

WRE 537 GROUND WATER ENGINEERING

Introduction : Occurrence of ground water, geological formations as aquifers; types of aquifers, ground water movement, Darcy's law, permeability and its measurement, tracing of ground water movement, fundamental equations for steady and unsteady ground water flow, flow nets. Well hydraulics: Steady and unsteady flow in confined, semi-confined and unconfined aquifers, radial flow, superposition; multiple well system. Different methods of well construction; construction of well casings and screens, natural and artificial gravel packed wells. Safe yields, estimation, pumping and recuperation tests. Infiltration galleries, Ground-water replenishment, recharge of ground water, different methods. Groundwater modeling techniques: porous media models, analog models, electric analog models, digital computer models. Salt water intrusion: Concept; interface and its location; control of intrusion. Pollutant transport ; Plume Transport, source identification, tracer methods.

References

1. Groundwater Hydrology David Keith Todd,
2. Hydraulics of Groundwater Jacob and Bear
3. Applied Hydrology Mutreja K.N.,
4. Groundwater & Well Hydraulics Raghunath,

WRE538 HYDRAULIC ENERGY DISSIPATORS

Introduction, mechanism & types of energy dissipators, hydraulic jump, outlet works control mechanism, stilling basins for small outlet works and low and medium-high spillways , Various aspects of stilling basins, types of stilling basins and different appurtenances.

References

1. Hydraulic Energy Dissipators Edward A. Elevatorski,
- 2 Energy Dissipators and Hydraulic Jump, W.H.Hager,

WRE539 WATER RESOURCES PROJECT PLANNING, ECONOMICS & MANAGEMENT

Principles of economic planning and decision making, price theory and resource allocation-Project Optimality conditions, cost-benefit studies: role of benefit-cost parameter in project selection. Economic feasibility tests. Involvement of risk and other variables, tangible and intangible benefits; Cost-benefit studies of single and multipurpose water resources projects; Economic planning: Capacity expansion and project scheduling, multiobjective planning models, international developments on water transfer, preparation of feasibility reports.

References

- 1 Principles Of Water Resources Planning, Alvin.S.Goodman,
- 2 Economic of Water Resources Planning, James L. D. and Lee R. R.,

WRE 541 SEDIMENT TRANSPORTATION ENGINEERING

Nature of sediment problems, Origin and formation of sediments, individual and bulk properties of sediments, competent velocity, lift force and critical tractive stress concept on cohesion less and cohesive soils; regimes of flow; Resistance to flow in alluvial streams, resistance relations based on total resistance and division of resistance into grain and form resistance, preparation of stage discharge curves for alluvial streams, velocity distribution in alluvial channel. Bed load computation by empirical equations, dimensional considerations and semitheoretical equations, saltation. Mechanism of suspension, general equations of diffusion. Integration of sediment distribution equation. Differences between actual and theoretical exponents, prediction of reference concentration, Method of integrating curves of concentration and velocity. Simple relations for suspended load, Effect of temperature on suspended load, Wash load, Nonequilibrium transport of suspended load. Microscopic, macroscopic methods.

Approximate methods of total load determination, sediment yield from catchments. Hydraulic geometry of alluvial streams, bed level variation of alluvial streams, aggradations and degradation models, reservoir sedimentation, local scours.

References

1. River Mechanics” Vol. I & II, Hsieh Wen Shen
2. Mechanics of sediment transportation and alluvial stream problems
Garde R. J. and Ranga Raju K. G.,
3. River morphology
Garde R. J
4. Loose boundary hydraulics
Raudkivi, A. J .

