Widdis, 'Electrical Measurements & Measuring Instruments', H. Wheeler & Co, 1994.
2. A.K. Sawhney, 'Electrical & Electronic Measurements and Instrumentation', Dhanpath Rai & Co (P) Ltd, 2004.
3. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K. Kataria & Sons, Delhi, 2003.
4. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2003.
5. H.S.Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 1995.
6. Martia U. Reissland, 'Electrical Measurement', New Age International (P) Ltd., 2001.

IE403: LINEAR SYSTEM AND SIGNALS

Code: IE403
Credit: 04
L-T-P: 3-1-0

Time domain analysis and discrete time signals and system: LTI system, impulse Response, convolution, correlation, casuality and stability, frequency domain analysis: FS, FT, DFS AND DTFT properties and application.

Modulation, sampling, sampling in frequency domain system,DFT, transform domain Analysis of system.

Application of Laplace transform and Z transform of a system, transfer functions poles Poles and zeros, representation of a system- signal flow graph and state –variable Representation.

Texts / References:

1. *Simon Haykin: Signals & Systems, John Wiley, 1998*

2. *Mc Chellan, R.W Schafer & Yoder: Signal Processing First, Pearson 2003*
3. *A. Ambarkar, Analog and Digital Signal Processing, Brooks Cole, 1999.*

IE501: MICROPROCESSOR AND MICROCONTROLLERS

Code: IE501
Credit: 04
L-T-P: 3-1-0

Introduction to computer architecture and organization: Architecture of 8-bit and 16 bit microprocessors, bus configurations, CPU module, introduction to assembly language and machine language programming, instruction set of a typical 8-bit and 16 bit microprocessor, subroutines and stacks, programming exercises.

Memory technology: Timing diagrams, Memory families, memory interfacing, programmable peripheral interface chips, interfacing of input-output ports, programmable interval timer.

Data transfer schemes: Serial and parallel data transfer schemes, interrupts and interrupt service procedure. Programmable interrupt controller. Programmed and interrupt driven data transfer. Programmable DMA controller.

Architectures of 8051 Microcontroller: Bus configuration, instruction sets, programming exercises. Embedded System software and hardware design, development and troubleshooting tools.

Text/Reference Books:

1. Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd,
1989 by Ramesh S. Gaonkar.
2. Intel Corp: The 8085 / 8085A. Microprocessor Book – Intel marketing communication, Wiley inter science publications, 1980.
3. An introduction to micro computers Vol. 2 – some real Microprocessor – Galgotia Book Source,
New Delhi by Adam Osborne and J. Kane
4. Advanced Microprocessors by Ray and Bhurchandi - TMH
5. Intel Corp. Micro Controller Handbook – Intel Publications, 1994.
6. Microprocessors and Interfacing by Douglas V. Hall, McGraw Hill International Ed. 1992
7. Assembly Language Programming the IBM PC by Alan R. Miller, Subex Inc, 1987
8. The Intel Microprocessors: 8086/8088, 80186, 80286, 80386 & 80486, Bary B. Brey, Prenti

IE502: TRANSDUCER ENGINEERING

Code: IE502
Credits: 04
L-T-P: 3-1-0

Science of Measurements and Instrumentation of Transducers, Units and standards – Calibration methods – Static calibration – Classification of errors – error analysis – statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers. Characteristics of Transducers:
Static characteristics – Accuracy, Precision, Resolution, Sensitivity, Linearity etc. Dynamic characteristics – Mathematical model of transducer – Zero, I and II order transducers. Response to impulse, step, ramp and sinusoidal inputs. Variable Resistance Transducers
Principle of operation, construction details, characteristics and application of resistance potentiometer, strain gauge, resistance thermometer, thermistor, hot-wire anemometer, Piezoresistive sensor and humidity sensor.

Variable Inductance and Variable Capacitance Transducers

Induction potentiometer – Variable reluctance transducers – EI pick up – LVDT – capacitive transducer and types – Capacitor microphone – Frequency response.

Other Transducers

Piezoelectric transducer, Magnetostrictive – IC sensor – Digital transducers – Smart sensor – Fibre optic transducer.

TEXT BOOKS

1. E.A. Doebelin, 'Measurement Systems – Applications and Design', Tata McGraw Hill, New York, 1990.
2. A.K. Sawhney, 'A Course in Electrical & Electronic Measurement and Instrumentation', Dhanpat Rai and Co (P) Ltd., 2004.
3. D. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.
4.John P. Bentley, 'Principles of Measurement Systems', III Edition, Pearson Education, 2000.
5. Hermann K.P. Neubert, 'Instrument Transducers', Oxford University Press, 2000.
6. D.V.S Murthy, 'Transducers and Instrumentation', Prentice Hall of India, 2001.
7. S. Ranganathan, 'Transducer Engineering', Allied Publishers Pvt. Ltd., 2003.
8. Al Sutko and J.D. Faulk, 'Industrial Instrumentation', Vikas Publications, Delhi, 1996.

