Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
M. Tech First Semester (CBCS)

Elective-II

DIFFERENTIAL EQUATIONS

Subject code: - PGOPENASH001

Teaching Scheme
Lectures: 4/week
Total credits: 04

Examination Scheme
T(U) 70 marks T(I) 30 marks
Duration of University Examination: 3 hours

Course Objectives and Expected Outcomes:
The objectives of this course are the approach of an engineering student to the study of differential equations has got to be practical unlike that of a student of mathematics, who is only interested in solving the differential equations without knowing as to how the differential equations are formed and how there solutions are physically interpreted. After going through this course, students will gain proficiency on formation of differential equation from the given physical situation, called modeling and physical interpretation of the solution.

Unit I: Ordinary Differential Equations of First Order (8 Hours)

Definition: Order & degree, Solutions. Equations of First order & First degree: Variable Separable form, Homogeneous equations, Equations reducible to Homogeneous form, Linear Equations, Bernoulli's Equation, Exact differential Equation, D. E. reducible to Exact form.

Unit II: Higher Order Linear Differential Equations
(10 Hours)

Solution of Linear Differential Equations with constant Coefficients, Particular Integral by Method of Variation of Parameters and Method of Undetermined Coefficients, Linear dependence of Solutions. Solution of the equations of the form $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$ by Method of Grouping & Method of Multipliers.

Unit III: First Order Partial Differential Equations (9 Hours)

Partial Differential Equation : definition and Solutions, Linear PDE of the First Order $(Pp+Qq=R)$, Non linear Equations of the type $f(p,q)=0$, $f(z,p,q)=0$, $f(x,p)=F(y,q)$, $z = px+qy+f(p,q)$, Charpit's Method for solving the equation $f(x,y,z,p,q)=0$.

Unit IV: Higher Order Partial Differential Equations (10 Hours)

Homogeneous Linear Equations with constant Coefficients, Non Homogeneous Linear Equations, Non Linear Equations of Second Order. Monge's method of Integrating $Rr+Ss+Tt=V$ and $Rr+Ss+Tt+U(rt-s^2)=V$, Canonical forms of Hyperbolic, Parabolic & Elliptic equations. Solution of Boundary Value Problems by method of Separation of Variables

Unit V: Series Solution of Differential Equations (8 Hours)

Power Series, Solution of the equation $P_0 \frac{d^2y}{dx^2} + P_1 \frac{dy}{dx} + P_2 y = 0$, Ordinary Point, Singular Point, Validity of the series solution, Solution by Frobenius method, Forms of series Solution, Solution of Bessel's & Legendre's equation.

Prescribed Book: Dr. B. S. Grewal: Higher Engineering Mathematics (Khanna Publications)

Reference Book : Ian N Sneddon: Elements of Partial Differential Equations (Dover Publications, INC)
J. N. Wartikar : A Text Book of Applied Mathematics (Volume II) (Pune Vidyarthi Griha)
N. P. Bali: Engineering Mathematics (Laxmi Publications)
Dr T. M. Karade: Lectures on Differential Equations(Einstein Foundation International)

LINEAR ALGEBRA

Subject code: - PGOPENASH002

Teaching Scheme
Lectures: 4/week
Total credits: 04

Examination Scheme
T(U) 70 marks T(I) 30 marks
Duration of University Examination: 3 hours

Course Objectives and Expected Outcomes:
To learn the important concepts of linear algebra such as matrices, vector space, linear transformations, projections, Eigen values and Eigen vectors. Also to understand the importance of linear algebra and learn its applicability to practical problems i.e. how the linear equations and Eigen value problems appears in some practical applications. At the end of this course the successful students will be familiar with the ideas of matrices and linear applications in solving problems involving system of linear equations and linear programming problems. Also he/she will be capable of representing geometric transformations by means of matrices and to express the volume of certain figures and equations of line using determinant.

Unit I: Vector Spaces (9 Hours)

Sets, Binary Operations on a set, , Relations, Functions, Vector Spaces, Subspaces, Span of set, Linear dependence, Independence, Dimension and Basis

Unit II: Linear Transformations (8 Hours)

Definition and examples, Range and Kernel of a linear map, Rank and Nullity, Inverse of a Linear Transformation, Singular and non singular linear transformation

Unit III: Matrices & Determinants (10 Hours)

Matrix associated with a linear map, Linear map associated with a Matrix, Rank and Nullity of a Matrix, Transpose of a Matrix and special types of Matrices, elementary Row operations, System of Linear Equations, Matrix inversion. Determinants: Definition, Fundamental properties of Determinant, Minors, Cofactors, Product of Determinants, Determinant of linear transformation,

Unit IV: Canonical Forms: (8 Hours)

Eigen Values, eigen vectors, Cayley Hamilton theorem, minimal polynomial, Diagonalizable operator, Jorden forms, Rational forms

Unit V: Inner Product Spaces (10 Hours)

Inner product spaces: definition, norm of a vector, distance in an inner product space, orthogonality, Orthonormal sets, Linear functionals and adjoints of linear transformation, Selt adjoint transformation, Unitary operator, Unitary matrix, Orthogonal matrix, Normal operators.

Prescribed Book: V. Krishnamurthy: An Introduction to Linear Algebra (East West Press Pvt. Ltd.)

Reference Book : J. N. Sharma : Linear Algebra (Krishna Prakashan Mandir)
Keneth Hoffman: Linear Algebra (Prentice- Hall of India)
I. N. Herstein: Topics in Algebra (Wiley Eastern Limited)

NUMERICAL ANALYSIS

Subject code: - PGOPENASH003

Teaching Scheme
Lectures: 4/week
Total credits: 04

Examination Scheme
T(U) 70 marks T(I) 30 marks
Duration of University Examination: 3 hours

Course Objectives and Expected Outcomes:
This course involves solving engineering problems drawn from all the fields of engineering. The course is not theory oriented one. The emphasis will be on understanding the concepts of the numerical methods and on applying these concepts for solving various engineering problems. At the end of this course, the students are expected to be able to aware of the mathematical background for different numerical methods such as to solve algebraic and transcendental equations, system of linear equations, interpretation, differentiation, integration and solving ordinary differential equations etc. Using these knowledge students may work on multidisciplinary projects.

Unit I: Solution of Algebraic & Transcendental Equations (9 Hours)

Bisection Method, iteration Method, Newton-Raphson Method, Method of False Position, Acceleration of Convergence (Aitken's Δ^2 process), Solution of system of non-linear equations : iteration method and Newton-Raphson method.

Unit II: Linear System of Equations (9 Hours)

Gauss elimination, Gauss- Jorden method, method of factorization (LU decomposition), iterative methods, Gauss-Seidel method, Largest Eigen Values by iteration method .

Unit III: Numerical Solutions (9 Hours)

Numerical Solution of Ordinary differential Equations: Taylor series method, Picard's method , Euler's method, Modified Euler Method, Runge-Kutta Methods, Predictor & Corrector methods, Solutions of Elliptic, Hyperbolic and Parabolic equations.

Unit IV: Interpolation (9 Hours)

Polynomial interpolation, finite differences, Factorial Polynomial, Newton's formulae for interpolation(forward & backward), Sterling's formula for central differences, interpolation with uneven spaced points: Lagranges's interpolation formula, Divided differences, Aitken's formula,.

Unit V: Numerical Calculus (9 Hours)

Numerical differentiation, Errors in numerical differentiation, Numerical Integration, Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule, error estimates for Trapezoidal and Simpson's rule. Difference Equations with constant coefficients

Prescribed Book: S. S. Sastry: Introductory Methods of Numerical Analysis

Reference Book : F. B. Hilderbrand: Introduction to Numerical Analysis
K. E. Aitkenson: An Introduction to Numerical Analysis

THEORY OF VECTORS

Subject code: - PGOPENASH004

Teaching Scheme
Lectures: 4/week
Total credits: 04

Examination Scheme
T(U) 70 marks T(I) 30 marks
Duration of University Examination: 3 hours

Course Objectives and Expected Outcomes:
The objective of this course is to provide applications of calculus operation on vectors with their physical interpretation and to introduce vector differentiation, integration on surfaces, volume etc. After going through this course, students will gain convenient tools for formulation of his relativity theory, is of good use in the study of mechanics, elasticity, electro – magnetic theory and numerous other fields of science and engineering.

Unit I: Vector Algebra (8 Hours)

Definition, Properties, Types of Vectors, Collinear & Coplanar Vectors, Scalar Product, Work Done as a Scalar Product, Vector Product: Properties, Geometrical Interpretation, Application to find Moment of Force and Angular Velocity of a Rigid body, Scalar Triple Product and Properties, Vector Triple Product, Product of Four Vectors.

Unit II: Vector Differentiation (10 Hours)

Vector Function, Derivative of a Vector Function, Rules for Differentiation, Velocity and Acceleration, Scalar & Vector Field, Point Function, Operator ∇ , Gradient: Geometrical Interpretation & Properties, Directional Derivative, Divergence: Physical Interpretation & Properties, solenoidal vector field ,Curl: Physical Interpretation & Properties , irrotational vector field Del applied twice to point function, Del applied to Product of two Point Functions.

Unit III: Vector Integration (9 Hours)

Integration of Vectors, Line Integral, Circulation, Work done, Surfaces, Surface Integral, Flux across a Surface, Volume Integral, Green's Divergence and Stoke's theorem (without proof), Irrotational and Solenoidal vector field

Unit IV: Curvilinear Coordinates (8 Hours)

Definition, coordinate surfaces, coordinate curves, Orthogonal curvilinear coordinates, Arc, Area and Volume elements, Gradient, Divergence and Curl in orthogonal coordinates , Laplacian in terms of Orthogonal curvilinear coordinates, curvilinear Cylindrical coordinates, Del applied to functions in Cylindrical, Spherical Polar coordinates, Del applied to Spherical Polar coordinate.

Unit V: Tensors (10 Hours)

Introduction, Coordinates in the space of N-dimensions, Coordinate transformation, Determinant, Kronecker delta, Summation convention, Invariants, Contravariant & Covariant tensors of first order, , Contravariant & Covariant tensors of Higher order, Mixed Tensor, Tensor fields, Matrix form of Transformation law, Symmetric & Skew Symmetric Tensors, Fundamental operations with Tensors, Reimannian Space & Metric Tensor, Conjugate Tensor, Associate Tensor, Length & angle between two vectors, Christoffel symbols, Transformation law of Christoffel's symbols, Covariant differentiation of a Covariant vector, Covariant differentiation of a Contravariant vector, Tensor form of Gradient, Divergence and Curl.

Prescribed Book: Dr. B. S. Grewal : Higher Engineering Mathematics (Khanna Publications)

Reference Book : N. P. Bali: A Text Book of Engineering Mathematics (Laxmi Publication)
J. K. Goyal, K. P. Gupta :Tensor Calculus(Pragati Prakashan)

Nano Science & Nano Technology

Subject code: - PGOPENASH005

Lectures : 3 Hours/week | Theory Tutorial : 1 Hours/week

T(U) : 70 Marks T(P) : 30 Marks | Total : Lectures + Tutorials= 50 hours

Duration of University Exam : 03 Hours | (Total Credits : 04)

Course Outcome of -- Nano Science & Nano Technology

At the end of completion of course,

1 The student shall able to learn the different aspects of nanoscience , nanomaterials and variation in properties of nonmaterial with shapes, sizes and morphology.

2. The student shall able to understand Various Methods of Synthesizing Semiconducting Nano Materials and their structural variations.

3. Students shall be able to learn Nano electronic Architectures along with various methods of testing and characterization.

4. The student shall able to understand concept of quantum dot and application of nano materials specially in CNT and memory devices .

Unit-1: Introduction to Nano Technology: 7 Hrs

Introduction to nanotechnology and materials, Nanomaterials, Introduction to nano sizes and properties comparison with the bulk materials, different shapes, sizes and morphology, History of Nano Technology

Unit-2: Nano Materials-Preparation Technique & Structures: 12 Hrs

Various Methods of Synthesizing Semiconducting Nano Materials ,Top Down Approach, Grinding, Planetary milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Micro emulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Sonochemical Approach, Microwave and Atomization, Gas phase Production Methods: Chemical Vapour Depositions.

Unit-3: Nano Material - Testing & Characterization: 9 Hrs

Nano electronic Architectures: Nanofabrication – Nano-patterning of Metallic / Semiconducting nanostructures (Organic, Glass, Structures -Spinal, Cubic ,Hexagonal , etc) ,Testing Methods of Nano-Size Materials(e-beam/X-RD, Optical lithography, STM/AFM- SEM,TEM & Soft-lithography) – Nano phase materials – Self- assembled Inorganic/Organic layers.

Unit-4: Quantum DOTs 6 Hrs

Quantum mechanics, Quantum dots and its Importance, Synthesis of quantum dots, Application of quantum Dots: quantum well, wire, dot, characteristics of quantum dots, Semiconductor quantum dots

Unit-5: Application of Nono Material (CNT & Memory Devices): 16 Hrs

Memory devices and sensors – Nano ferroelectrics – Ferroelectric random access memory –Fe-RAM circuit design –ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses –identification of hazardous solvents and gases – semiconductor sensor array ,Carbon Nanotube (CNT):Structure of CNT, Synthesis of CNT, electronic, vibrational, mechanical and optical properties of CNT, Applications of CNT.