WRE 542 STOCHASTIC HYDROLOGY

Statistical methods in hydrology, probability distribution of hydrologic variables, hypothesis testing and goodness of fit, flood frequency analysis, single and multiple regression analysis, classification of time series, characteristics of hydrologic time series, statistical principles and techniques for hydrologic time series modelling, time series modelling of annual and periodic hydrologic time series (including AR, ARMA, ARIMA, and DARMA models), multivariate modelling of hydrologic time series, practical considerations in time series modelling applications

Books Recommended

- 1 Stochastic Hydrology P.Jayrami Reddy
- 2 Applied Stochastic Hydrology Y.K. Zhang

Open electives

WRE551 GEOSPATIAL TECHNIQUES IN WATER RESOURCES ENGINEERING

Introduction to Geospatial Technologies. Usefulness in Water Resources Engineering. Fundamentals of remote sensing - Interpretation - Equipments - Techniques of data acquisition – Satellites and sensors – Digital Image processing. Introduction to GPS - Working principle of GPS - Measurement and mapping techniques. Introduction - Geo referenced data - Data input & output - Data quality and management - GIS analysis functions - Implementation of GIS. Geospatial Analysis-Methods - Measurements - Analysis – Geovisualization Different geospatial technology software - Salient features – Capabilities. Application of Geospatial Technologies to Water resources Engineering - Case studies

References

1. Essentials of GPS Agrawal N.K.,
2. Remote Sensing and GIS Bhatta B.,
3. Remote Sensing and Image Interpretation Lillesand T.M. and Kieter R. W.,
4. Geographical Information Systems Stan Aronoff,

WRE552 FINITE ELEMENT METHOD FOR WATER RESOURCES ENGG.

Basic concepts of mathematical models and numerical simulation, Initial and boundary value problems, classification of partial differential equations, flow governing equations applied to water resources, features and steps of FEM analysis, weak formulation, Ritz method, weighted residual methods, discretisation of domain, coordinate systems, interpolation functions, element matrix, assembly of element matrices, application of boundary conditions, solution of algebraic equations, numerical integration, parametric formulations, serendipity elements, Jacobians, application of FEM to simple discrete system and continuous domain problems of water resources

References

1. An Introduction to The Finite Element Method Reddy J.N
2. Finite Element Analysis- Theory and Programming, C.S. Krishnamoorthy

WRE 553 TRANSIENTS IN PIPE FLOW

Causes of transients; Governing Equations; Method of characteristics; Transients in pumping schemes and hydro electric schemes; Transient bubble flow; Transient control.

Department electives**WRE 531 ECOHYDROLOGY**

Origin and scope of ecohydrology. Ecohydrological processes: Interactions between physical, chemical and biological processes at basin scale - soil water dynamics, land surface energy budgets; scales of interactions; ecohydrological optimality theory; ecohydrological controls on nutrient cycle. Techniques in ecohydrological measurements: Measuring energy and water fluxes in atmosphere, soil and vegetation; atmosphere – latent, sensible and CO₂ fluxes, distribution of wind, temperature and humidity; soil – soil moisture, soil respiration and soil heat flux; vegetation – leaf area index, stomatal conductance and transpiration. Ecohydrological modelling: Governing equations; mathematical models - stochastic and deterministic models; process based and empirical models; calibration and validation of models; scale issues in ecohydrological modelling. Applications of ecohydrology: Use of ecohydrological principles in paleohydrology and climate change studies; ecohydrological approach for sustainable management of floods and droughts; case studies from tropical river basins and dryland ecosystems.

WRE 532 AI TECHNIQUES IN WATER RESOURCES ENGG

Expert Systems (ES): history of ES, basic concepts of ES, definition and components of ES, inference engines and reasoning mechanisms e.g. forward reasoning, backward reasoning, and mixed reasoning, knowledge representation methods and development of the rule based knowledge base, dealing with uncertainty, and selected case studies of ES applications to engineering and sciences; Artificial Neural Networks (ANNs): background and history of ANNs, definitions and basic concepts of ANNs, biological and artificial neural networks, feed-forward and feed-back networks, supervised and unsupervised learning methods—standard back-propagation (BP), conjugate gradients BP, self organizing networks, etc., development of ANN models for specific problems and selected case studies; Genetic Algorithms (GAs): fundamentals and preliminary concepts of evolution and GA, preliminaries of optimization, genetic operators—selection, crossover, and mutation, binary and real-coded GAs, constraint handling in GAs, and selected case studies involving GA applications to engineering.