IE503: CONTROL SYSTEM-I

Code: IE503
Credits: 04
L-T-P: 3-1-0

Elementary Concepts: of control systems: Open loop and closed loop systems. Examples of modern control systems, Definition of linear, non-linear, time-invariant and time variant, continuous and discrete control system.

Models of physical systems: Formulation of differential equations for dynamic systems. Mechanical and Electrical systems. Transfer functions of a linear system. Block diagrams and reduction techniques, Signal flow graphs. Mason's formula. Standard test signals - step, ramp, parabolic and impulse. Impulse response.

Introduction to control system components: error detectors, servo motors, techno-generators and servo amplifiers. Determination of transfer functions.

Time domain analysis: Poles, Zeros and characteristic equations, Relation between S-plane root locations and transient response. Performance specifications in time domain such as overshot, rise time, settling time and steady state error. Transient response of second order systems. Derivative and Integral Control and their effect on the performance of the 2^{nd} order system. System types and error constants. Generalized error co-efficients. Transient response of higher order systems (out line only). Roth's stability criterion, scopes and limitations of Routh's criterion.

The root locus technique: Introduction, Rule for construction. System analysis and design (out line only) using root locus.

Frequency Domain analysis: Logarithmic plots, polar plots, log-magnitude Vs phase plots.

Nyquist stability criterion, Stability analysis. Relative stability. Close loop frequency response. Experimental determination of transfer functions. M and N circle.

Text/Reference Books:

1. Modern control system – Ogata
2. Automatic control system – B.C.Kuo
3. Modern control system – Nagrath & Gopal
4. Control system design – Graham C.Goodwin
5. Linear control system - Prof. B.S.Manke

IE504: ELECTRONIC INSTRUMENTATION

Code: IE504
Credits: 04
L-T-P: 3-1-0

Analog Meters: D.C, A.C voltmeters, ammeters, Multimeter, power meter, Q-meter, true RMS meter, vector impedance meter, vector voltmeter, component measuring instrument. Signal Generators and Analyzers: Sine wave generator – Frequency synthesized sine wave generator – Sweep frequency generator, pulse and square wave generator – Function generator – Wave analyzer – Applications – Harmonic distortion analyzer – Spectrum analyzer – Applications – Audio Frequency generator – Noise generator.

Cathode Ray Oscilloscope

General purpose oscilloscope – Screens for CRT graticules – Vertical & horizontal deflection systems – Delay line – Multiple trace – Dual beam & dual trace – Probes – Oscilloscope techniques – Special oscilloscopes – Storage oscilloscopes – Sampling oscilloscope – Digital CRO. Digital Instruments, Digital method for measuring frequency, period, phase difference, pulse width, time interval, total count – Digital voltmeter – Types – Automatic polarity indication, automatic ranging, auto zeroing – DMM – Microprocessor based DM0M – DPM – IEEE 488 bus.

Display and Recording Devices

Bar graph display – Segmental and dot matrix display – X-Y recorders, magnetic tape recorders – Digital recording – Data loggers. Interference and screening – Electrostatic and electromagnetic interference & earth loops.

TEXT BOOKS

1. Albert D. Helfrick & William D. Cooper, 'Modern Electronic Instrumentation & Measurement Techniques', Prentice Hall of India, 2002.
2. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
3. B.M.Oliver and J.M.cage, 'Electronic Measurements & Instrumentation', McGraw Hill International Edition, 1975.
4.Joseph. J. Carr, 'Elements of Electronic Instrumentation & Measurements', III edition, Pearson Education, 2003.
5. C.S. Rangan, G.R. Sarma, V.S.V. Mani, 'Instrumentation Devices & Systems', Tata McGraw Hill, 2002.
6. D. A. Bell, 'Electronic Instrumentation and Measurements', Prentice Hall of India, 2002.
7. Rajendra Prasad, 'Electronic Measurements and Instrumentation', Khanna Publishers, Delhi, 2003.

IE505: ANALYTICAL INSTRUMENTATION

Code: IE505
Credits: 04
L-T-P: 3-1-0

Colorimetry and Spectrophotometry
Special methods of analysis – Beer-Lambert law – Colorimeters – UV-Vis spectrophotometers – Single and double beam instruments – Sources and detectors – IR Spectrophotometers – Types – Attenuated total reflectance flame photometers – Atomic absorption spectrophotometers – Sources and detectors – FTIR spectrophotometers – Flame emission photometers.