TEXT BOOKS

1. Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices: Karl Goser, JanDienstuhl and others.

2. Nano Electronics and Information Technology: Rainer Waser

3. Intoduction to Nanotechnology- Charles P Poole & Frank J. Ownes.

REFERENCES

1. Concepts in Spintronics – Sadamichi Maekawa

2. Spin Electronics – David Awschalom Physical properties of Carbon Nanotube-R Satio

3. Applied Physics Of Carbon Nanotubes : Fundamentals Of Theory, Optics And Transport Devices - S.Subramony & S.V. Rotkins

4. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell

5. Carbon Nano Technology - Liming Dai

Advanced Materials & Its Application

Subject code: - PGOPENASH006

Lectures : 3 Hours/week Theory | Tutorial : 1 Hours/week

T(U) : 70 Marks T(P) : 30 Marks | Total : Lectures + Tutorials= 50 hours

Duration of University Exam : 03 Hours | (Total Credits : 04)

Course Outcome of -- Advanced Materials & Its Application

At the end of completion of course,

1 The student shall able to learn the concept of Various synthesis methods of Ferroelectric materials and working of various devices based on these materials.

2. The student shall able to understand synthesis of magnetic nano composites by Sol-Gel, Auto combustion, Hydrothermal, Co precipitation method and the properties of these materials with applications for various sensors .

3. The student shall able to learn the **Phenomenon of superconductivity,** Type-I and type-II superconductors and Quantum dots and its Importance.

4. The student shall able to understand importance of Luminescent Materials & Fuel cells along with various characterization techniques.

Unit I: Ferroelectric Materials: (10 Hours)

Synthesis methods: Solid state reactions, Wet Chemical synthesis, Hydrothermal, Sol-Gel
Applications:Capacitors,Non-volatile memory, Electro-optic materials for data storage, Light deflectors, modulators and displays
Devices:Ferroelectric materials for FERAM devices, Barrier layer and multilayer dielectrics for capacitor technology, High–K dielectrics for electronics, Sensors and actuators.

Unit II: Magnetic nano composites : (10 Hours)

Synthesis methods: Sol-Gel, Auto combustion, Hydrothermal, Co precipitation method

Applications: Cell separation, Bio-imaging, MRI contrast agents, Hyperthermia

Properties: Biocompatibility, magnetization, heat generation by AC field.

Devices; Memory devices, GMR sensors, Spintronics switches, Biosensors

Unit III: Superconductors & Quantum Dots (8 Hours)

Superconductors :

Basic properties of metals in normal state: Resistivity, electronic and phonon specific heats, thermal conductivity, magnetic susceptibility and Hall effect.

Phenomenon of superconductivity: Zero resistance, persistent currents, superconducting transition temperature T_c, isotope effect, perfect diamagnetism and Meissner effect, penetration depth and critical field.

Type-I and Type-II superconductivity : Type-I and type-II superconductors, intermediate states, mixed states.

Unconventional superconductors: Heavy-fermion superconductors, metal-oxide superconductors, organic superconductors, magnesium diboride, iron pnictides.

Quantum Dots : Quantum mechanics, Quantum dots and its Importance, Synthesis of quantum dots, Application of quantum Dots: quantum well, wire, dot, characteristics of quantum dots, Semiconductor quantum dots

Unit IV: Luminescent Materials & Fuel cells (15 Hours)

Luminescent materials - Aluminate based phosphors-fluorides-nitrides-oxides-sulfides.

Synthesis methods: one step combustion synthesis, Recrystallization from acid (Yamashita's method), solid state reaction, Co-precipation method.

Devices : LED, Solid state lighting, solar cells, LASER, TLD.

Definition of Fuel Cells -history-advantages and disadvantages - classification - efficiency-emf of fuel cells-hydrogen/oxygen fuel cell- criteria for the selection of electrode and electrolyte-methanol fuel cell-solid oxide fuel cells-phosphoric acis fuel cells-molten carbonate fuel cell-proton exchange membrane fuel cell-biochemical fuel cell.

Unit V: Characterization & Instrumentation (07 Hours)

XRD , SEM, TEM, AFM, VSM, SQUID Analysis, spectrophotometer and TL reader.

Recommended Books:

1. Materials Science and engineering: a first course, V. Raghavan fifth Edition (Prentice-Hall of India)2004.

2. Materials Science and Engineering – An Introduction, W.D. Callister Jr. (John Wiley & Sons,)1991.

3. Materials Science, J. C. Anderson, K. D. Leaver, R.D. Rawlings and J.M. Alexander, 4th Edition,Chapman & Hall (1994).

4. Electrical Properties of Materials , seventh Edition l.Solymar and D. Walsh (Oxford Univ. Press Indian Edition) 2006

5. Essentials of Materials Science and Engineering, Askeland, Pradeep Phule, Thomson learning (India Edition)

6. Principles of Materials Science and Engineering, William Smith, McGraw-Hill Publication

Laser, Fiber optics and Application

Subject code: - PGOPENASH007

Lectures : 3 Hours/week Theory — Tutorial : 1
Hours/week T(U) : 70 Marks T(P) : 30 Marks — Total :
Lectures+Tutorials= 50 hours — Duration of University Exam : 03 Hours
(Total Credits : 04)

Course Outcome of --Laser, Fiber optics and Application

At the end of completion of course,

1 .The student shall able to learn thefundamental characteristics of lasers along withpumping scheme &Excitation mechanism applied to different laser types.

2.The student shall able to understandCW , Pulsed laser beam characteristics and its measurements and applications of Holographic interferometry,Laser gyroscope,

3.The student shall able to learn the concepts of optical fibre ,Principles of light propagation through a fibre ,various fiber optic cables and specialty fibers.

4. The student shall able to understand Transmission characteristics of optical fibers,VariousOptical sources , detectors and their applications**.**

UNIT I : LASER FUNDAMENTALS and TYPES (12 Hours)

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping.
Electrical discharge mechanism – Gas discharge processes, Glow discharge, RF discharge, Hollow Selective Excitation processes in gas discharges-Excitation mechanism, Argon-ion laser, Excitation mechanism Carbon-dioxide laser
Pumping mechanism - Arc lamp - Diode pumping - Cavity configuration - Nd:YAG; Ti - Sapphire laser

UNIT II :APPLICATION OF LASERS (11 Hours)

Holography – Basic principle - Methods – Holographic interferometry and application, Holographyfor non-destructive testing Medical applications of lasers, laser andtissue interactive – Laser instruments for surgery, removal of tumors of vocal chordsand oncology.
Metrological Application: CW and Pulsed laser beam characteristics and its measurements Interferometric techniques –Calibration Methods -LIDARS - Theory and different experimental arrangements - Pollution monitoring by remote sensing - Applications - Laser gyroscope.
Material Processing : Models for laser heating - Choice of a laser for material processing - Laser welding, drilling, machining and cutting - Laser surface treatment - Laser vapour deposition - Thin film applications.

UNIT III: OPTICAL FIBRES COMMUNICATION (7Hours)

Principles of light propagation through a fibre , optical fiber waveguides, Ray theory, cylindrical fiber (no derivations), single mode fiber, cutoff wave length, mode filed diameter.
Fiber materials, photonic crystal, fiber optic cables specialty fibers.

UNIT IV : TRANSMISSION CHARACTERISTICS of OPTICAL FIBERS (7 Hours)

Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion.

UNIT V : OPTICAL SOURCES AND DETECTORS AND APPLICATIONS (13 Hours)

Introduction, LED's, LASER diodes, Photo detectors, Response time, Photo diodes, comparison of photo detectors. Fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers.
Fibre optic sensors – Fibre optic instrumentation system –Interferometric method of measurement of length, Measurement of pressure,temperature, current, voltage, liquid level and strain.

References:

1. Lasers: Theory and Applications 1st Edition by K. Thyagarajan , A. Ghatak
2. John F. Read, 'Industrial Applications of Lasers', Academic Press, 1978.
3. R.B. Laud - Lasers and Non linear optics. New Age International (P) Ltd. Publishers, New Delhi.
4. Pike High Power Gas Lasers, Institute of Physics, London. (1976).
5. Walter Koechner - Solid State Lasers Engineering, Springer Verlag, New York. (1992).
6. J. Verdeyen - Laser Electronics,. Prentice Hall, London. (1989).
7. F.J. Durate and L.W. Hilman - Dye Lasers Principles With Applications, Inc Academic Press, New York. (1990).
8. M N Avadhanulu& R S Hemne "An Introduction to Lasers- Theory and Applications" S. Chand, publication.
9. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, 1985.
10. Eric Udd and W.B. Spillman (Eds.), " Fiber optic sesnsors: An introduction for engineers and scientists", Wiley (2011).
11. Allen H. Cherin, An Introduction to Optical Fibers, McGraw Hill Inc., Tokyo, 1995.
12. John M. Senior, Optical Fiber Communications, Prentice Hall International Ltd., London 1992.
13. Govind P. Agrawal, Fiber Optic Communication Systems, John Wiley & Sons Inc., New York, 1997.
14. Gerd Keiser, Optical fiber Communications, McGraw Hill Inc. Company, Tokyo, 1995.
15. C.M. Davis et al, 'Fiber Optic Sensor Technology Hand Book', Dynamic Systems, Reston, Virginia, (1992).
16. Krohn D.A., 'Fiber Optic Sensors - Fundamentals and Applications', Instrument Society of America, U.S.A, (1988)
17. Bishnu P. Pal (Ed.)., "Fundamentals of fiber optics in telecommunication and sensor systems", John Wiley & Sons (1993).

Polymer Science and Technology

Subject code: - PGOPENASH008

Teaching Scheme	Th (U): 70 Marks
Lectures: 4 Hrs/Week	Th (I) : 30 Marks
Total Credit: 4	Duration of University Exam : 03 Hrs.

Course Objective:

1. To provide knowledge and competency in scientific and engineering aspects of polymers, complemented by the appropriate skills and attributes.

2. To impart the fundamental physical concepts controlling the synthetic methods for polymerisation.

3. To provide knowledge of application and mechanism of additives to control the properties of polymers. The structure-property-performance concepts are extended to commercial applications of polymers.

4. To gain knowledge on plastic and fibers in engineering applications.

Course Outcome:

1. Students Identify structures of polymers and related chemicals and explain the chemical reactions, and techniques associated with polymer chemistry and synthesis of polymer.

2. To apply and integrate knowledge from four elements i.e., polymer structure, properties,

process and performance to solve the industrial problems and also to develop an

Entrepreneur skill.

3. Apply the knowledge, techniques, skills, and modern tools of plastics and polymer technology to narrowly defined plastics engineering technology activities.

Unit -I): Mechanisms of Polymerization (10 Hrs)

Free radical addition polymerization-mechanism, Ionic polymerization: common features of the two types of ionic polymerization mechanism, Ziegler-Natta polymerization: Ziegler-Natta catalysts, mechanism of coordination.

Copolymerization and its types , the copolymer composition equation, synthesis of alternating, block and graft copolymers. Step reaction (condensation) polymerization-kinetics and mechanism of step reaction polymerization

Polymer Reactions-hydrolysis, acidolysis, aminolysis, crosslinking, addition and substitution reactions, cyclisation reactions, reactions leading to graft and block copolymers, polymeric reagents used for oxidation and reduction.

Unit II) : Methods of Polymerization, compounding & processing (10 Hrs)

Controlled polymerization methods-nitroxide mediated polymerization Polymerization techniques-bulk polymerization, solution polymerization, emulsion polymerization, suspension polymerization solid and gas phase polymerization.

Additives for compounding plastics, fillers, plasticizers and softners, lubricants and flow promoters, anti-aging additives, flame retarders, colorants, blowing agents, UV stabilizers, requirement and functions of each ingredient. Vulcanization of rubber, types of vulcanisation, rheograph, cure time, scorch time. Compound development-formulation of mixes, compounding for specific applications, ozone resistance, heat resistance, weather, resistance to action of oil and radiation,

Unit-III) Processing of plastics, properties of Polymers (10 Hrs)

Processing methods of plastics-methods of mixing-injection, compression and transfer moulding, extrusion, calendaring, thermoforming. Polymer properties- polymer chain flexibility, glass transition temperature and crystalline melting points. Polymer viscoelasticity, the elastic modulus. Structural parameters determining various properties.

Unit IV): Fibre Science and Technology (08 Hrs)

Definition , classification and nomenclature, structural principles.Chemical composition, production and properties of man-made fibres. Fundamentals and general techniques of fibre spinning (melt, wet and dry spinning), fibre drawing, heat setting, texturing of fibres.

UNIT –V) Special Polymers (08 Hrs)

Heat resistant and fire resistant polymers, Polymers with electrical and electronic properties, Photo conducting polymers, polymers with piezo, pyro, ferro electric characters, PVDF, trifluroethylene copolymers. Thermoplastic elastomers: preparation, properties and application of SBS, olefinic types, urethanes, copolymers,

Liquid crystalline polymers: definition and synthesis, application of liquid crystalline polymers.