References

1. Machine Learning – Neural Networks, Genetic Algorithms and Fuzzy Systems

Adeli H. and Hung S.,

WRE 533 HYDRO POWER ENGINEERING

Renewable and non-renewable sources of energy, non-conventional sources of energy , comparison of various sources of energy, need of hydropower., Concern about environment, Environmental planning and management. Planning for water power development, Geological investigations studies for water power development, Estimation of available water power, Power duration curve, Storage and pondage, Load studies, Hydropower terms likes Load factor, Load duration curve, Power system load etc. Classification of hydropower development, Economics of hydropower development. Operation and maintenance of hydro plants. Components of storage power development, run-off-river power development and pumped storage power plant (PSPP). Advantages, types and location of underground power station, its components, types of layout, limitations of underground power plants. Advantages of

small hydropower, Classification of small hydropower, , Components of small hydropower development, Economics of small hydropower schemes. General layout of the power house and arrangement of hydropower units. Variation in design of power house. Under Ground power Station: Types of underground power plants, Alignment and layout of cavities, Investigations and studies, Safety requirements, Sizing of a power house, Types, Location and Alignment of intakes, Losses in Intakes. Hydraulic design of penstocks, valves and gates.

References

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| 1. Water Power Engineering | Barrows H. K |
| 2. Water Power Engineering | Dandekar and Sharma |
| 3. Water Power Engineering | Deshmukh M.M |
| 4. Handbook of hydroelectric engineering | Nigam P S |

WRE 534 RAINWATER HARVESTING

Concepts of Water Shed, need for watershed development in India, Integrated and multidisciplinary approach for watershed management, planning of watershed management. Characteristics of Watershed and Ground Water : size, shape, slope, climate, drainage, land use, geology of soils, hydrology and hydrogeology, basic data for watersheds, need for artificial recharge and rainwater harvesting - types of wells - drilling technology - design, construction and development of water wells: dug wells and bore wells. Recharge Structures: various artificial recharge structures: recharge ponds - recharge pits - percolation ponds - Rainwater harvesting in urban areas : RWH structures - design - construction. Recharge Estimation & Maintenance: Estimation of probable runoff from an area including roof tops - maintenance and monitoring of RWH structures Exploration techniques and selection of artificial recharge zones

References

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| 1. Groundwater Hydrology | David Keith Todd |
| 2. Rainwater Harvesting Techniques to augment Groundwater, | Ministry of Water Resources, |
| 3. Groundwater and Wells | Edward E. Johnson |

ix) GEOINFORMATICS AND APPLICATIONS (M.Tech.)

First semester

GI 511 BASICS OF MAPPING AND CARTOGRAPHY

Principles and classifications of surveying, chain surveying basic concepts and terminology and instruments used. Linear measurements along sloping ground and base line correction including slope corrections. Conventional symbols, different types of scales and field and office work for the preparation of maps.

Measurement of angles and Directions: different types of bearings and their measurement systems, reference meridians, azimuth, magnetic declination and local attraction. Different types of compasses for the measurement of bearings compass traversing and closing error adjustments.

Leveling: Principle, terminology and instrumentation, booking of leveling readings, reduction of levels, difficulties, sources of errors and precautions in leveling and setting of grade stakes. Classifications of leveling, profile leveling, cross-sectioning and reciprocal leveling.

Contouring: Definition and terminology, methods, interpolation and characteristics of contours, contour gradients and uses of contour maps.

Angles and Directions with Theodolites: Different types of theodolites and their construction, use and adjustment, measurement of horizontal angles. Theodolite traversing, latitude and departure, traverse computations and plotting, balancing of traverse, calculation of traverse area and omitted measurements.