Chromatography
Different techniques – Gas chromatography – Detectors – Liquid chromatographs – Applications – High-pressure liquid chromatographs – Applications.

Industrial Gas Analyzers and Pollution Monitoring Instruments

Types of gas analyzers – Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

pH Meters and Dissolved Component Analyzers
Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer.

Radio Chemical and Magnetic Resonance Techniques
Nuclear radiations – Detectors – GM counter – Proportional counter – Solid state detectors – Gamma cameras – X-ray spectroscopy – Detectors – Diffractometers – Absorption meters – Detectors. NMR – Basic principles – NMR spectrometer - Applications. Mass spectrometers – Different types – Applications.

TEXT BOOKS

1. R.S. Khandpur, 'Handbook of Analytical Instruments', Tata McGraw Hill publishing Co. Ltd., 2003.
2. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, 'Instrumental Methods of Analysis', CBS publishing & distribution, 1995.

REFERENCE BOOKS

1. Robert D. Braun, 'Introduction to Instrumental Analysis', McGraw Hill, Singapore, 1987.
2. G.W. Ewing, 'Instrumental Methods of Analysis', McGraw Hill, 1992.
3. D.A. Skoog and D.M. West, 'Principles of Instrumental Analysis', Holt, Saunders Publishing, 1985.
4. C.K. Mann, T.J. Vickers & W.H. Gullick, 'Instrumental Analysis', Harper and Row publishers, 1974.

IE601: PROCESS CONTROL

Code: IE601
Credits: 04
L-T-P: 3-1-0

Mathematical Modelling Of Processes
Need for process control – Mathematical model of first order liquid level and thermal processes – Higher order process – Process with dead time, process with inverse response – Interacting and non-interacting systems – Continuous and batch process – Servo and regulator operation.

Controller Characteristics & Tuning
Basic control action – Characteristics of ON-OFF, proportional, integral and derivative control modes – Composite control modes – P+I, P+D and P+I+D control modes – Electronic controllers to realize various control actions – Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – Tuning of controllers – Ziegler-Nichol's method and cohencoon method – Damped oscillation method.

Control Systems with Multiple Loops
Cascade control – Feed forward control – Ratio control – Selective control systems – Split range control – Adaptive and inferential control.

Final Control Element
I/P converter – Pneumatic and electric actuators – Valve positioner – Control valves characteristics – Classification of control valves – Control valve sizing – Cavitations and flashing – Selection of control valves.

Selected Unit Operations
Mixing – Evaporation – Drying – Heat exchanger – Distillation process – Case study of control schemes of binary distillation column.

TEXT BOOKS

1. Donald P. Eckman, 'Automatic Process Control', Wiley Eastern Ltd., New Delhi, 1993.
2. G.Stephanopoulis, 'Chemical Process Control', Prentice Hall of India, New Delhi, 1990.

REFERENCE BOOKS

1. B.G.Liptak, 'Process Control', Chilton Book Company, 1994.
2. Curtis D. Johnson, 'Process Control Instrumentation Technology', 7th Edition, Pearson Education, New Delhi, 2002 / PHI.

3. J.G.Balchen and K.J.Mumme, 'Process Control structures and Application', Van nostrand Reinhold Co., New York, 1988.

IE602: POWER ELECTRONICS

Code: IE602
Credits: 04
L-T-P: 3-1-0

Power semiconductor devices: Power diodes-types, power transistors, thyristor family, SCRs, Triac, GTOs, power MOSFETs, IGBTs, MCTs-static and dynamic characteristics, protection circuits, series and parallel connections, turn-on characteristics, turn off characteristics.

Controlled rectifiers- single phase and three phase converters-power factor improvements-design of converter circuits-AC voltage controllers-single phase and three phase-cyclo converters-single phase and three phase, design of AC voltage controller circuits.

DC choppers – principle of step down and step up operations – step down chopper with RL load, Classes of chopper, MOSFET/IGBT choppers.

DC to AC converters: Thyristor inverters, McMurray-McMurray Bedford inverter, current source inverter, voltage control waveform control, inverters using devices other than thyristors, vector control of induction motors.

DC and AC power supplies: Switched mode, resonant, bi-directional and multistage conversions, buck, boost, buck boost regulators. UPS-block diagram, types. Drive requirements and design of simple drive circuits for power BJT, MOSFET and IGBT. Advanced control of power electronic circuits using microprocessors, microcontrollers, isolation amplifier circuits, synchronization circuits.