References

01. G. Odian, Principles of Polymerization, 4th Edn., John-Interscience, 2004.
02. K.J. Saunders, Organic Polymer Chemistry, 2nd Edn., Saunders, 1888.
03. K. Matyjaszewski, T.P. Davis, Handbook of Radical Polymerization, Wiley-Interscience, 2002.
04. M. Chanda, Introduction to Polymer Science and Chemistry:, CRS Press, 2006.
05. M. Chanda, S.K. Roy, Plastic Technology Hand Book, Marcel Dekker, 1986.
06. J.R. Fried, Polymer Science and Technology, 2nd Edn., Prentice Hall, 2003.
07. R.P. Bown, Hand Book of Plastic Test Methods, 3rd Edn., Longman Sc. & Technical, 1988.
08. V. Shah, Hand Book of Plastic Testing Technology, Wiely-VCH, 1998.
09. J.M.G. Cowie, V. Arrighi, Polymers: Chemistry and Physics of Modern Materials, 3rd Edn.,
10. S.V. Bhat, B.A. Nagasampagi, M. Sivakumar, Chemistry of Natural Products,Narosa, 2005.

Instrumental Methods of Chemical Analysis

Subject code: - PGOPENASH009

Teaching Scheme	Th (U): 70 Marks
Lectures: 4 Hrs/Week	Th (I) : 30 Marks
Total Credit: 4	Duration of University Exam : 03 Hrs.

Course Objective:

1. Providing fundamental knowledge about the physical and physico-chemical principles

necessary for understanding the principles of analytical instruments.

2. Understanding the role, importance and application areas of the instrumental methods in analysis.

3. Developing practical skills and ability to handle simpler instruments and to apply the standard methodology in solving problems and tasks in the field of instrumental analysis.

Course Outcome:

At the end of the course, the student will be able to

1. To identify where the instrumental methods of analysis are used in contemporary environment;

2. Demonstrate fundamental knowledge of key concepts in solving basic known or unknown analytical problems and quantitative tasks;

3. To properly handle simple instruments for physical-chemical analysis of given samples;

4. To implement appropriate laboratory procedures (optical, electroanalytical, chromatographic and other methods) in solving practical problems of instrumental analysis;

5. To reliably, accurately and precisely measure when performing the set of instrumental analysis and to interpret the experimental results and write reports on the analysis that was performed.

UNIT-I) General Techniques For Analysis: (10 Hrs.)
Precisions and errors, Brief principle and applications of following techniques: turbidimetric, flame photometry, Conductometry, Potentiometry, pH metry.

UNIT- II) Chromatographic methods of analysis (08 Hrs.)
Introduction, Principle and applications of- Paper, TLC, column, Gas Chromatography, HPLC.

UNIT-III) Spectroscopic Techniques (10 Hrs.)
Principle and applications of – uv-visible spectroscopy, IR spectroscopy, NMR spectroscopy (H^1, C^{13}), Mass spectroscopy.

UNIT-IV) Modern Analytical Techniques (08 Hrs.)
Principle and applications of – TGA, Thermometric titration, Atomic Absorption spectroscopy , SEM.

UNIT-V) Analysis of Industrial Products (10 Hrs.)

Analysis of Fertilizers: Estimation of nitrogen, phosphorus and potassium, Analysis of cements, (CaO, Al_2O_3, Fe_2O_3 & SiO_2). Analysis of steel and ferrous alloys, Dolomite, and Bauxite. Numerical based upon above estimations.

Books:

1. "Standard methods of Chemical Analysis", Vol. 2, (Part A & B), F. J. Welcher, 5th edn., Von Nostrand & Robert E. Krieger Publishing Co. New York, (1975 and 2000)
2. "Quantitative Inorganic Analysis" A. I. Vogel, English Language Book Society, London, (1975)

References

1. Instrumental methods of chemical analysis- *Chatwal and Anand*
2. Introduction to Instrumental Analysis- *R. D. Braun*, Pharmamed Press, Indian Reprint (2006)
3. Principles of Instrumental Analysis, 5th edition- *D. A. Skoog, F. J. Holler, T. A. Nieman,* Philadelphia Saunders College Publishing (1988)
4. Instrumental methods of analysis H.H.Wilard,L.L.Merritt, J A Dean.
5. Instrumental Methods of Chemical analysis.
6. Analytical Chemistry G.D. Chritiain. Wiley
7. Introduction of instrumental analysis. R.P.Braun
8 .Principles of Instrumental Analysis Fifth edition Skoog, Holler, Niemay.

Waste Management

Subject code: - PGOPENASH010

Teaching Scheme	Th (U): 70 Marks
Lectures: 4 Hrs/Week	Th (I) : 30 Marks
Total Credit: 4	Duration of University Exam : 03 Hrs.

Course Objective:

1. To give sound knowledge with understanding of Different type of waste management and industrial sector pollution problems

2. To implement career oriented education and skills to students interested in environmental management.

3. To impliment basic and applied approach with vigour and depth in following major components:

(1) Chemical analysis of different wastes
(2) Solid waste and Waste water management
(3) Hazardous engineering, covering Biomedical waste, Nuclear (Radioactive) waste, thermal power plants waste, Wastes from industries and E-waste.
(4) Advanced technologies for waste management.

General Outcomes:

At the end of the course, the student will be able to

1. The students becomes knowledgeable with respect to the subject and it practicable applicability.

2. The students will capable to understand basic and advanced concepts in Industrial pollution aspects and waste water treatment technologies.

3. To expose the students to different processes used in industries and in research field.

4. To prepare the students to accept the challenges in industrial sectors.

UNIT 1: Objective and Characteristics of waste: (Lectures: 10)

Introduction, Classification of waste, Characteristics and monitoring -
Liquid waste - pH, electrical conductivity, COD, BOD (estimation of BOD rate constant by Thomas slope method), total solids, total dissolved solids, total suspended solids, total volatile solids, chlorides, sulphates, oil & grease. Solid waste- pH, electrical conductivity, total volatile solids, ash. Concepts of 3R's (waste reduction, recycling and reuse).

UNIT 2: Solid Waste and its Management (Lectures: 10)

Definition, Sources, Impact on environmental health, Collection and storage of municipal solid wastes, Solid waste processing technologies –

Composting :- Aerobic composting, Anaerobic composting, advantages and limitations of composting technologies
Incineration:- General Introduction, advantages and limitations of incineration.
Sanitary Landfilling:- General Introduction of land filling techniques, recovery of methane from landfill sites for power generation.Land farming & Land Reclamation

UNIT 3: Waste Water and its Management (Lectures: 10)

Introduction, Flow diagram of wastewater treatment, Sewage and waste water treatments methods -
Preliminary treatments:- Screen and shredder, grit chamber, skimming tank.
Primary treatment methods:- sedimentation, primary clarifier, final clarifier.
Secondary treatment methods:- Biological tower, combined filtration and aeration process,
Tertiary treatment methods:- Chemical precipitation, Membrane Bio-Reactor (MBR), Reverse osmosis, Ion exchange, Concept of effluent treatment plant (ETP).
Brief about rules and regulations for industrial Waste water.

UNIT 4: Hazardous Waste and its Management (Lectures: 08)

Introduction, Classification, Hazardous waste management-
Biomedical waste:- handling and disposal
Nuclear (Radioactive) waste:- Definition, Sources, safe disposal of Nuclear Waste.
Waste from thermal power plants:- disposal and reuse of Fly ash.
E-waste:- Disposal and managemt (home appliances, Spent batteries and others).

UNIT 5: Biotechnological management of waste (Lectures: 08)

Phytoextraction technique, Biofilteration techniques, root zone treatment of waste water by plants, General Intoduction of Advanced oxidation processes for waste water treatment

Books Recommendated:

1. Mishra, S.G. and Dinesh, M. (1993). Pollution through solid waste. Ashish Publishing house New Delhi
2. Solid Waste Management, K. Sasikumar & Sanoop Gopi Krishana, PHI publications
3. Solid and Hazardous waste Management, M. N. Rao, Razia Sultana.
4. Solid Waste Management, Jagbir Singh, A. L. Ramanathan, TR Publications.
5. Wastewater Treatment For Pollution Control And Reuse, 3rd Edition by Shyam. R Asolekar and Soli. J Arceivala, Tata McGraw Hill.
6. Industrial Waste Water Treatment by Patwardhan A.D., PHL Publications.
7. Photochemical Purification of Water and Air: Advanced Oxidation ProcessesBy Thomas Oppenländer, Wiley Interscience.
8. Advanced Oxidation Processes for Water and Wastewater Treatment, simon-parsons, IWA.
9. Biomedical Waste Disposal by Anantpreet Dingh and Sukhjit Kaur, Jaypee Publications.
10. Understanding Radioactive Waste by Raymond Leroy Murray and Kristin L. Manke, Battelle Pr.
11. Compost Science and Technology, **Edited by** L.F. Diaz, M. de Bertoldi, W. Bidlingmaier, Elservier.
12. Biotechnology for Waste Management and Site Restoration,**Ronneau**, C.,**Bitchaeva**, O. (Eds.), Springer Netherlands.
13. Murthy, D.B.N. (2004). Environmental Awareness and Protection. Deep & Deep Publications. New Delhi.
14. Rangi, S.S. and Randhawa,S.S. (2006). Environment Education. Vikas & company Jalandhar

15. Sharma, H.D., and Lewis, S.P., Waste Containment Systems, Waste Stabilization, and Landfills: Design and Evaluation. Wiley Interscience, 1994. ISBN: 0471575364.
16. George Techobanoglous et al, " Integrated Solid Waste Management ", McGraw-Hill Publication, 1993.
17. Charles A. W entz; " Hazardous Waste Management ", McGraw Hill Publication, 1995.
18. Bagchi, A., Design, Construction, and Monitoring of Landfills, (2nd Ed). Wiley Interscience, 1994. ISBN: 0-471-30681-9.
19. Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", TataMcGraw-Hill Publications, New Delhi, 2003
20. Manual on Municipal solid Waste Management, CPHEEO, Govt. of India.
21. Guidelines for Management and Handling of Hazardous wastes MOEF (1991), Govt. of India.
22. Datta, M; Waste Disposal in Engineered Landfills, Narosa Publishers, Delhi.
23. Environmental Sciences by Daniel B. Botkin and Edward A. Keller, Wiley student, 6th edition- 2009.

1. Life Skills/ Soft Skills

Subject code: - PGOPENARCH011

Objective : To enable students to cope with challenges of today's world and live a life which is socially and emotionally enriching.

WHO Department of Mental Health has identified five basic areas of life

Skills those are relevant across cultures

- Decision-making and problem-solving
- Creative thinking and critical thinking
- Communication and interpersonal skills
- Self-awareness and empathy
- Coping with emotions and coping with stress.

Course objectives-The life skills education contributes to

- Basic education
- Gender equality
- Democracy
- Good citizenship
- Quality and efficiency of the education system
- The promotion of lifelong learning
- Quality of life
- The promotion of peace.

Modules for the elective on soft skills

- Decision Making
- Critical thinking
- Communication and Interpersonal skills
- Self-awareness and empathy
- Coping with emotions and stress

PRODUCT DESIGN AND DEVELOPMENT PROCESS

Subject code: - PGOPENARCH012

OBJECTIVES:

The focus of Product Design and Development Process is to give the students an insight about fundamentals of product design and integration of design, manufacturing and marketing aspects involved in the process of creating a new product for a firm. It also aims at impart the knowledge about various legal issues involved in new product development.

Upon completion of the course, the students will be able to:

1. Understand various aspects of product design and development process.
2. Identify and classify various stages involved in the process of product design from market survey to detailed design.
3. Gain knowledge about process of prototyping and performance testing of the product.
4. Be exposed to the legal issues involved in new product development.
5. Understand the rules and regulations involved in trademarks, copyrights, patents and industrial design rights and infringement of the same.

UNIT I - INTRODUCTION TO PRODUCT DESIGN AND PRODUCT DEVELOPMENT PROCESS

Significance of product design, objectives of product design, factors influencing product design and development process, the challenges of product development, Identifying opportunities.

UNIT II - MARKET SURVEY, CUSTOMER NEED IDENTIFICATION AND PRODUCT SPECIFICATIONS

Indentifying target market and customer, market survey questionnaire, market survey analysis, market trends, SWOT Analysis, customer need identification, requirement generation based on market survey analysis and customer needs, analysis of technical constraints, establish target specifications, setting final specifications.

UNIT III - CONCEPTUAL DESIGN AND SELECTION

Product concepts based on product requirements, feasibility, cost, safety, compatibility, efficiency and other criteria for selection, concept screening, methods of selection.

UNIT IV DETAIL DESIGN OF PRODUCT AND PROTOTYPING

2D and 3D drawings of the product, mock models, prototypes, functional tests to determine the performance of the product.

UNIT V - INTELLECTUAL PROPERTY

Intellectual property rights (IPR) like trademarks, copyrights, patents, industrial design rights, etc, design for environment impact, government regulations, ISO system.