Computation of area: Area computations from field notes and plotted plans using graphical methods and planimeter.

Computation of volumes: Formulae for the calculation of cross-sectional area and volume and Mass Haul diagram. Computation of the volume of earth work and storage from contour maps using end area method and prismatic formulae.

ELECTRONIC TOTAL STATION: Principle, Components and working.

REFERENCES:

1. Plane Surveying A. M. Chandra
2. Surveying and Leveling-Part-I & II T. P. Kanetkar and S. V. Kulkarni,

GI 512 BASIC CONCEPTS OF PHOTOGRAMMETRY

History and development – types of aerial photo- classification of aerial cameras – optics for photogrammetry, camera calibration – photographic process Scale – overlaps – stereoscopy – concepts – viewing and measuring systems – image and object co-ordinates – floating mark – parallax equation – height information – Tilt – Rectification – Displacement. Flight planning – computation for flight plan – photo control – cost estimation – aerial mosaics – types.

Concepts of interior, relative, absolute orientation – object, image relation – linearization – effect of orientation elements – scaling and leveling – analytical procedures – map compilation using stereo plotters – Introduction to digital photogrammetry. Elements of Aero triangulation and analytical method – strip deformation, strip and block adjustment – Terrestrial photogrammetry – Geometry & products – orthophoto – mapping.

References:

1. Geoinformation: Remote Sensing, Photogrammetry and Geographic Information Systems. Gottfried Konecny,
2. Elements of Photogrammetry, Paul R.Wolf,
3. Photogrammetry, Vol 1&II Karl Kraus,
4. Introduction to Modern Edward M. Mikhail , James S. Bethel , J. Chris McGlone,

GI 513 PRINCIPLES OF REMOTE SENSING TECHNOLOGY

Definitions and introduction to remote sensing, components of remote sensing system, active and passive remote sensing, electromagnetic radiations and their interactions with the earth features and atmosphere. Spectral windows and spectral signatures and their significance in remote sensing. Radiometric quantities used in the collection of spectral signatures.

Remote sensing satellite orbits, image acquisition process, repeativity, row/path and ground swath and coverage. Introduction to various global remote sensing satellite sensors and their data products like Landsat Return Beam Videocon (RBV), Multi–Spectral Scanners (MSS), Thematic Mapper (TM), SPOT push broom scanners, ISRO Linear Imaging Self Scanner (LISS) and Cartosat sensor etc. Thermal infrared scanning systems, radiometers, Radar, Lidar and SAR.

Geometry, radiometry and other characteristics of remotely sensed data products. Pre-processing of remotely sensed imagery and ground truth collection methods for various applications

Characteristics of photographic images and colour, tone, texture etc. photo-image interpretation keys. Digital image analysis techniques: False color Composite (FCC), vegetation Index map density slicing, digital image classification techniques and extraction of thematic information

Role of remote sensing in terrain investigation and advantages over conventional mapping techniques. Extraction of topographic information from remotely sensed data and generation of digital terrain model

from stereo pairs of images. Resource mapping for engineering projects and various application in Civil Engg.

References:

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| 5. Remote Sensing and image interpretation | Lillesand T.M. and Kiefer R. W |
| 6. Introduction to remote sensing | J. B. Campbell |
| 7. Introductory digital image processing | J. R.Jensen |
| 8. Remote Sensing in Civil Engineering, | Kennie, T. J. M. and Matthews M. C |

GI 514 REMOTE SENSING & CARTOGRAPHY LAB

List of experiments

- 1 Study of conventional and modern surveying equipments
- 2 Drawing of conventional symbols of maps
- 3 Study and use of Prismatic Compass for plotting of ground objects
- 4 Study and use of Theodolite for plotting of ground objects
- 5 Study of the given stereo pairs of aerial photographs for the geometric elements and determination of area , scale and distances
- 6 Visual Interpretation of given stereo pairs of aerial photographs for the Drainage Pattern, Physiography of the area, Landuse/Landcover pattern etc.
- 7 Use of stereoscope for the analysis of stereo pairs of aerial photographs.
- 8 Position and Navigation data collection using hand-held GPS receiver
- 9 Introduction to basic operations of Erdas Imagine software like data export/ import, satellite image reading and manipulations
- 10 Georeferencing of remote sensing satellite images
- 11 Digital remote sensing image Classification using ERDAS Imagine software