Books/ References:

1. *M. H. Rashid, Power Electronics: Circuits, Devices and Applications, 3rd ed., Pearson Education, Delhi, 2002*
2. *N. Mohan, T. M. Underland, and W. P. Robbins, Power Electronics: Converter, Applications and Design, John Wiley & Sons, New York, 1995*
3. *P. S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi, 2002*
4. *G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, Thyristorised Power Controllers, New Age International Publishers, New Delhi, 1996*

IE603: COMMUNICATION ENGINEERING

Code: IE603
Credits: 04
L-T-P: 3-1-0

AMPLITUDE MODULATION
Need for Modulation_ Amplitude Modulation – Generation of AM waves (DSB-FC) - Suppressed carrier systems (DSB-SC) – Single side band modulation(SSB) – Vestigial side band modulation (VSM) - comparison of various AM systems - Source of noise – Internal and external – Types – Demodulation of AM waves – Envelope Detectors.

TRANSMITTERS AND RECEIVERS
AM Transmitters - Low level and High level transmitters – AM Receivers – TRF receiver, super heterodyne receiver – Frequency Division Multiplexing.

FREQUENCY MODULATION AND DEMODULATION
Introduction to angle modulation systems – Definitions for FM & PM – Narrow band FM – Wide band FM – FM Modulators - Direct method – FM Transmitters - FM Demodulators – Slope detector - Frequency discriminator – PLL - FM Receivers - Comparison between AM & FM.

PULSE MODULATION
Introduction to Pulse modulation systems – Pulse amplitude modulation – Pulse Time modulation – Pulse code modulation – Inter symbol Interference - Eye Pattern – Equalization - companding – time division multiplexing – synchronous and asynchronous - Bandwidth of PCM – noise in PCM – delta modulation – comparison between PCM and DM.

COMMUNICATION SERVICES (Elementary Treatment Only)
Television: Picture elements – Transmission and reception of picture information – Motion picture – Horizontal and vertical scanning frequencies – TV transmitters– TV channels. Satellite communication: Orbit – Satellite altitude – Transmission path – loss – Satellite system.

Fiber optical communication: Need – Principles of light transmission in a fiber – optical fiber communication system – optical fiber – Light sources – Photo detectors – Advantages.

TEXT BOOKS

1. Singh.R.P. Sapre.S.D, *Communication Systems, Analog and Digital*, McGraw Hill Pub. 5th Reprint.
2. Deshpande,N.D , *Communication Electronics*, Tata McGraw Hill Pub.

REFERENCE BOOKS

1. Kennedy, "Electronics of Communication Systems, McGraw Hill.
2. Roddy D. and Coolen J., *Electronic communications*, Prentice Hall of India P. Ltd.
3. Anokh Singh, "Principles of communication Engineering" – S.Chand & Co.

IE604: CONTROL SYSTEM-II

Code: IE604
Credits: 03
L-T-P: 3-0-0

Compensation techniques: Preliminary design specifications in time and frequency domains, gain compensation; load compensation, lag compensation, leg- load compensation.

Describing function analysis of non linear control systems: Introduction to nonlinear systems. Describing functions of common non linearities; nonlinear control systems, describing function analysis of nonlinear control systems.

Phase- Plane Analysis: Introduction, methods of constructing phase- plane trajectories, time information and solutions from phase- plane trajectories, singular points, phase- plane analysis of linear and nonlinear control systems.

Discrete time systems: Introduction to discrete – time systems; Z- transform, inverse Z-transformation; solving difference equation by the Z-transform method; pulse- transfer function; stability analysis in the Z- plane.

State – Space Analysis of control systems: Concepts of space, state variables and state models; state – space representation of linear systems; transfer matrix; state- space representation of discrete- time systems. Solution of linear time- invariant and discrete-time state equations.

Stability Analysis by Liapunov's second method: Definition of stability in the sense of Liapunov; the second method of Liapunov; Stability analysis of linear systems; estimating the transient response behaviour of dynamic systems; stability analysis of nonlinear systems.

Design of Feedback Control systems: Concept of controllability and observality; state feedback and output feedback; a brief idea of pole placement by state feedback and output feedback; optimal control law; cost function or performance index; quadratic performance index; linear quadratic state feedback regulator problem; a brief introduction to model reference systems; adaptive control systems.

Text/Reference Books:

1. Modern control system – Ogata
2. Automatic control system – B.C.Kuo
3. Modern control system – Nagrath & Gopal
4. Control system design – Graham C.Goodwin
5. Linear control system - Prof. B.S.Manke

EC603: DIGITAL SIGNAL PROCESSING

Code: EC603
Credits: 04
L-T-P: 3-1-0

Review of time domain and frequency domain properties of discrete time signal and System.

Discrete fourier Transform : properties of DFT, linear convolution of DFT, FFT Algorithms.