TEXT BOOKS/REFERENCES

1. Ulrich K. T, Eppinger S.D. and Anita Goyal , "*Product Design and Development"*, Tata McGraw Hill, 2009.
2. Otto K, and Wood K, "Product Design", Pearson Education, 2001.
3. Jones, J.C : Design methods: Seeds of human futures, Wiley inter science, London, 1992.
4. Gorb, Peter (Ed), Living by Design, Lund Humphries, London 1978.
5. Andreasen M.M, Hein L, Integrated Product Development, IFS Publications Ltd. / Springer Verlag, Berlin, 1987.

6. Asimow Morris; Introduction to Design, Englewood Cliffs, N.J: Prentice Hall, 1962.

Disaster management and mitigation

Subject code: - PGOPENARCH013

COURSE OBJECTVES -

A Disaster is an event or series of events, which gives rise to casualties and damage or loss of properties, infrastructure, environment, essential services or means of livelihood on such a scale which is beyond the normal capacity of the affected community to cope with. Disaster is also sometimes described as a "catastrophic situation in which the normal pattern of life or ecosystem has been disrupted and extra-ordinary emergency interventions are required to save and preserve lives and or the environment". This course is an effort to contribute to Pool of Disaster Management's Strategic Plan which is to build a national hub to share and learn and to create a critical mass of institutions, trainers and trained professionals.

By the end of semester students will be able to.

- To work as a think tank for the society by providing assistance in policy formulation.
- Develop ability and understanding of disaster mitigation and management.

The course is designed for post graduate course for all brancehes of engineering and technology of RTM Nagpur University.

Unit I Introduction to Development
Concepts and apporoches to growth and Development in the globalised world, Poorty and human Development.Understanding the Co-relation between Development, Environment and Natural Disasters as well as learning the limitations of the assesssment of human development(H.D.I)

Unit II laws & standards in disaster management
Studying the evolution & history of 'humanitarianism' to understand its aspects applying to the context of disaster and studying the fundamental humanitarian principles & the 'International Disaster Response Law' (I.R.D.L).

Unit III Introduction to hazards, vulnerabilities & disasters
Introducing the basic concepts of hazards, exposure, risks, vulnerabilities, disasters and their inter-relationships; Understanding the political , social, economic, environmental perspectives of risks & vulnerabilities as well as the contributing factors, potential impacts & the different types of disasters.

Unit IV Disaster risk reduction & development planning
Introducing the approaches to disaster risk, vulnerability assessment, disaster prevention & preparedness; examining the 'Hyogo' framework for action(assessment, early warning, natural resource management etc)

Unit V Disaster response, recovery & geo-informatics technology in disaster management
Understanding resilience & linking vulnerability reduction & disaster recovery; developing understanding about multiple stakeholders involved in disaster response & standards of aid, relief, rehabilitation; dealing with the application of G.I.S, remote sensing in planning & mitigation; working on case-studies in disaster response and management.

Text Books and Referances
Anil Sinha&Vinod K. Sharma **(1999) "**Culture of Prevention"National Institute of Disaster Management.
Vinod K. Sharma (2001) " Disaster Management "National Institute of Disaster Management.

AjinderWalia (2015) " TOT module on gender and Disaster Management National Institute of Disaster Management.
Amnesty International. 2004. *Clouds of Injustice: Bhopal Disaster 20 Years On.* London: Amnesty International. p 1.Accessed at http://amnesty.org/en/library/info/ASA20/015/2004/en on May 05, 2009.

Internet Of Things (IoT)

Subject code: - PGOPENCE014

Teaching Scheme	**Examination Scheme**
Lectures: 4 Hrs/Week	Total Marks(IA+TH) : 100
No.Of Credits: 04	Internal Assessment(IA) : 30
	Theory(TH) : 70

Course Objectives:

The main objective of the course is to develop the students to work on the present technology standard.

Course Outcomes:

Upon completion of this course the student should be able to

- Understand the theoretical framework of IoT
- Describes Applications of IoT, its Privacy, Security and Governance
- Describes Architectural Approaches for IoT and IoT Challenges
- Learn the theoretical foundation for developing large-scale practical IoT systems

Unit I. IoT Web Technology

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Unit II. IoT Applications for Value Creations

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Unit III. Internet of Things Privacy, Security and Governance

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Unit IV. Architectural Approach for IoT Empowerment

Introduction, Defining a Common Architectural Ground, IoT Standardization, M2M Service Layer Standardization, OGC Sensor Web for IoT, IEEE, IETF and ITU-T standardization activities,

Unit V. Interoperability Challenges

Introduction, Physical vs Virtual, Solve the Basic First, Data Interoperability, Semantic Interoperability, Organizational Interoperability, Eternal Interoperability, Importance of Standardization, Plan for validation and testing, Important Economic Dimension, Research Roadmap for IoT Testing Methodologies, Semantic as an Interoperability Enabler and related work.

Text Books

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013, ISBN: 978-87-92982-96-4 (E-Book), ISBN: 978-87-92982-73-5 (Print)

Reference Book

1. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1

STORAGE AREA NETWORKS AND MANAGEMENT

Subject code: - PGOPENCE015

Teaching Scheme
Lectures: 4 Hrs/Week
No.Of Credits: 04

Examination Scheme
Total Marks(IA+TH) : 100
Internal Assessment(IA) : 30
Theory(TH) : 70

Course Objectives:

The main objective of the course is to expose the students to different Backup, Archive and Replication, Business Continuity, Local Replication, Cloud Computing, Securing Storage Infrastructure.

Course Outcomes:

Upon completion of this course, the student should be able to:

- Describe about Information availability and Business continuity.
- Describe the backup/recovery topologies.
- Describe local replication and remote replication technologies and their operation.
- Describe processes and technologies for identifying, analyzing, and mitigating security risks in storage infrastructure.
- Students will demonstrate effective oral and writing communication skills necessary to be effective and to compete at global business environment.

UNIT – I. Introduction to Storage Technology

Introduction, Information storage, evolution of storage technology and architecture, data center infrastructure, key challenges in Managing information, information lifecycle. Storage system Environments: components of storage system environment, Disk Drive components, Disk Drive Performance, fundamental laws governing disk performance, logical components of the host, application requirements and disk performance.

UNIT – II. Data Protection

RAID: Implementation of RAID, RAID array components, RAID levels, RAID comparison, RAID Impact on disk performance, host spares. Intelligent Storage System: Components of an Intelligent Storage System, Intelligent Storage array, concepts in Practice: EMC CLARIION and Symmetric.

UNIT – III. Direct – Attached Storage and Introduction to SCSI

Types of DAS, DAS benefits and limitations, disk drive interfaces, introduction to parallel SCSI, SCSI command model. Storage Area Networks: fibre channel, The SAN and Its evolution, components of SAN, FC connectivity, Fibre channel ports, fibre channel architecture, zoning, fiber channel login types, concepts in practice: EMC Connectrix.

UNIT – IV. Network attached storage

General purpose servers vs NAS Devices, benefits of NAS, NAS file I/O, components of NAS, NAS Implementations, NAS file sharing protocols, NAS I/O operations, factors effecting NAS Performance and availability, concepts in practice: EMC Celerra.IP SAN: iscsi, fcip. Content – addressed storage: Fixed content and Archives, types of archives, features and benefits of CAS, CAS Architecture, object storage and retrieval in CAS, CAS Examples, concepts in practice: EMC Centera.

UNIT – V. Storage Virtualization

Forms of Virtualization, SNIA Storage virtualization taxonomy, storage virtvalization configurations, storage virtualization challenges, types of storage virtualization, concepts in practice: EMC Invista, Rainifinity. Introduction to business continuity: information availability, BC terminology, BC planning life cycle, Failure analysis, business impact analysis, BC technology solutions, concepts in practice: EMC Power path. Backup and recovery: backup purpose, backup considerations, backup granularity, recovery considerations, backup methods, backup process, backup and restore operations , backup topologies, backup in NAS environments, backup technologies, concepts in practice: EMC Networker, EMC Disk Library(EDL).

Text Books:

1. G. Somasundaram, A. Shrivastava, EMC Corporation : Information Storage and Management, 1st Edition, wiley publishing, 2009.
2. Robert Spalding, Storage Networks : The Complete Reference, 1st Edition,TMH, 2003.

Reference Books:

1. Meeta Gupta : Storage Area Network Fundamentals, 2nd Edition, Pearson Education Limited, 2002.
2. Marc Farley : Building Storage Networks, 2nd Edition, Tata McGraw Hill, Osborne, 2001.

Chemical Engineering Mathematics (Theory)

Subject code: - PGOPENCHE016/PGOPENCHT018

Lecture	: 4 Hours	No. of Credits	: 4
University	: 70 Marks	College Assessment	: 30 Marks

Duration of Examination: 3 Hours

Unit 1: **Algebraic Equations**: Systems of linear equations – Jacabi, Gauss Seidel, Successive over Relaxation methods, Thomas algorithm for tridiagonal systems; Systems of non-linear equations – Successive approximation method, methods for improved convergence, Muller method, Chebyshev third order method, Newton method and its variants, Continuation methods for multiple solutions.

Unit 2: **Ordinary Differential Equations**: RungeKutta methods, step size control and estimates of error, stability of the steady state of a linear system, solution of stiff ODEs, ODE-IVPs coupled with algebraic equations.

Unit 3: **Ordinary Differential Equations (BVPs):** Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method, stability analysis, shooting methods.

Unit 4: **Partial Differential Equations – Finite Difference Method**: Parabolic equations – Explicit and implicit methods – Alternating direction explicit and implicit methods; Chemical reaction and diffusion in a spherical catalyst pellet – Elliptic equations – Point iterative methods – Finite difference solution of a Poisson BVP – First order hypabolic equations – methods of characteristics – explicit and implicit methods – numerical stability analysis, method of lines.

Unit 5: **Partial Differential Equations – Finite Element Method:** Partial differential equations – Finite element method – Orthogonal collocation method, Orthogonal collocation with finite element method, Galerkin finite element method – Function approximation.

Recommended Books:

1. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6th Edition, Tata-McGraw Hill Publications, 2012.
2. K. J. Beers, Numerical methods for Chemical Engineering, Cambridge University Press, New York, 2007.
3. S.K. Gupta, Numerical methods for Engineers, New age publishers 2003.
4. M.K. Jain. S.R.K. Iyengar, R.K. Jain, Numerical methods: Problems and solutions, Wiley Eastern Limited, 2008
5. M.K. Jain, S.R. Iyenkar, M.B. Kanchi, R.K. Jain, Computational methods for partial differential equations, New Age publishers, 2007.

Modern Chemical Instrumentation (Theory)

Subject : PGOPENCHE017/PGOPENCHT019

Lecture	: 4 Hours	No. of Credits	: 4
University	: 70 Marks	College Assessment	: 30 Marks

Duration of Examination: 3 Hours

Unit 1: UV & IR spectroscopy, basic principles of UV & IR, Microwave spectroscopy, radiation sources, monochromators, detectors, instrumentation & Application of qualitative & Quantitative chemical analysis, Raman spectroscopy, sample handling & illumination & applications

Unit 2: Atomic absorption & Atomic emission spectroscopy, flame & flame temperatures, instrumentation & Application, in chemical analysis, fluorescence & phosphoresce, spectrophotometry

Unit 3: Mass spectrometry, basic principles, commercial mass spectrometers, correlation of mass spectra with molecular structure for a few typical cases, application of mass spectral data

Unit 4 : NMR spectroscopy, NMR phenomena, principle & Instrumentation, chemical shift , its measurement, spin – spin coupling, spin – spin splitting, application of NMR in structural diagnosis & Quantitative analysis, electron spin resonance spectroscopy, principle & application in chemical analysis,

Unit 5: Gas chromatography, HPLC, GCMS, SEM, Basic principal of XRD & XRF techniques, Differential Thermal Analysis & Differential scanning calorimeter, thermogravimetry, thermometric titrimetry, electrogravimetry, colorometry, principles applications of colorometry, colorometric titration stripping analysis

Recommended Books:

1. V.M. Parikh, Absorption Spectroscopy of Organic Molecules, Addison - Wesley Publishing Company, 1974.
2. H.H. Willard, I.I. Merritt, J.A. Dean, F.A. Settle, Instrumental Methods of Analysis, Sixth edition, CBS publishers, 1986.
3. D.A. Skoog, D.M. West, Fundamentals of Analytical Chemistry, Saunders-College Publishing, 1982.
4. G.C. Banwell, Fundamentals of Molecular Spectroscopy, TMH, 1992.

Advance Data Mining and Big Data Analytics

SUBJECT CODE:- PGOPENCSE020

Unit-I

Data mining Overview and Advanced Pattern Mining: Data mining tasks – mining frequent patterns, associations and correlations, classification and regression for predictive analysis, cluster analysis , outlier analysis; advanced pattern mining in multilevel, multidimensional space – mining multilevel associations, mining multidimensional associations, mining quantitative association rules, mining rare patterns and negative patterns.