Second Semester

GI 521 SPACE GEODESY AND GNSS BASED MAPPING

Definition & fundamentals of Geodesy, Development - Applications in space geodesy – Geoid and Ellipsoid. Map projection-necessity and classification, properties of commonly used map projection. Global and Local Datums and datum transformation . GPS – different segments – space, control and user segment – satellite configuration – GPS signal structure – orbit determination and orbit representation, Anti spoofing and selective availability – task of control segment – GPS receiver- main receiver component- example of GPS receiver.

GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – data processing – software modules – solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid static methods with GPS - semi kinematic and pure kinematic methods – basic constellation of satellite geometry and accuracy measures.

Geodetic control surveys, cadastral surveying, photogrammetry and remote sensing, engineering applications and monitoring – GIS. GLONASS satellite configuration comparison – satellite laser ranging & applications – concept of satellite altimetry. Mobile mapping system for GIS database

References:

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| 1. GPS satellite surveying, | Alfred Leick, |
| 2. GPS Theory, Algorithms and Applications, | Guocheng Xu, |
| 3. Introduction to GPS, the global positioning system, | Ahmed ei-rabbany, |
| 4. GPS: Theory & Applications progress in astronautics and aeronautics, | |

GI 522 BASIC CONCEPTS OF GIS

Basics of Geographic Information System (GIS) – Definition– Evolution & Components. Data : Spatial and Non-spatial – Spatial Data: Point, Line, Polygon/Area and Surface – Non-Spatial Data. Geographical concepts and terminology. Introduction to GIS data input devices like scanner, digitizer, GPS, Remote sensing etc. Guidelines for the selection of map digitization accuracy and scanning DPI for various types of maps. Manual and semi-automatic line following digitization.

Data Model: Raster Data Model – Grid – Tessellations – Geometry of Tessellations — Data Compression – Vector Data Model – Topology – Topological consistency – Vector data input– Raster Vs. Vector comparison – File Formats for Raster and Vector – Vector to Raster conversion- raster formats

Spatial and attribute data model structure. Digital Elevation Models: Generation, Representation, Applications. Spatial and attribute data visualization and query, Vector Data analysis tools: Buffering, overlays, distance measurements and pattern analysis. Raster data analysis using local, neighborhood, zonal and other operations. Viewshed and water shed analysis. Spatial interpolation models for GIS. Path analysis and network applications for planning and management of highways and utility lines. Open GIS consortium – Customization in GIS – Object Oriented GIS – WebGIS. Introduction to popular GIS software like ArcGIS and Q-GIS.

References

1. Principles of Geographic Information Systems for land Resources Assessment P.A. Burrough
2. Geographic Information Systems: A Management Perspective, Stan Arnoff
3. Fundamentals of Spatial Information Systems Robert Laurini and Derek Thompson
4. Geographical Information Systems, Vo. I and II Paul Longely, M.F. Goodchild, et.al,

GI 523 DIGITAL PROCESSING OF REMOTELY SENSED DATA

Pixel bands, digital numbers(DN), Grey level, image formats like BIL, BSQ, RLE etc., header, DPI, Look up Table (LUT). Special relevance to remote sensing satellite, images for read, write and display tasks. Commercial image processing system software.. Geometric and radiometric correction, establishing, spatial transformation, model using GCP's, intensity interpolation techniques (nearest neighbour, bilinear and cubic convolution).