Digital filter design: Fiter structure, FIR filter design, IIR filter design, finite Word length effect.

Non parametric and parametric effects for power spectrum estimation.

Decimation, interpolition, short time FT, Multi resolution signal analysis

Real time implementation of DSP algorithm: custom VLSI, DSP processor.

Texts / References:

1. *J. G. Proakis and D.G. Manolakis: Introduction to Digital Signal Processing, Pearson, 2003*
2. *A.V. Oppenheim and R.W. Schafer: Discrete time signal Processing, Pearson, 2002*
3. *Sanjit K. Mitra: Digital Signal Processing: A Computer Bases Approach: TMH, 2002*

IE701: INDUSTRIAL INSTRUMENTATION

Code: IE701
Credits: 04
L-T-P: 3-1-0

Measurement of Force, Torque and Velocity
Electric balance – Different types of load cells – Magnets – Elastic load cells - Strain gauge load cell – Different methods of torque measurement – Strain gauge, relative regular twist – Speed measurement – Revolution counter – Capacitive tacho-drag cup type tacho – D.C and A.C tacho generators – Stroboscope.

Measurement of acceleration, vibration, density and viscosity
Accelerometers – LVDT, piezoelectric, strain gauge and variable reluctance type accelerometers – Mechanical type vibration instruments – Seismic instrument as an accelerometer and vibrometer – Calibration of vibration pick-ups – Units of density, specific gravity and viscosity used in industries – Baume scale, API scale – Pressure head type densitometer – Float type densitometer – Ultrasonic densitometer – Bridge type gas densitometer – Viscosity terms – Saybolt viscometer – Rotameter type.

Pressure Measurement
Units of pressure - Manometers – Different types – Elastic type pressure gauges – Bourdon type bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezoresistive pressure sensor – resonator pressure sensor – Measurement of vacuum – McLeod gauge – Thermal conductivity gauges – Ionization gauge,

cold cathode and hot cathode types – Testing and calibration of pressure gauges – Dead weight tester.

Temperature Measurement
Definitions and standards – Primary and Secondary fixed points – Calibration of thermometer, different types of filled in system thermometer – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – Electrical methods of temperature measurement – Signal conditioning of industrial RTDs and their characteristics – three lead and four lead RTDs.

Thermocouples and Pyrometers
Thermocouples – Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output – Thermal block reference functions – Commercial circuits for cold junction compensation – Response of thermocouple – special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers.

TEXT BOOKS

1. *E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2003.*

2. *R.K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1999.*

REFERENCE BOOKS

1. *D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw Hill Publishing Company Ltd, 1996.*

2. *A.K. Sawhney and P. Sawhney, 'A Course on Mechanical Measurements, Instrumentation and Control', Dhanpath Rai and Co, 2004.*

3. *B.C. Nakra & K.K.Chaudary, 'Instrumentation Measurement & Analysis', Tata McGraw Hill Publishing Ltd, 2004.*

4. *S.K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill, 2003.*

5. *D.P. Eckman', Industrial Instrumentation', Wiley Eastern Ltd.,*

IE702: INSTRUMENTATION SYSTEM COMPONENTS

Code: IE702
Credits: 04
L-T-P: 3-1-0

Synchros – transmitter- transformer – receiver, construction, working principle, application as error detector and angular displacement transducer.

DC and AC servomotors- construction, theory of operation, applications.

PD, PI and PID controllers – principles, transfer functions, physical realization, applications.

Tachogenerators – AC and DC: construction, principle of operation, position and speed regulator, and transducer.

Stepper motors- construction, method of operation, torque equation, driver circuit, logic translator, applications

Feedback transducers- negative feedback principle, advantages and typical schemes.

Hydraulic systems – different types of valves, construction and principles of operation, pitot valve, flapper valve, slide valve, two-stage valve.

Pneumatic control system – equivalent circuit of pneumatic valve and transfer function, pneumatic servo in jet engine application.

BOOKS:

1. *Transducers and Instrumentation : Murthy, DVS, PHI*
2. *Principles of Industrial Instrumentation: Patranabis, TMH*
3. *Control System Components: Gibson and Tutor,*
4. *Electromechanical Devices for Energy Conversion and Control System : Vincent Del Toro*
5. *Electromechanical Components for Servo-mechanism : Davies, SA and Ledgerwood, BK*
6. *.Automatic Control Systems : Raven*

IE703: FIBRE OPTICS AND LASER INSTRUMENTS

Code: IE703
Credits: 04
L-T-P: 3-1-0

Optical Fibres and Their Properties

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors & splicers – Fibre termination – Optical sources – Optical detectors.