Unit-II

Advance Classification: Classification by back propagation, support vector machines, classification using frequent patterns, other classification methods – genetic algorithms, roughest approach, fuzzy set approach;

Unit-III

Advance Clustering Density - based methods –DBSCAN, OPTICS, DENCLUE; Grid-Based methods – STING, CLIQUE; Exception – maximization algorithm; clustering High- Dimensional Data; Clustering Graph and Network Data.

Unit-IV

Big data and social sensing: Big data acquisition. Web scraping, crawling, crowdsourcing, crowdsensing. Big data technologies and platforms, NOsql and map-reduce paradigm.

Social media mining:- Listening social media sources. Monitoring social trends. Basics of opinion mining and sentiment analysis. Exemplar social media mining projects.

Unit-V

Mobility data analytics. Big data proxies of human mobility. Basic measures of human mobility. Data-driven human mobility models. Mobility data mining with GPS tracking data. Analysis of traffic and city dynamics with vehicular telematics data. Analysis of personal vs. collective mobility.

Mobility data mining with mobile phone data. Analysis of traffic and city dynamics with GSM data. Systematic vs. occasional mobility. Demographic and socio-economic indicators based on GSM data.

Data visualization and visual analytics. Basics of visual representation of data: hierarchies, networks, maps, time series, spatio-temporal data, text. Exemplar case studies.

Text Books:

1. Data Mining Concepts and Techniques, Jiawei Hang Micheline Kamber, Jian pei, Morgan Kaufmannn.

2. Data Mining Techniques – Arun K pujari, Universities Press.

Reference Books:

1. Big Data Analytics – by Seema Acharya, Subhashini Chellappan

Cyber Forensic and Computer Crimes

SUBJECT CODE:- PGOPENCSE021

UNIT-I:- Computer Forensics Fundamentals: What is Computer Forensics?, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement - Computer Forensic Technology - Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined -Data Back-up and Recovery-The Role of Back-up in Data Recovery - The Data-Recovery Solution

UNIT-II:- Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options obstacles-- Types of Evidence - The Rules of Evidence-Volatile Evidence - General Procedure - Collection and Archiving - Methods of Collection -Artifacts - Collection Steps - Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene - Computer Evidence Processing Steps - Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication - Practical Consideration -Practical Implementation

UNIT-III:-Computer Forensics analysis and validation: Determining what data to collect and analyze, validating forensic data. addressing data-hiding techniques, performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project. Processing Crime and Incident Scenes: Identifying digital evidence. collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case

UNIT—IV:- Current Computer Forensic tools: evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in email, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools Cell phone and mobile device forensics: Understanding mobile device forensics, understanding acquisition procedures for cell phones arid mobile devices.

UNIT— V:- Working with Windows and DOS Systems: understanding file systems, exploring Microsoft File Structures. Examining NTH disks. Understanding whole disk encryption, windows registry. Microsoft startup tasks. MS-DOS startup tasks, virtual machines.

Text Books:

1. Computer Forensics, Computer Crime Investigation by Jhon R. Vacca, Firewall Media, New Delhi.

2. Computer Forensics and Investigations by Nelson. Phillips Enfinger.Steuart, CENGAGE Learning

Artificial Intelligence

Subject codes:- PGOPENEE022

Course Objectives:

To learn various types of algorithms useful in Artificial Intelligence (AI).

To convey the ideas in AI research and programming language related to emerging technology.

To understand the concepts of machine learning, probabilistic reasoning, robotics, computer vision, and natural language processing.

To understand the numerous applications and huge possibilities in the field of AI that go beyond the normal human imagination.

Course Outcomes:

After the completion of this course, the students shall be able to:

Design and implement key components of intelligent agents and expert systems.

To apply knowledge representation techniques and problem solving strategies to common AI applications.

Apply and integrate various artificial intelligence techniques in intelligent system

Development as well as understand the importance of maintaining intelligent systems.

Build rule-based and other knowledge-intensive problem solvers.

Unit 01: Introduction to Artificial Neural Network:

Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments. Essentials of Artificial Neural Networks: Artificial Neuron Model, operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures

Unit 02: Classification Taxonomy of ANN:

Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules. Perceptron Models: Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem. Multilayer feed forward Neural Networks

Unit 03: Memory:

Associative Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART).

Unit 04: Introduction to Fuzzy Logic system:

Fuzzy versus crisp, fuzzy sets: membership function, Basic fuzzy set operations, properties of fuzzy sets, fuzzy relations. Fuzzy Control**,** Predicate logic (Interpretation of predicate logic formula, Inference in predicate logic), fuzzy logic (Fuzzy quantifiers, fuzzy Inference), fuzzy rule based system, defuzzification methods

Unit 05: Introduction to other intelligent tools:

Introduction to Genetic Algorithm: biological background, GA operators, selection, encoding, crossover, mutation, chromosome. Expert System: software architecture, rule base system.

Text Books:

1. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2nd Edition, Pearson Education
2. S. Rajsekaram, G. A. Vijayalaxmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms Synthesis & Applications", Practice Hall India
3. James A. Anderson, "An Introduction to Neural Networks", Practice Hall India Publication
4. Mohamed H. Hassoun, "Fundamentals of Artificial Neural Network", Practice Hall India

Reference books:

1. Kelvin Waruicke, Arthur Ekwlle, Raj Agarwal, "AI Techniques in Power System", IEE London U.K.
2. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Network Using MATLAB 6.0", Tata McGraw Hill
3. Jacek Zurada, "Introduction to Artificial Neural Network", Jaico Publishing House India

Utilization of Electrical Energy

Subject codes:- PGOPENEE023

Course Objective:

To understand the Illumination -Design of lighting scheme-sources of light

To understand the Drives-Suitability for different applications

To understand Electric Heating and Welding - Different methods.

Course Outcome:

To select their electric drive system based on application and availability of power source.

Apply power electronics technology in efficient utilization of electrical heating
Apply power electronics technology in efficient utilization of electrical welding
Create lighting system using illumination fundamentals and various illumination Technologies.
Analyze effective utilization of Power Electronic technologies in Electrical Traction.

UNIT-I ELECTRIC DRIVES:

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, Particular applications of electric drives, Types of industrial loads, continuous, Intermittent and variable loads, load Equalization.

UNIT-II ELECTRIC HEATING:

Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating.

UNIT-III ELECTRIC WELDING:

Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT-IV ILLUMINATION FUNDAMENTALS & VARIOUS ILLUMINATION METHODS:

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood ighting.

UNIT-V ELECTRIC TRACTION:

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostatic braking and regenerative braking, Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

TEXT BOOKS:

1. J.B. Gupta, "Utilization of Electric Power and Electric Traction", Kataria & Sons publishers, Delhi, IX Edtion, 2004.

2. C.L. Wadhwa, "Generation, Distribution and Utilization of electrical Energy", New Age International (P) Limited Publishers, 3rd Edition, 2010.

REFERENCES:

1. N.V. Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric traction", New Age International (P) Limited Publishers, 1st Edition,1994.

2. E. Open Shaw Taylor, "Utilization of Electric Energy", Orient Longman,1st Edition,1937.

Biomedical Systems Engineering

Subject codes:- PGOPENETX024

Course Objectives: The objective of this course is to provide students with the understanding of

1. An acquaintance of the physiology of cardiovascular system, respiratory system and nervous system
2. Biomedical sensing and measuring devices.
3. Analysis of Biomedical Signals.
4. Application of Artificial Intelligence for Medical Decision Making.

Course Outcome: Upon the completion of this course, students shall be able to:

1. Understand application of electronics in Medical field.
2. Identify various sensing devices and their applications in medical field
3. Understand working of bioelectronics systems such as EEG, EEG, MRI etc. and various imagining techniques.

UNIT I:

Biomedical signals: origins and dynamic characteristics, Biomedical signal acquisition and processing

UNIT II:

Compression of biomedical signals, Analysis of biomedical signal using advanced techniques (e.g. neural networks, orthogonal transformations including singular value decomposition) and wavelet transformation, higher order spectra).

UNIT III:

Nonlinear dynamical analysis of biomedical signals, Physiological modelling, identification and simulation. Control of physiological processes and computer controlled drug infusion medical signaling (including CT Scan, MRI and Ultrasound).

UNIT IV:

Medical Informatics, Artificial intelligence methods for medical decision making

UNIT V:

Study of biological sensors: Sensors / receptors in the human body, basic organization of nervous system-neural mechanism and circuit processing. Chemoreceptor: hot and cold receptors, barro receptors, sensors for smell, sound, vision, osmolality and taste. Sensor models in the time and frequency domains.

TEXT BOOKS:

1. R. S. Khandpur “Handbook of Bio-Medical Instrumentation”, Tata McGraw Hill.

2. Carr & Brown, “Introduction to Biomedical EquipmentTechnology” Pearson Education, Asia.

3. Cromwell, Weibell & Pfeiffer, “Biomedical Instrumentation & Measurement”, Prentice Hall, India

REFERENCES BOOKS:

1. Joseph Bronzino, “Biomedical Engineering and Instrumentation”, PWS Engg . , Boston.

2. J.Webster, “Bioinstrumentation”, Wiley & Sons.

3. Joseph D.Bronzino, “The Biomedical Engineering handbook”, CRC Press.

Soft Computing Techniques

Subject Code:- PGOPENETX025

Course Objectives:

1. To familiarize with soft computing concepts.
2. To introduce the ideas of Neural networks, fuzzy logic and use of heuristics based on human experience.
3. To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.

Course Outcome: By the end of the course, the students shall be able to

1. Understand the concept fuzzy logic control to real time systems.
2. Provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic
3. Understand and design genetic controller.

UNIT I: **(9)**

Fuzzy Logic: Crisp set and Fuzzy set, Basic concepts of fuzzy sets, membership functions. Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations

UNIT II: **(8)**

Propositional logic and Predicate logic, fuzzy If – Then rules, fuzzy mapping rules and fuzzy implication functions, Applications.

UNIT III: **(9)**

Neural Networks: Basic concepts of neural networks, Neural network architectures, Learning methods, Architecture of a back propagation network, Applications.

UNIT IV: **(9)**

Genetic Algorithms: Basic concepts of genetic algorithms, encoding, genetic modelling.

UNIT V: **(9)**

Hybrid Systems: Integration of neural networks, fuzzy logic and genetic algorithms.

TEXT BOOK:

1. S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007. ISBN: 10:

81-265-1075-7.

REFERENCE BOOKS:

1. S. Rajasekaran and G.A.Vijaylakshmi Pai.. Neural Networks Fuzzy Logic, and Genetic

Algorithms, Prentice Hall of India.

2. K.H.Lee.. First Course on Fuzzy Theory and Applications, Springer-Verlag.

3. J. Yen and R. Langari.. Fuzzy Logic, Intelligence, Control and Information, Pearson Education

Digital Forensics

Subject Code:- PGOPENETX026

Course Objectives:

1. To study fundamentals of Digital Forensics.
2. To study classification of Cyber Crimes.
3. To learn and understand analysis of forensic data.

Course Outcome: By the end of the course, the students shall be able to

1. Identify the type of Cyber Crimes.
2. Identify digital forensics evidences.
3. Analyse the acquired forensic data.

Unit I: **(8)**

Digital Forensics Fundamentals: Introduction, What is Digital forensics?, Use of Digital forensics in law enforcement, Digital forensics assistance to human resources/employment proceedings, Benefits of professional forensics methodology, Steps taken by Digital forensics specialists.

Cyber Crimes: Definition, motives, and classification of cyber crimes. Modus operandi of cyber crime, Types of cyber crimes,

Data Acquisition: Understanding

Processing Crime and Incident Scenes: Identifying digital evidence, collecting evidence in private sector incident scenes, processing law enforcement crime scenes, preparing for a search securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case

Unit II: **(8)**

Digital Forensics Evidence Capture: Data recovery defined, Data backup and recovery, the role of backup in data recovery, Data recovery solution. Preserving the digital crime scene computer evidence processing steps, legal aspects of collecting and preserving computer forensic evidence

Evidence Collection and Data Seizure: Evidence, Collection options, Obstacles, Types of evidence, Rules of evidence, Handling volatile evidence: General procedure, Collection and archiving, Methods of collection, Artifacts, Collection steps, Controlling contamination: the chain of custody.

Analysis and Validation of forensic data: Determining what data to collect and analyse, Validating forensic data, Addressing data hiding techniques, Performing remote acquisitions.

UNIT III: **(9)**

Operating Systems forensics:

Windows Forensics: Understanding file systems, exploring Microsoft file structures, examining NTFS disks, understanding whole disc encryption, windows registry, Microsoft start-up tasks, MSDOS start-up tasks, virtual machines

Linux Forensics: Examining Unix and Linux Disk Structures and Boot processes, understanding inodes, boot processes, loader and GRUB, UNIX and Linux Drives and Partition schemes, examing disk structures

Macintosh Forensics: Examining Macintosh Structures and Boot processes, Mac OS 9 volumes, exploring Mac Boot tasks, Mac forensic s/w.

UNIT IV: **(10)**

Disk Forensics: Examining: CD data Structures, SCSI Disks, IDE/EIDE and SATA Devices.