Contrast manipulation: Grey Level thresholding, level slicing and contrast stretching. Spatial feature manipulation: spatial filter, edge enhancement and Fourier analysis. Point, local and regional operation – Fourier transform, scale- space transform, wavelet transform –principle component analysis- Multi image manipulation: Multi-band rationing and differencing principal components, vegetation indexes, color composition (True and False Color Composite) and Intensity Hue Saturation (IHS).

Image histogram, mean, standard deviation, variance, covariance matrices. Image display alternatives: mono and color, composites of MSS, Band Combination and optimum index factor (OIF), Variance-Covariance and correlation matrices. Pattern recognition, boundary detection and representation, textural and contextual analysis,

Image Classification and thematic information extraction, General steps for land cover information extraction, classification levels and supervised and unsupervised classification techniques, selection of appropriate algorithms for classification: Parallelopiped, Minimum distance, Maximum likelihood, Isodata, fuzzy classification, classification accuracy assessment. Hybrid training, Non- parametric, and sub-pixel classification, Hyper – spectral image analysis.

References

1. Physical Principles of Remote Sensing, W.G.Rees -

- | | |
|--|---------------------------------------|
| 2. Remote sensing models & methods for image processing, | Robert Shcoweberdt , |
| 3. Digital Image Processing | Rafael C. Gonzalez , Richard E. Woods |
| 4. Remate Sensing Digital Image Analysis | John A.Richards, |

GI 524 GPS AND GIS LAB (GI-591)

Practical exercises on the use of GPS for field data collection and GIS data storage & analysis techniques

Department Elective

GI 531 REMOTE SENSING & GIS FOR ENVIRONMENTAL ENGINEERING

Revenue management-environment and ecological concerns- Resource development in remote areas- Impacts of anthropogenic activity- Solid Waste management- Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status. Taxonomical classification of soils, soil survey interpretation and mapping, impact of agricultural and industrial activity on soil properties. soil salinity/alkalinity, erosion studies, Applications of GIS in assessing soil salinity, erosion productivity etc. Classification of water quality for various purposes. Data base creation and quality modeling using GIS. Database Creation and maintaining water supply network, sewerage network using GIS. Case studies. Aquifer Vulnerability Intrinsic and specific vulnerability.

Atmosphere: Chemicals, Particulate matters present in the atmosphere, allowable limits, Remote Sensing technique to monitor atmosphere constituents, air pollution due to industrial activity, modeling using GIS case Studies.. Introduction to environmental satellites GEOS, NOAA, AVHRR, etc. for Monitoring land, water, atmosphere and ocean using Remote Sensing Data, case studies.

References:

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| 1. Integrated Solid Waste Management | Techobanoglous | George, Hilary Theisen, Samuel Vigi, |
| 2. , GIS for sustainable development | | Michele Campagna |

GI 532 MICROWAVE REMOTE SENSING

Introduction and early history, Basic concepts, plane waves, antenna systems, radiometry, microwave interactions with atmospheric constituents, Earth's surface and vegetation, Radiometric systems, Sensors, Data products and its applications. Radar Basics, Radar interaction with Earth surface and vegetation, Surface scattering theory. Radar equation, fading concept, Measurement and discrimination, Physical mechanisms and empirical models for scattering and emission, Geometry of Radar images, Radar return and image signature, Resolution concepts, SAR, Speckle in radar imagery, concept of roughness, geometry of targets, resonance, dielectric constant, surface and volume scattering, signal penetration and enhancement.

Airborne, Spaceborne, different platforms and sensors, Data products and selection procedure, SEASAT, SIRA, SIRB, ERS, JERS, RADARSAT missions, Doppler radar, JASON, TOPEX/POSEIDON, Aircraft: AirSAR, C/X SAR, E-SAR, STAR-1. SAR interferometry-Basics- differential SAR interferometry, Radar polarimetry-Radargrammetry and applications- Altimeter and its applications, scatterometer and its applications.

Applications in Agriculture, Forestry, Geology, Hydrology, ice studies, landuse mapping and ocean related studies, military and surveillance applications, search and rescue operations, ground and air target detection and tracking.