Industrial Application of Optical Fibres

Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

Laser Fundamentals

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

Industrial Application of Lasers

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

Hologram and Medical Applications

Holography – Basic principle - Methods – Helographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumours of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TEXT BOOKS

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.

REFERENCE BOOKS

1. Donald J.Sterling Jr, 'Technicians Guide to Fibre Optics', 3rd Edition, Vikas Publishing *House, 2000.*
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Read, 'Industrial Applications of Lasers', Academic Press, 1978.
4. Monte Ross, 'Laser Applications', McGraw Hill, 1968

5. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
6. Mr. Gupta, 'Fiber Optics Communication', Prentice Hall of India, 2004.

IE801: BIO-MEDICAL INSTRUMENTATION

Code: IE801
Credits: 03
L-T-P: 3-0-0

Physiology and Transducers
Cell and its structure – Action and resting – Potential propagation of action potential – Sodium pump – Nervous system – CNS – PNS – Nerve cell – Synapse – Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration – Transducers – Different types – Piezo–electric, ultrasonic, resistive, capacitive, inductive transducers – selection criteria.

Electro – Physiological Measurements
Basic components of a biomedical system – Electrodes – Micro, needle and surface electrodes – Amplifiers – Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier.

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.

Non-Electrical Parameter Measurements
Measurement of blood pressure – Cardiac output – Cardiac rate – Heart sound – Respiratory rate – Gas volume – Flow rate of Co_2, O_2 in exhaust air - pH of blood, ESR, GSR measurements – Plethysmography.

Medical Imaging and PMS
X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Electrical safety.

Assisting and Therapeutic Equipments
Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dializers.

TEXT BOOKS
1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2002 / PHI.
2. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.
REFERENCE BOOKS
1. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

2.L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.
5.S.K. Gupta, 'Introduction to Medical Electronics', Bharathi Bhavan, Patna, 1969.

ELECTIVE COURSES

IE710: INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES

Code: IE710
Credits: 03
L-T-P: 3-0-0

Petroleum Processing
Petroleum exploration – Recovery techniques – Oil – Gas separation - Processing wet gases – Refining of crude oil.

Operations in Petroleum Industry
Thermal cracking – Catalytic cracking – Catalytic reforming – Polymerisation – Alkylation – Isomerization – Production of ethylene, acetylene and propylene from petroleum.

Chemicals from Petroleum Products
Chemicals from petroleum – Methane derivatives – Acetylene derivatives – Ethylene derivatives – Propylene derivatives – Other products.

Measurements in Petrochemical Industry
Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments – Intrinsic safety of Instruments.

Control Loops in Petrochemical Industry
Process control in refinery and petrochemical industry – Control of distillation column – Control of catalytic crackers and pyrolysis unit – Automatic control of polyethylene production – Control of vinyl chloride and PVC production.

TEXT BOOKS

1. L. Waddams, 'Chemicals from Petroleum', Butter and Janner Ltd., 1968.

2. J.G. Balchan. and K.I. Mumme, 'Process Control Structures and Applications', Van Nostrand Reinhold Company, New York, 1988.

REFERENCE BOOKS

1. Austin G.T. Shreeves, 'Chemical Process Industries', McGraw Hill International Student edition, Singapore, 1985.

1. B.G Liptak, 'Instrumentation in Process Industries', Chilton Book Company, 1994

IE711: FLUIDIC POWER AND CONTROL

Code: IE711
Credits: 03
L-T-P: 3-0-0

Scope & potential of application of pneumatics, hydraulics in instrumentation and control, fundamentals of fluid flow through orifices, restrictions, linearization of fluid flow equations. Pneumatic system elements and devices and their linearized modeling , e.g.- sources, regulated sources, valve actuators etc…Hydraulic system elements & devices & their linearized modeling. Feedback & its applications to development of hydraulic controllers. Pneumatic controllers, control schemes & control circuits, pneumatic telemetering, hydraulic power transmission. Hydraulic pumps & motors, hydraulic and pneumatic valves Fluidic elements, characteristics, logic devices. Analysis & synthesis of fluid logic systems with applications.

Books:

1) Control system components, Gibson & Tutor, McGraw hill.
2) Analysis & design of pneumatic Systems, Anderson & Blaine,.
3) Fluidic power systems, Morse, AC
4) Fluid Power & applications, Espisito

IE712: COMPUTER CONTROL OF PROCESS

Code: IE712
Credits: 03
L-T-P: 3-0-0

Analysis of Discrete Data System
State-space representation of discrete data systems – Selection of sampling process – Selection of sampling period – Review of z-transform – Pulse transfer function – Modified z-transform - Stability of discrete data system – Jury's stability test.