Network Forensics: Virtual machines, Network forensics overview, Performing live acquisitions, Developing standard procedures for network forensics, Protocol Analysis, Using network tools.

E-mail Investigations: Exploring the role of e-mail in investigations, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools,

Cell phone and mobile device forensics: Understanding mobile device forensics, understanding

Acquisition procedures for cell phones and mobile devices, files present in SIM card, device data, external memory dump, evidences in memory card, operators systems,

i-phone Forensics: Procedures for handling an i-phone device, imaging android USB mass storage devices, logical and physical techniques Android forensics: Procedures for handling an android device, imaging android USB mass storage devices, logical and physical techniques

UNIT V: **(9)**

Image Forensics: Recognizing Graphics file, understanding data compression, locating and recovering graphics files, identifying unknown file formats, understanding copyright issues with graphics.

Current Forensic Tools: Evaluating computer forensic tool needs, computer forensic software Tools, computer forensic hardware tools, validating and testing forensic software

TEXT BOOK:

1. Guide to Computer Forensics and Investigations, Fourth Edition-2014, Bill Nelson, Amela Philips and Christopher Steuart, Cenage Learning, ISBN-13: 978-81-315-1946-2

REFERENCE BOOKS:

1. Warren G. Kruse II and Jay G. Heiser**, "**Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd edition, Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

Nano Electronics

Subject Code:- PGOPENETX027

Course Objectives:

1. To learn and understand basic and advance concepts of nanoelectronics.
2. Study different tools for measuring nanostructures.
3. Learn different nano-devices and its fabrication process

Course Outcome:

1. The students should be able to understand basic and advanced concepts of nanoelectronic devices, sensors and transducers and their applications in nanotechnology.
2. Identify the critical parameters that one must evaluate when considering any new nanoelectronics device.

UNIT I: **(9)**

Energy band structure of solids, Kronig Penny model, Effective mass approximation of Schrodinger equation, Single electron and few electron phenomena and devices: Tunnel junction and applications of tunneling, Tunneling Through a Potential Barrier, Potential Energy Profiles for Material Interfaces, Metal Insulator, Metal Semiconductor, and Metal Insulator Metal Junctions.

UNIT II: **(8)**

Applications of Tunneling; Field Emission, Gate Oxide Tunneling and Hot Electron Effects in MOSFETs, Theory of Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode.

UNIT III: **(10)**

Coulomb Blockade: Coulomb Blockade, Coulomb Blockade in a Nanocapacitor, Tunnel Junctions, Tunnel Junction Excited by a Current Source, Coulomb blockade in a Quantum Dot Circuit. Tuning the Band gap of Nanoscale Semiconductors, Excitons, Semiconductor nanowires-Fabrication strategies, quantum conductance effects in semiconductor nanowires, porous Silicon, nanobelts, nanoribbons, nanosprings; Quantum dot

UNIT IV: **(9)**

The Single Electron Transistor: The Single Electron Transistor Single Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs, Molecular SETs and Molecular Electronics.

UNIT V: **(8)**

Nano-Photonics: Foundation of Nano-Photonics, Photonic band gap materials, quantum wells, wires, dots -optical applications, Plasmonics.

TEXT BOOKS:

1. Fundamentals of nano electronics by George W Hanson Pearson publications, India 2008

2. Nanotechnology and Nano Electronics Materials, devices and measurement Techniques by WR Fahrner Springer

3. Nanomaterials: Synthesis, properties and applications\edited by A.S. Edelstein and R.C. Cammarata (Institute of Physics, UK Series in Micro and Nanoscience and Technology)

4. W. Ranier, "Nano Electronics and Information Technology", Wiley, (2003).

REFERENCE BOOK:

1. Nano: The Essentials Understanding Nano Science and Nanotechnology by T.Pradeep; Tata Mc.Graw Hill

CMOS VLSI Design

Subject Code:- PGOPENETX028

Unit:1

MOS Transistor Theory: n MOS / p MOS transistor, threshold voltage equation, body effect, MOS device design equation, sub threshold region, Channel length modulation. mobility variation, Tunneling, punch through, hot electron effect MOS models, small signal AC Characteristics, CMOS inverter, βn / βp ratio, noise margin, static load MOS inverters, differential inverter, transmission gate, tristate inverter, BiCMOS inverter. (Ref.1 Chap.2)

Unit:2

CMOS Process Technology: Lambda Based Design rules, scaling factor, semiconductor Technology overview, basic CMOS technology, p well / n well / twin well process. Current CMOS enhancement (oxide isolation, LDD. refractory gate, multilayer inter connect), Circuit elements, resistor, capacitor, interconnects, sheet resistance & standard unit capacitance concepts delay unit time, inverter delays, driving capacitive loads, propagate delays, MOS mask layer, stick diagram, design rules and layout, symbolic diagram, mask feints, scaling of MOS circuits. (Ref.3 Chap.4, 5)

Unit:3

Basics of Digital CMOS Design: Combinational MOS Logic circuits Introduction, CMOS logic circuits with a MOS load, CMOS logic circuits, complex logic circuits, Transmission Gate. Sequential MOS logic Circuits - Introduction, Behavior of hi stable elements, SR latch Circuit, clocked latch and Flip Flop Circuits, CMOS D latch and triggered Flip Flop. Dynamic Logic Circuits - Introduction, principles of pass transistor circuits, Voltage boot strapping synchronous dynamic circuits techniques, Dynamic CMOS circuit techniques. (Ref.4 Chap.7, 8, 9)

Unit:4

CMOS Analog Design: Introduction, Single Amplifier. Differential Amplifier, Current mirrors, Band gap references, basis of cross operational amplifier. (Ref.5 Chap.3.2, 4.2, 5.1)

Unit:5

Dynamic CMOS and clocking: Introduction, advantages of CMOS over NMOS, CMOS\SOS technology, CMOS\bulk technology, latch up in bulk CMOS., static CMOS design, Domino CMOS structure and design, Charge 2 sharing, Clocking- clock generation, clock distribution, clocked storage elements. (Ref.2 Chap.7)

Reference Books:

1. Neil Weste and K. Eshragian, “Principles of CMOS VLSI Design: A System Perspective,” 2 nd edition, Pearson Education (Asia) Pvt.. Ltd., 2000.
2. Wayne, Wolf, “Modern VLSI design: System on Silicon” Pearson Education”, 2nd Edition
3. Douglas A Pucknell & Kamran Eshragian , “Basic VLSI Design” PHI 3rd Edition (original Edition – 1994)
4. Sung Mo Kang & Yosuf Lederabic Law, “CMOS Digital Integrated Circuits: Analysis and Design”, McGraw-Hill (Third Edition)

5. “Design of Analog CMOS Integrated Circuits”, Behzad Razavi, TMH, 2007.

Soft Computing

Subject Code:- PGOPENETX029

UNIT-I :-

Learning and Soft Computing: Examples, basic tools of soft computing, basic mathematics of soft computing, learning and statistical approaches to regression and classification.

UNIT-II :-

Single-Layer Networks: Perceptron, adaptive linear neuron (Adaline), and the LMS algorithm.

UNIT-III :-

Multilayer Perceptrons: Error back propagation algorithm, generalized delta rule, practical aspects of error back propagation algorithm.

UNIT-IV :-

Radial Basis Function Networks: Ill-posed problems and the regularization technique, stabilizers and basis functions, generalized radial basis function networks.

UNIT-V :-

Fuzzy Logic Systems: Basics of fuzzy logic theory, mathematical similarities between neural networks and fuzzy logic models, fuzzy additive models.

Text Books:

Vojislav Kecman, “Learning and Soft Computing,” Pearson Education (Asia) Pte. Ltd. 2004.

S. Haykin, "Neural Networks: A Comprehensive Foundation," Pearson Education (Asia) Pte. Ltd./Prentice Hall of India, 2003.

M.T. Hagan, H.B. Demuth and M. Beale, "Neural Network Design," Thomson Learning, 2002.

References:

Bart Kosko, "Neural Networks and Fuzzy Systems," Prentice Hall of India, 2005.

2.George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Application," Prentice Hall of India, 2001.

Entrepreneurship Development

Course Code: PGOPENIND030

L: 4Hrs. T: 0Hrs. Per week Total Credits: 4

Course Outcomes:

1. To Develop conceptual understanding of Entrepreneurship.
3. To encourage self employment
4. To know role of government in promoting employment .

Syllabus:

The Entrepreneurial Development Perspective

1. Concepts of Entrepreneurship Development
2. Evolution of the concept of Entrepreneur
3. Attributes and Characteristics of a successful Entrepreneur

Creating Entrepreneurial Venture

1. Business Planning Process
2. Environmental Analysis - Search and Scanning
3. Identifying problems and opportunities
4. Defining Business Idea

Project Management

1. Technical, Financial, Marketing, Personnel and Management Feasibility
2. Estimating and Financing funds requirement - Schemes offered by various commercial banks and financial institutions like IDBI,SIDBI, SFCs,Venture Capital Funding

Entrepreneurship Development and Government

1. Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available
2. Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB)

References:

1. Entrepreneurship: New Venture Creation - David H. Holt
2. Entrepreneurship - Hisrich Peters
3. The Culture of Entrepreneurship - Brigitte Berger
4. Project Management - K. Nagarajan
5. Dynamics of Entrepreneurship Development - Vasant Desai
6. Entrepreneurship Development - Dr. P.C.Shejwalkar
7. Thought Leaders - Shrinivas Pandit
8. Entrepreneurship, 3rd Ed. - Steven Brandt

Computer Aided Facilities Planning

Course Code: PGOPENIND031

L: 4Hrs. T: 0Hrs. Per week Total Credits: 4

Course Outcomes:

1. To get familiarized with the computer aided drawing.
2. To realize the importance of information for decision making in the organizing.
3. Use of the computer in strategic planning process.
4. To do the cost benefit analysis of information System.

Syllabus:

Defining Requirements – Introduction - Product, Process, and Schedule Design - Flow, Space, and Activity Relationships.

Developing Alternatives: Concepts and Techniques - Material Handling - Layout Planning Models and Design Algorithms.

Facility Design for Various Functions - Warehouse Operations, Manufacturing Systems, Facilities Systems.

Developing Alternatives: Quantitative Approaches - Quantitative Facilities Planning Models Evaluating, Selecting, Preparing, Presenting, Implementing, and Maintaining - Evaluating and Selecting the Facilities Plan - Preparing, Presenting, Implementing, and Maintaining the Facilities Plan.

Facilities planning for various industries like Manufacturing, Pharma, Food Service, Underground gas storage and Health care. Computer aided tools for facilities design.

Text Books:

1. Tompkins, James A; White John A; et al; Facilities Planning, Wiley, 2008

Reference Books

1. Andrew A. Signore, Terry Jacobs, Good Design Practices For Gmp Pharmaceutical Facilities, Taylor & Francis Group, 2005

2. Orin Flanigan, Underground Gas Storage Facilities: Design and Implementation, Gulf Professional Publishing, 1995

Total Quality System & Engineering

Course Code: PGOPENCADCAM032

Course Objective: to understand concept & Principal of TQM, importance of customer satisfaction and loyalty, Methods and Philosophy of Statistical Process Control, **ISO9000:** Universal Standards of Quality.

UNIT I:

INTRODUCTION: The concept and Principles of TQM, Definition of quality, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Leadership, Organizational Structure, Team Building, Information Systems and Documentation.

UNIT – II:

CUSTOMER FOCUS AND SATISFACTION: The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marking, the bench marking process, pitfalls of bench Marketing

UNIT III:

ORGANIZING FOR TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT IV:

STATISTICAL PROCESS CONTROL**:** Methods and Philosophy of Statistical Process Control, Control Charts for Variables and Attributes, Cumulative sum and exponentially weighted moving average control charts, Others SPC Techniques – Process Capability Analysis . Acceptance Sampling Problem , Single Sampling Plans for attributes , double, multiple and sequential sampling,

THE COST OF QUALITY**:** Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT V:

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, Quality Auditing, Documentation ISO9000 and services, the cost of certification implementing the system. Quality awards Single Vendor Concept , J.I.T. , Quality Function deployment , Quality Circles , KAIZEN , SGA POKA -YOKE , Taguchi Methods. Six sigma manufacturing concepts

REFERENCES:

1. Total Quality Management / Joel E.Ross/Taylor and Franscis Limited
2. Total Quality Management/P.N.Mukherjee/PHI
3. Beyond TQM / Robert L.Flood
4. Statistical Quality Control / E.L. Grant.
5. Total Quality Management- A Practical Approach/H. Lal
6. Quality Management/Kanishka Bedi/Oxford University Press/2011
7. Total Engineering Quality Management/Sunil Sharma/Macmillan

Reliability Engineering

Course Code: PGOPENCADCAM033

Objectives: To equip the students to analyze reliability data. To introduce the concepts of reliability and useful life availability of products. To impart knowledge on maintainability and availability analyses of products.

UNIT I:

Reliability Concept: Reliability function - failure rate - Mean Time Between Failures (MTBF) - Mean Time to Failure (MTTF) - a priori and a posteriori concept - mortality curve - useful life availability – maintainability - system effectiveness.