References:

- | | |
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| 1. Microwave remote sensing vol-1, vol-2 | Ulaby, F.T., Moore, K.R. and Fung, |
| 2. Principles and applications of Imaging | Floyd.M.Handerson and Anthony, J.Lewis |
| 3. Air and spaceborne radar systems-An introduction, | |

Philippe Lacomme, Jean Claude Marchais, Jean-Philippe Hardarge and Eric Normant,

4. Introduction to microwave remote sensing,

Iain H. Woodhouse,

GI 533 AIR BORNE LASER TERRAIN MAPPING (GI-516)

LASER, LiDAR – Principles and properties – Different LiDAR system – Applications – Advantages, Disadvantages – Space borne and airborne LiDAR missions – Typical parameters of a LiDAR system. Principle of Laser Altimetry – Components of the system – GPS, IMU LASER, LiDAR data formats – Terrain Mapping Laser Configuration – Ocean bathymetry Laser Configuration – Limitations of the system. GPS and IMU data processing – Strip Adjustment – Geometric Correction – Data quality enhancement – Digital Surface Model – Filtering – Ground Point Filtering – Digital Elevation Model.

Hydrology, Disaster Mitigation and Management – 3D city models – Telecommunication Modeling – Urban planning – Coastal Zone Bathymetry Mapping – Feature extraction, vectorisation – Surface and landuse classification.

Orthophoto rectification using LiDAR – Integrated LiDAR and Digital Photogrammetry Techniques – Integration of LiDAR DEM with other hyper spectral data.

References:

1. Laser Altimetry: Principles and Applications

Mathias Lemmens,

2. Digital Photogrammetry

Yves Egels and Michel Kasser,

3. Manual of Aerial Survey: Primary Data Acquisition,

Roger Read and Ron Graham,

4. Digital Terrain Modeling: Principles and Methodology,

Zhilin Li Qing Zhu, Chris Gold, Christopher Gold,

GI 534 HYPERSPECTRAL REMOTE SENSING

History and Description of Hyperspectral Imaging, Spectral Radiometry, Imaging Spectrometers, Hyperspectral Remote Sensing and the Atmosphere, Information Extraction from Optical Image Data, Hyperspectral and Ultraspectral Information Extraction Approaches, AVIRIS data, JPL data and USGS hyperspectral data classification, Application of Hyperion data in Agricultural, Environmental, Forestry, Geology, Mining and coastal mapping.

References:

1. Hyperspectral Remote Sensing, Principles and Applications Marcus Borengasser, William S. Hungate

2. Introductory Digital Image Processing,

Jensen, J.R..

3. Remote Sensing and Image Interpretation,

Lillesand, T.M. and Kiefer, R.W.

GI 535 REMOTE SENSING AND GIS FOR HYDROLOGY AND WATER RESOURCES

Hydrological cycle, estimation of various components of hydrology cycle, clouds, rainfall, runoff evaporation, transpiration, evapo-transpiration, interception, depression storage, spectral properties of water, GIS application in surface water modeling, case studies. Watershed divide, stream networks, Delineation and codification of watersheds morphometric analysis, linear, areal, relief aspects, Rainfall-runoff modeling, urban hydrology, case studies. Mapping of snow covered area, snow melt runoff, flood forecasting, risk mapping and flood damage assessment soil moisture area drought forecasting and damage assessment, GIS application in aerial assessment, case studies

Project investigation, implementation, maintenance stage- location of storage/ diversion works canal alignment, depth-area capacity curve generation, conjunctive use of surface and ground water, Mapping and monitoring the catchment command area, artificial recharge of groundwater, water harvesting structures, sediment yield, modeling of reservoir siltation, prioritization of watershed, modeling of sustainable development, Development of information system for Natural resource management, case studies. Applications of Remote Sensing, GPS & GIS in water resources projects.