Design of Digital Controller
Digital PID – Position and velocity form – Deadbeat's algorithm – Dahlin's algorithm–Kalman's algorithm - Pole placement controller – Predictive controller.

Computer as a Controller
Basic building blocks of computer control system – Data acquisition systems – SCADA – Direct digital control – Introduction to AI and expert control system – Case study - Design of computerized multi loop controller.

Programmable Logic Controller
Evolution of PLC's – Components of PLC – Advantages over relay logic - PLC programming languages – Ladder diagram – Programming timers and counters – Design of PLC.

Applications of PLC
Instructions in PLC – Program control instructions, math instructions, sequencer instructions – Use of PC as PLC – Application of PLC – Case study of bottle filling system.

TEXT BOOKS

1. P.B. Deshpande, and R.H.Ash, 'Computer Process Control', ISA Publication, USA, 1995.
2. Petruzella, 'Programmable Controllers', McGraw Hill, 1989.

REFERENCE BOOKS

1. C.M.Houpis, G.B.Lamount, 'Digital Control Systems Theory, Hardware and Software', International Student Edition, McGraw Hill Book Co., 1985.
2. G. Stephanoupoulis, 'Chemical Process Control', Prentice Hall of India, New Delhi, 1990.

IE 713: DIGITAL IMAGE PROCESSING

Code: IE713
Credits: 03
L-T-P: 3-0-0

Introduction - digital image representation - fundamental steps in image processing - elements of digital image processing systems. digital image fundamentals - elements of visual perception - a simple image model – sampling and quantization - basic relationship between pixels - image geometry - image transforms - Fourier transform - discrete Fourier transform - Properties of 2D-fourier transform (DFT) - FFT algorithm- other separable image transforms.

Image enhancement - point processing - spatial filtering - frequency domain - color image processing – image restoration - degradation model - diagonalization of circulant and block circulant matrices, deconvolution, inverse filtering- Wiener filtering -least mean square filter.

Image compression - image compression models - elements of information theory – basic ideas of variable length coding, predictive coding, transform coding- error-free compression - lossy compression - image compression standards.

Image reconstruction from projections - basics of projection - parallel beam and fan beam projection - ART - method of generating projections - Fourier slice theorem - filtered back projection algorithms - testing back projection algorithms.

Text Book:

1. *R. Gonzalez and R. E. Woods, Digital Image Processing, 2nd ed., Pearson Education, Delhi, 2002.*

Reference Books:

1. A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, New Delhi, 1988

2. A. Rosenfeld and A. C. Kak, Digital Picture Processing, 2nd ed., Academic Press, New York, 1997

3. W. K. Pratt, Digital Image Processing, 3rd ed., John Wiley & Sons, New York, 2001
Andrews A. C and Hunt B. R., Digital Image Restoration, Prentice Hall, New Jersey, 1997

IE 810: VIRTUAL INSTRUMENTATION

Code: IE810
Credits: 03
L-T-P: 3-0-0

Review of Digital Instrumentation
Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

Fundamentals of Virtual Instrumentation
Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

Cluster of Instruments in VI System
Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.

Graphical Programming Environment in VI
Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes –Local and global variables – String and file I/O.

Analysis Tools and Simple Applications in VI
Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.

TEXT BOOKS
1. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.
2. Peter W. Gofton, 'Understanding Serial Communications', Sybex International.
3. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.

REFERENCE BOOKS
1. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.
2. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.
Note: To offer this elective, multi-user licensed copy of Lab-view software should be available.

IE811: OPERATIONS RESEARCH

Code: IE811
Credits: 03
L-T-P: 3-0-0

Operations Research Models – Operations Research Techniques – Art of Modeling – Construction of LP Model – Graphical LP solution – Graphical Sensitivity Analysis – The Simplex Algorithm – The M- method – The two phase method – degeneracy – Alternative optima – unbounded solutions – infeasible solution – redundancies – LP packages.

Definition of the Dual problem – primal-dual relationship – Economic interpretation of duality – Dual simplex method – primal dual computation – post optimal or sensitivity analysis – Changes affecting feasibility – Changes affecting optimality – Revised simplex method – LP packages.

Definition of Transportation model – The transportation algorithm – Determination of the starting solution – Iterative computations of the Algorithm – The Assignment Model – The Hungarian method – The Transshipment model – Inter programming problem – Cutting plane Algorithm.

Scope of Network Applications – Network solution – Minimal spanning tree Algorithm – Shortest Route problem – Examples – Shortest Route Algorithm – Maximal flow model – Minimum cost capacitated flow problems.

Network diagram representation – Critical path method – Time estimates – Crashing – Time charts – PERT and CPM for project scheduling – Resource planning – Case studies.