UNIT II:

Reliability Data Analysis: Time-to-failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques - Hazard plotting.

UNIT III:

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT IV:

Reliability Management: Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model.

UNIT V:

Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources – industrial safety and risk assesment.

Reference Books:

1. Modarres, " Reliability and Risk analysis ", Mara Dekker Inc., 1993.

2. John Davidson, “The Reliability of Mechanical system ", Institution of Mechanical Engineers, London,

3. C.O. Smith" Introduction to Reliability in Design ", McGraw Hill, London, 1976.

Artificial Intelligence

Course Code: PGOPENCADMA034

Unit-I

Human and machine intelligence, Artificial Intelligence (AI), Programming in AI environment, Natural Language processing (NLP), Need of AI.

Unit-II

Architecture of an Expert system, Knowledge base, inference engine forward and backward chaining, use of probability and fuzzy logic. Selection of inference mechanism, (Relevant case studies)

Unit-III

Neural Network and application artificial neural network models, NN applications in Cellular manufacturing and other areas of mechanical Engg..(Relevant case studies)

Unit-IV

Introduction to Rule Based System. Conflict Resolution Advantages and Drawbacks of Rule Based Systems Clausal Form Logic, Rule Base Verification, Refinement and Validation. Creating Knowledge Base, Knowledge Engineer and Domain Expert, Phases of Knowledge Engineering, Tools for Knowledge Engineering.

Unit-V

Fundamentals of OOP (Object oriented programming), creating structures and objects, object operations, invoking procedures, programming applications, Object oriented expert systems. Semantic nets, structure and objects, ruled systems for semantic nets, certainty factors, automated. Relevant case studies.

Books Recommended:

1. Addis, T.R., ―Designing Knowledge Based System‖, Prentice Hall, 1985.
2. Rolston, D.W., ―Principles of Artificial Intelligence and Expert Systems Development‖, McGraw Hill, 1988.
3. Maus, R. and Keyes, J., ―Handbook of Expert Systems in Manufacturing‖, McGraw Hill, 1991
4. Robert Levine, ―A comprehensive guide to artificial intelligence and expert systems",Elain Rich , Artificial Intelligence,
5. Sasikumar, Ramani, et al ,Rule based expert systems.

6. Graham Winstanley, ―Program Design for Knowledge Based Systems, Galgotia Publications.

7. Artificial Neural Networks", Zurada

8. V.B. Rao and H.V. Rao, ―C++ : Neural Networks and Fuzzy Logic‖, BPB Publications.

Control System Engineering

Course Code: PGOPENCADMA035

Unit-I

Introduction: Need for automation and automatic control systems. Classification of control system, Mathematical modeling of control systems, concept of transfer function, differential equations. Block diagram algebra, and signal flow graphs. Effect of feedback on parameter variations.

Unit-II

Time response analysis: Time response of control system, standard test signal, Time Response Analysis of First and Second order system, Time Domain specifications. Step response of second order system. steady-state errors, steady state, analysis of Different type of systems using Step, Ramp, Impulse and Parabolic inputs.

Stability analysis: Introduction to concepts of stability. The Routh-Hurwitz criteria. Special cases for determining Relative stability analysis.

Unit-III

Root locus Techniques: Root location and it's effect on time response, elementary idea of root locus, effect of adding pole and zero and proximity of imaginary axis.

Frequency Response Analysis: Frequency domain specifications Correlation between time and frequency response. Polar Plots. Bode Plots, Nyquist Plots.

Unit-IV

Compensation (Introduction only): Types of compensator, selection of compensator, Lead, Lag and Lag-Lead compensation.

Unit-V

State space modeling: Concept of state, state variable, state model. State space representation using physical and phase variables, decomposition of transfer function, diagonalisation. State transition matrix. Transfer function from state model. Controllability and Observability of linear system. Digital control system.

Control system components: Servomotor, servo mechanism, stepper motors, Potentiometer, amplifiers,Sensors, actuators.

BOOKS RECOMMENDATED:

1) Modern Control Engineering by Ogata, PHI, 5th Edition, 2011

2) Control System Engineering by Nagrath & Gopal, New Age International Pvt Ltd,5th Edition ,2008

3) Linear Control System (With Matlab Application) by B. S. Manke, Khanna Publisher, 10th Edition, 2010

4) Feedback Control System by R A. Barapatre, TechMax Pub,11th Edition, 2009

5) Control Systems: Principles and Design by M.Gopal, Tata McGraw Hill, 2nd Edition, 2007

6) Control System Analysis by Bhide,TechMax Pub.
7) Automatic Control Systems –Benjamin C. Kuo, PHI, 7th Edition, 2003
8) Systems and Control - Stanislawhizak, Oxford Pub.

9) Control system Engineering by Nise [Willey]

Micro Electro Mechanical Systems

Course Code: PGOPENCADMA036

Unit-I

Introduction to MEMS & Applications

• Introduction to Micro-Electro-Mechanical Systems,

• Applications and Materials,

• Advantages & Disadvantages of Micro-sensors, and micro-actuators.

Sensors and Actuators in Micro-domain

• Concept of Sensors & Actuators,

• Sensing & Actuation Principles: Mechanical Sensing, Capacitive,

Electrostatic, Electromagnetic, Piezo Resistive, Piezo Electric, Thin Films,

Shape Memory Alloys

• Comb Drive Actuation & Sensing. Micro-mechanisms, Air-Bag Sensors,

Chemical Sensors

Unit-II

Fabrication Methods

Microfabrication Methods (VLSI Techniques)

• Positive and Negative Photoresists,

• Bulk Micromachining,

• Surface Micromachining,

• Etching (Isotropic and Anisotropic),

• Deposition techniques such as CVD (Chemical Vapor Deposition),

Metallization Techniques. 3D High Aspect Ratio Techniques LIGA, AMANDA, Microstereolithography, IH-Process, X-Ray Techniques, Ion-beam Lithography.

Unit-III

Modelling and Simulation Techniques

• Micro-mechanism modelling and analysis techniques : Lumped Parameter Modelling and Distributed Parameter Modeling

• Modelling of Micro-channel as heat exchanger, accelerometers, microhinges, compound microstructures.

• Linear & Nonlinear Model.

• Introduction to Numerical Methods used for MEMS analysis.

Unit-IV

Characterization Techniques

Topography Methods (Optical, Electrical and Mechanical Methods)

• Microscopy, STM (Scanning Tunneling Microscopes),

• SEM (Scanning Electron Microscopes),SPM(Scanning Probe Microscopes), AFM (Atomic Force Microscopes)

Mechanical Structure Analysis

• Deformation & Vibration Measurement Techniques (Piezo resistive and piezo electric)

• Interferometry Techniques,

• SPI (Speckle Pattern Interferometry),

• ESPI (Electronic Speckle Pattern Interferometry),

• Laser Techniques, Laser Doppler Vibro-meters

Unit-V

Introduction to Advances of MEMS and Nanotechnology

• CNT (Carbon Nano Tubes) Applications, its properties, and Fabrication Method,

• Nano-mechanical Systems (NEMS),

• Nano-tribology, &nano-indentation techniques,

• Domestic and Industrial Applications of nanotechnology

• Molecular Modelling Techniques.

• Social and Ethical Implications of nanotechnology in Society

Books Recommended:

1. Julian W. Garden, Vijay K. Varadan and Osama O. Awadelkarim "Microsensors MEMS and Smart devices", John Wiley and sons, Ltd.
2. NadimMulaf and Kirt Williams, "An Introduction to Microelectromechanical systems

   Engineering", Artech House.

3. NicolaeLobontiu and Ephrahim Garcia, "Mechanics of Microelectromechanical systems", Kluwer Academic Publication.

4. Stanley Wolf and Richard Tauber, "Silicon Processing for the VLSI era Volume -1

   Technology", Lattice press.

5. Vijay K. Varadan, K.J.Vinoy and S. Gopalkrishnan, "Smart Material Systems and MEMS:Design and Development Methodologies", John Wiley and sons Ltd.

6. Bhushan, "Springer Handbook of Nanotechnology", Springer Inc.

ENERGY CONSERVATION AND MANAGEMENT

Course Code: PGOPENMECHHPE037

Course Outcomes

- Ability to understand the basic concept of energy conservation and its role in energy management.
- Learn the purpose and detailed methodology of energy audit.
- Ability to analyze the energy conservation opportunities in the energy intensive industries.
- Ability to analyze the quantum of electrical energy that can be saved by the use of energy efficient system.
- Learn the concept of cogeneration and waste heat recovery system.

Unit – I

Introduction: Energy Scenario, Enegy conservation, Principles and imperatives of Energy Conservation, Energy consumption patterns, Resource availability, Role of energy management in industry , Role of instruments in energy conservation, Project Management, Energy Action Planning , Energy Monitoring.

Unit - II

Energy Audit – Types and Methodology, Material and Energy Balance.

Thermal Energy Auditing: Energy Audit- Purpose, methodology with respect to process industry, power plants, boilers etc. Energy performance assessment of Boilers, industrial Furnace, air compressors, cogeneration and Turbines (GAS, STEAM), Heat Exchangers, fan and blower, Pumps and Refrigeration system.

Unit - III

Electrical Energy Auditing: Electrical energy basics, Potential areas for electrical energy conservation in various industries, importance of power factor improvements methods, determination of percentage of motor loading, AC drive and its use, Energy performance assessment of lighting systems, AC and DC motors and variable speed drives.

Unit – IV

Energy Management: Importance, Principles of energy management, energy manager and Auditor, Performance Financial Analysis technique - discount rates, simple pay back periods, Net Present Value Method, Internal rate of returns, life cycle costing, and factor affecting analysis.

References

1. Principles Energy Conservation, Archie, Wculp, McGraw Hill, 1991.
2. Energy Management, P. O. Callaghan, McGraw Hill Book Company, 1993.
3. C.B. Smith, Energy Management Principles, Pergamon Press NY 1981.
4. Trivedi, P.R., Jolka K.R., Energy Management, Common Wealth Publications, New Delhi 1997.
5. Write Larry C., Industrial Energy Management and Utilization, hemisphere Publisher, Sashington, 1988.
6. The Handbook on Bureau of Energy Efficiency Study material for Energy Manager and Auditors Examinatiobn : Paper I to IV

AUTOMOBILE ENGINEERING

Course Code: PGOPENMECHHPE038

UNIT-I

Chassis layout, power train-clutch and gearbox, design of clutch and gear, torque converter, gear selector mechanism, transfer cage, automatic transmission system

UNIT-II

Propeller shaft, joints, drives differential, rare and front axle, braking system, design of brakes, brake adjustment, steering system, electronic power steering, steering alignment, wheel balancing

UNIT-III

Suspension system, need of suspension system, air suspension, hydragas suspension, tyres, factor affecting tyre performance, aspect ratio, tubeless tyre, rim, tyre precautions

UNIT –IV

Electrical system in automobile, battery, starter motor, ignition system, lighting system, automobile air-conditioning, ABS, recent developments in automobile

References

1. H. S. sethy, Automotive Technology, TMH
2. Heitner Joseph, Automotive machines
3. Dolan J. A., Motor Vehicle Technology, Heinemann education books
4. R. s. khurmi, Machine Design, S. Chand
5. V. b. Bhandari, Design of Machine Elements, TMH
6. K. K. ramalingm, Fundamentals of Automobile engineering, Scietech publication

ADVANCED OPERATIONS RESEARCH

Course Code: PGOPENMECHHPE039

Course Objectives

This course is for students new to the topics of Operations Research. The course emphasizes the application of Operations Research for solving business problems. Throughout this course, students are expected to know and understand common and important business problems. Students will develop problem modeling and solving skills and learn how to make intelligent business decisions from the point of view of optimization.

UNIT 1: Introduction
General description of Operations Research - Review of OR , Introduction to GAMS.

Nonlinear Programming:
Nonlinear models - Review of linear algebra and calculus - Local and global solutions - Feasible directions- Improving directions - KKT conditions - Convexity.

UNIT 2: Integer Programming &Dynamic programming:
Integer programming models, Relaxations - Branch-and-bound algorithm, Better and ideal formulations- Cutting planes.

Dynamic programming models and applications, Graphical representation , Optimality principle.

UNIT 3: Probability review & stochastic dynamic programming
Conditional probability - Discrete and continuous distributions - Expectation and variance - Sums of random variables - Exponential and normal distributions.

Dynamic programming models and their application , Graphical representation - Recursion.

UNIT 4: Markov chains & Queuing theory

Stochastic processes - States, Markov Chains, Transition matrices - Types of chains ,Steady-state probabilities.
Applications - Arrival and service process - Birth-and-death processes - M/M queues.

Main Reference

- Operations Research, An Introduction, 8th edition; Taha, Hamdy A.; Prentice-Hall, 2007
- Introduction to Operations Research 8th edition, Hillier, Frederick S.; Lieberman, Gerald J. New York. McGraw-Hill.

Other References

- Operations Research Applications and Algorithms 4th edition, Wayne L. Winston, Thomson Brooks/Cole

Subject: Robotics

Subject Code: - PGOPENMED040

Course Objective:

The course deals with various robot components, kinematic and dynamic analysis and control of robot manipulator. The objective of this course is to learn various components, configuration, programming method and applications of robot.