TEXT BOOK

Handy A. Taha, "Operation Research – An Introduction", 7th Edition, Pearson Education, Asia, 2002.

REFERENCE BOOKS

Ronald. L. Rardin, "Optimization in Operation Research", Person Education, Asia, 2002.
JIT.S Chandran, Mahendran P. Kawatra Ki Ho Kim, "Essential of Linear Programming", Vikas Publishing House Pvt.Ltd., New Delhi, 1994.
Hiller F.S Liberman G.J, "Introduction to Operation Research", 6th Edition, McGraw Hill, 1995.
R.Panneer Selvam, "Operations Research", Prentice Hall of India, 2002.

P.C. Tulsin, "Quantitative Technique : Theory and Problem", Pearson Education, 2002.

IE812: INSTRUMENTATION AND CONTROL IN PAPER INDUSTRY

Code: IE812
Credits: 03
L-T-P: 3-0-0

Role of paper in various forms in the civilized world; history of paper making; per-capita consumption of paper and board in India and in other countries. Process description in diagrammatic and functional block details; conventional and non-conventional raw materials for paper manufacture. Various grades of paper; properties of paper.

Different pulping processes; importance of Kraft process; continuous and batch digesters, brown stock washers, bleaching plant, chemical recovery process; paper machine operations; conversion processes. Pulping process involves various chemical processes; impact of effluents and need for treatment and disposal. Paper making is addition and removal of water; process water, DM water and potable water; water treatment plant. Cogeneration Plant for steam and power generation.

Identification of various process parameters in the industry; selection of suitable measurement hardware for flow, pressure, level, temperature, density, solids, consistency, pH, ORP, conductivity. Special gauges for measurement of basis weight, moisture and caliper. Control room layout for mill operations; graphic displays; alarm management.

Special applications for controls; Digester blow tank controls; digester liquor feed pump control; brown stock washer level control; stock chest level control; dissolving tank density control; white liquor classifier density control; white liquor flow control; condensate conductivity control. dryer temperature control. Basis weight control; web moisture control.

Evolution of computer applications in the industry; Review of data logging, SCADA, DDC, PLC and DCS. Computer controls for online basis weight and web moisture in modern mills.

TEXT BOOK

1. *Liptak, Bela G, Instrumentation in the Processing Industries, Chilton Publishers, 1973.*

REFERENCE BOOKS

1. Considine, D.M, Hand Book of Applied Instrumentation, McGraw Hill, 1964.
2. Considine D. M., Process/Industrial Instruments and control Handbook, McGraw Hill, 4thedition 1993.
3. www.tappi.com

4. Robert H. Perry, Green D.W. and Maloney J.O., Perry's Chemical Engineers, Handbook, McGraw HillInc, New York, 7th ed, 1998.

IE813: INSTRUMENTATION IN AEROSPACE AND NAVIGATION

Code: IE813
Credits: 03
L-T-P: 3-0-0

Air craft and aerospace vehicle instrumentation: Air data instruments: altimeter, air speed rate of climb – gyroscopic instruments – turn and back indicator – artificial horizon – directional Gyro Schuler Tuning, Stable Platform – Automatic pilots – integrated flight instruments – Capacitance type fuel level indicating system – altitude compensation – magnetic compass.

Radio Navigation Aids: automatic direction finder – instruments landing system – visual omni range – distance measuring equipments – radar – optical instruments – engine instruments and control – pressure measurements – thermal meter control – pressure measurement – thermal meter – tachometer – accelerometer – smoke and fire detection – propeller controls – cabin pressure and temperature**.**

Satellite and space vehicle instrumentations – propulsion controls – stabilisation – stabilisation sensors – Gyros – Sun sensors – Horizon sensors – star tracker – Stabilisation controls.

Air Craft Flight Simulation Instrumentation: Basic description of a flight simulator – Solution of Aerodynamics equations – simulation of abnormal conditions – Jet engine power plant troubles – Flight controls and auto pilot troubles.

Electrical Troubles: Hydraulic systems troubles – landing gear troubles – cabin conditioning troubles – indication of unsafe canopy – Boeing condition – Radio troubles – Separate generator – System troubles – Trouble indicator light – Advantages of instrumentated flight – Simulation – Simulation of difficult conditions – Weapons system trainer – Need for realism – Instrumentation**.**

TEXT BOOKS

1. Pallett E.G.H., Aircraft Instrumentation and Integrated Systems, Longman Scientific and Technical', 1992.
2. Nagaraja N.S., Elements of Electronic Navigation,,Tata Mcgraw Hill Publishing Ltd., New Delhi, 1975.

REFERENCES

1. Douglas M. Considine and S.D. Ross, Handbook of Applied Instrumentation, McGraw Hill, 1965.