Expected Outcomes:

The student will be able to perform kinematic analysis i.e. robot mechanism synthesis and its dynamic analysis to calculate the forces and torque required to actuate the joints and hence intern can select proper linear and rotary actuators. Also student will understand motion analysis, trajectory planning of end effectors, various robot sensors and programming methods.

Syllabus:

UNIT - I Basic concepts in Robotics: Advanced and applications of robotics of Robots, Resolution, Accuracy and Repeatability, Point, Continuous part system control loops, types of manipulators, wrist & Grippers.

UNIT - II Kinematic Analysis of Robots. Geometry based direct kinematics, Co-ordinate and vector transformation using matrix, Denant - Hardenberg Convention, application of DH notation, Inverse Kinematics.

UNIT - III Robot- an D y n a m c i s : Elementary treatment of Lagrange - Euler, Newton - Euler formulations, Generalised D Alembert equations of motion.

UNIT - IV Drives, Control of Trajectory: Hydraulic system stepper motor, Direct c u r r e n t servomotors, A-C servomotors, adaptive control, interpolators, trajectory planning, resolved motion rate control method.

UNIT - V Robotic Sensors: Vision system, range ,proximity, touch, force and torque sensors, Assembly Aid devices, Robot programming, Artificial Intelligence.

UNIT - VI Application of Robot: Handling loading, unloading welding, Painting Assembly, Machining Manufacturing , Work- cell, Installation of Robots .

Tutorial: - Based on above syllabus.

References :

1. M.P. Groover, M.Weiss, P.N.Nagal, and N.G Odrey, Industrial Robotics, McGraw Hill International Deduction, 1986.
2. Shimon Y. Nof (Editor), hand book of industrial robotics Jhon Wiley and sons, 1985,
3. Fu. K. S. , Gonzalez R. C. and Lee C. S. G., Robotics : Control sensing vision and intelligence, Mc Graw Hill, 1987.
4. D. T. Pham , Expert – System in Engineering , Springer Verlog , 1988.
5. Anthony C. , Mc Donald, Robot Technology, theory , design

and applications, Prntice Hall, New Jersey, 1986.
6. Yoren Koren , Robotes for engineers.
7. K. S. Fu, R.C. Gonzaler C.S.G. Lee, Robothes (Control, sensing vision & intelligence).

Subject: Mechanization in Food Processing

Subject Code: - PGOPENMED041

Course Objective:

The course deals with the various processes in food processing as cleaning material, sorting, heat processing, dehydration, packaging etc. The course objective is to learn the basics involved in above mentioned various food processing processes and engineering solutions to them.

Expected Outcomes:

The students will be able to understand the various constructional and operational characteristics of food processing devices and will be able to design unit for particular food processing application.

Syllabus:

Constructional features, operation, Operational characteristics Advantages & Disadvantages, Limitations designing considerations of following food processing devices. Cleaning of new materials, sorting and grading , size reductions and Expression, centrifugation, crystallizations, Heat Processing , Evaporation, Dehydration, Freezing, Irradiation ,Pumps, piping, packaging, Automation and Computer systems, Lubrication, Food plant design.

Tutorial: - Based on above syllabus.

References

1. J.G. Brennan Butters " Food Engineering operations ". Elsevier Publication
2. Farral " Food Engineering System", AVI publishing .
3. Ian McFarlane," Automatic Control of Food Manufacturing Process ", Applied Science Publishing .

Engineering Materials and Metallurgy.

Subject Code:- PGOPENMETA042

Teaching Scheme | Examination Scheme

Lectures:4/week | T(U) 70 marks T(I)30 marks

Total Credits:04 | Duration Of University Exam:03 Hours

Course Objectives

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

Expected Outcomes:

Upon completion of this course, the students can able

1. To apply the different materials, their processing, heat treatments in suitable application in engineering fields.

2. Classify the main type of Engineering materials used in the industry

3. Know the structure of Engg. Materials and how it is related to their properties.

4. Select the material for specific engineering application.

UNIT I ALLOYS AND PHASE (7 hours)

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and application.

UNIT II HEAT TREATMENT (8 hours)

Definition – Full annealing, stress relief, recrystallisation and spheroidising , normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T.diagram CCR – Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

UNIT III Alloy steel and cast iron (8 hours)

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron – Grey, white, malleable, spheroidal – alloy cast irons,

UNIT IV Nonferrous Alloys (8 hours)

Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys

UNIT V Polymer (8 hours)

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)-

UNIT VI Ceramics and composites (8 hours)

Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites- Classifications- Metal Matrix and FRP – Applications of Composites.

TEXT BOOKS:

1. Avner,, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company,1994.

2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007

3. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2002

4. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.

Real Time System & Software

Subject Code:- PGOPENSE043

Objective: The concepts and principles, of this course provide students with an accessible approach to software design. It presents several examples of commercial and research systems throughout the steps to explain and justify the concepts. Real-Time System Software presented technically diverse, including discussions of state machines,logic, concurrent programming, and scheduling algorithms Introduction: RTS, Characteristics of RTS, RTOS, Types of RTOS, Characteristics of RTOS, Processors and micro controllers of RTS, Skill set required for various types of RTS.

UNIT I: S/W Engg Involved: SDLC for RTS, Process models for RTS-SPIRAL, incremental Xtreame, prototyping, RAD, Risk & Failure Analysis.

UNIT II: Requirement Analysis: RT requirement eliciation and analysis using structured and object-oriented approach, Applications of formal methods for requirement specification.

UNIT III: Architecture & Design: Architecture properties, RT Architecture, design temporal & non temporal,. Techniques, scheduling- (Tasks, T&S, RM scheduling).

UNIT IV: Testing of RTS: verification& validation, test strategy, RTS test techniques.

UNIT V: Languages& Tools: Introduction to languages used for development of RTS, Introduction to tools- Rational Test Real Time, STATE-MATE from i-Logix, Software through Pictures (StP).

Suggested Readings/ Books:

1. Alan C Shaw, “Real-Time Systems and software”, John Wiely and Sons, 2001.

2. Philip Laplante, “Real-Time Systems and design and analysis”, IEEE computer society press,2004 .

3. J. E .Cooling, “Software design for Real-Time Systems”, Chapman and Hall, 1991.

4. Krishna M Kavi, “Real-Time Systems: abstraction, languages and design methodologies”, IEEE Computer Society press,1998.

Operation Research

Subject Code:- PGOPENSE044

Objective: This course deals with the theoretical aspects of operations research, and explains the concepts with practical examples. It begins by focusing on the need and prerequisites of operations research and moves on to discuss topics such as linear programming, integer programming, nonlinear programming, assignment problems, and inventory models in sufficient detail. This course helps students how to achieve different goals in the order of priority to optimize the objective function, various criteria of decision making under certainty, uncertainty and risk.

UNIT I: Introduction: Development, Definition, Characteristics and Phases, Types of models, operation Research models and their applications.

Allocation: Linear Programming Problem Formulation, Graphical solution, Simplex method, Artificial variables techniques: Two–phase method, Big-M method, Duality Principle.

UNIT II: Transportation Problem: Formulation, Optimal solution, unbalanced transportation problem, Degeneracy.

Assignment problem, Formulation, Optimal solution, Variants of Assignment Problem, Traveling Salesman problem.

UNIT III: Sequencing: Introduction, Flow, Shop sequencing, n jobs through two machines, n jobs through three machines, Job shop sequencing, two jobs through „m‟ machines.

Replacement: Introduction, Replacement of items that deteriorate with time, when money value is not counted and counted, Replacement of items that fail completely, group replacement.

UNIT IV: Theory of Games: Introduction, Minimax (maximin), Criterion and optimal strategy, Solution of games with saddle points, Rectangular games without saddle points, 2 X 2 games, dominance principle, m X 2 & 2 X n games, and graphical method.

Waiting Lines : Introduction, Single Channel, Poisson arrivals, exponential service times, with infinite population and finite population models, Multichannel, Poisson arrivals, exponential service times with infinite population single channel Poisson arrivals.

UNIT V: Inventory : Introduction, Single item, Deterministic models, Purchase inventory models with one price break and multiple price breaks, shortages are not allowed, Stochastic models, demand may be discrete variable or continuous variable, Instantaneous production, Instantaneous demand and continuous demand and no set up cost.

Dynamic Programming: Introduction, Bellman‟s Principle of optimality, Applications of dynamic programming, capital budgeting problem, shortest path problem, linear programming problem.

Suggested Readings/ Books:

1. A. M. Natarajan, P. Balasubramani,“Operations Research”,Pearson Education India, 2006.

2. Shah Gor & Soni, “Operations Research” PHI Learning Pvt. Ltd., 2007.

3. Panneerselvam, “Operations Research” PHI Learning Pvt. Ltd., 2006.

4. Sen, “Operations Research: Algorithms and Applications”, PHI Learning Pvt. Ltd., 2010.

Mobile Computing

Subject Code:- PGOPENSE045

UNIT-I :-

Wireless and Mobile Network Architecture: Principle of Cellular Communication. Overview 1G, 2G, 2.5G and 3G and 4G technologies. GSM Architecture and Mobility management hand off management, Network signaling. Mobile Computing fundamental challenges, Mobile Devices –PDA and mobile OS, PalmOs, Win CE and Symbian.

UNIT-II :-

Mobile IP Protocol Architecture: Mobile IP and IP v 6 and its application in mobile computing, Cellular Digital Packet Data CDPD, VOIP, GPRS Services, Wireless Local Loop-WLL system.

UNIT-III:-

Wireless Application Protocol (WAP): The Wireless Application Protocol application environment, wireless application protocol client software, hardware and websites, wireless application protocol gateways, implementing enterprise wireless application protocol strategy,

UNIT-IV :-

Wireless Mark-up Language: An Introduction to Wireless Technologies, Markup Languages, An Introduction to XML, Fundamentals of WML., Writing and Formatting Text, Navigating between Cards and Decks, Displaying Images, Tables, Using Variables, Acquiring User Input

Wireless Mark-up Language Script: An Introduction to WMLScript, WMLScript Control Structures, Events, Phone.com Extensions, Usability.

UNIT-V :-

Application of Mobile computing: ASP and Dynamic WAP Sites, XML and XSLT, Dynamic WML Generation with ASP and XSLT, Developing WAP Applications using Emulators.

Distributed Mobile Computing: Distributed OS and file systems, Mobile Computing Software (Pervasive Computing) Development Strategies and tools, Data Management for Mobile Computing.

Text Books:

1. Yi Bing Lin, “Wireless and Mobile Networks Architecture”, John Wiley
2. Wrox “The Beginning WML and WML Script”, Wrox Publication
3. Tomasz Imielinski et.al, “Mobile Computing”, Kluwer Academic Press 1996

References:

1. Uwe Hansmann, “Pervasive Computing Handbook. The Mobile World”, IEE publication 2002

Biometric Technologies and Applications

Subject Code:- PGOPENSE046

Unit 1:-

BIOMETRIC FUNDAMENTALS AND STANDARDS: Definition, Biometrics versus traditional techniques, Characteristics, Key biometric processes: Verification - Identification - Biometric matching, Performance measures in biometric systems, assessing the privacy risks of biometrics - Designing privacy sympathetic biometric systems, Different biometric standards, Application properties

Unit 2:-

PHYSIOLOGICAL BIOMETRICS: Facial scan, Ear scan, Retina scan, Iris scan, Finger scan, Automated fingerprint identification system, Palm print, Hand vascular geometry analysis, DNA, Dental.

Unit 3:-

BEHAVIOURAL BIOMETRICS: Signature scan, Keystroke scan, Voice scan, Gait recognition, Gesture recognition, Video face, Mapping the body technology.

Unit 4:-

USER INTERFACES: Biometric interfaces: Human machine interface - BHMI structure, Human side interface: Iris image interface - Hand geometry and fingerprint sensor, Machine side interface: Parallel port - Serial port - Network topologies, Case study: Palm Scanner interface.

Unit 5:-

BIOMETRIC APPLICATIONS: Categorizing biometric applications, Application areas: Criminal and citizen identification – Surveillance - PC/network access - E-commerce and retail/ATM, Costs to deploy, Issues in deployment, Biometrics in medicine, cancellable biometrics.

Reference Books:

1. Anil K Jain, Patrick Flynn and Arun A Ross, “Handbook of Biometrics”, Springer, USA, 2010.
2. John R Vacca, “Biometric Technologies and Verification Systems”, Elsevier, USA, 2007.
3. Samir Nanavati, Michael Thieme and Raj Nanavati, “Biometrics – Identity Verification in a Networked World”, John Wiley & Sons, New Delhi, 2003.
4. Paul Reid, “Biometrics for Network Security”, Pearson Education, New Delhi, 2004.
5. Ruud M. Bolle et al, “Guide to Biometrics”, Springer, USA, 2003.
6. David D Zhang, “Automated Biometrics: Technologies and Systems”, Kluwer Academic Publishers, New Delhi, 2000.