References:

1. Satellite Remote Sensing for Hydrology and Water Management, Eric C. Barrett, Clare H. Power,
2. Hydrologic and Hydraulic Modeling Support with Geographic Information Systems
Dr. David Maidment, Dr. Dean Djokic,
3. Hydrology: An Introduction
Wilfried Brutsaert,
4. Trimble, Environmental Hydrology
Andy D. Ward and Stanley W.

GI 536 REMOTE SENSING AND GIS FOR OCEAN ENGINEERING AND COASTAL MAPPING

Coastal processes, Oceanic circulation, Upwelling and sinking, current Measurement, Waves, surface waves, Water motion in waves, reflection, diffraction and refraction, wave generated currents, catastrophic waves, Tides, Tidal forces, sediment drift, salinity intrusion.

Study of physical properties of sea water and parameters, chemistry of sea water, Biological parameters, Oceanographic instruments, collection of water samples, current measuring devices, deep sea coring devices, dredges.

Coastal Hydrodynamic, Coastal erosion and protection, different Coastal protection works, design of Breakwaters, Estuaries and their impact on coastal process, Hydrodynamics of pollution dispersion.

Use of Microwave data, CZCS studies, chlorophyll production index, various sensors used for coastal application, physical oceanographic parameter estimation, sea surface temperature, significant wave height, wind speed and direction, coastal Bathymetry, sea level rise.

Introduction, Major issues/problem, Thematic maps on coastal resources, wetland classification, creation of CZIS, Coastal Regulation zone, Coastal aquifer modelling using GIS, Integrated coastal Management using GIS.

REFERENCES:

1. Handbook of Coastal Engineering, Johnb. Herbich,
2. Physical Fluid Dynamics, : D. J. Tritton,
3. Water Wave Mechanics for Engineers & Scientists, Robert G. Dean, Robert A. Dalrymple
4. Introduction To Coastal Engineering And Management J. William Kamphuis ,.

GI 536 CHANGE DETECTION USING REMOTE SENSING

Definition and importance of Change detection, Land use Land cover, Classification of Multitemporal data sets, LULC classification system, Stages of land use land cover classification, General Methods of change detection for land use land cover, Change Detection Based on Remote Sensing Information Model.

Algebraic methods of Change Detection, principle components, post classification comparison, Multivariate alteration detection (Canonical correlation analysis, Orthogonality properties, Scale invariance, iteratively reweighted MAD, Correlation with the original observation, postprocessing), Decision thresholds and unsupervised classification of changes, Radiometric Normalization.

Image Fusion techniques of change detection, Change Vector analysis Technique, Change detection using remote sensing technology as a tool for Natural hazards planning and damage assessment.

Urban change detection mapping and analysis, Landslides, causes of landslides, Factors affecting, Detection of landslides using remote sensing and GIS techniques.

References:

1. Remote sensing and image interpretation Lillesand and Kiefer .

2. Image analysis Classification and Change Detection in remote Sensing with algorithms for ENVI/IDL
Morton J Canty .

3. Remote Sensing and GIS accuracy Assessment
Ross Luneta and John G Lyon

4. Spatial statistics for Remote Sensing- Alfred Stein, Freek Vander Meer and Ben Gorte - Kluwer

GI 537 REMOTE SENSING AND GIS FOR EARTH SCIENCES

Introduction – Rocks and Minerals, image characters of igneous, sedimentary and metamorphic rocks - Lithological mapping using aerial and satellite data- Structural Geology, introduction, Mapping structural feature such as folds, Lineaments / faults, fractures image characters of folds, faults, lineaments etc., - Digital techniques for lithological and structural analysis , case studies.

Spectral properties of geologic features in different regions of Electromagnetic Spectrum, Elemental composition and nature of the spectra of rocks and minerals, Optimal spectral windows , Geologic Remote sensing and its significance in Geologic mapping - case studies. Geomorphic Landforms, Drainage network and patterns classification and implications of drainage patterns, geomorphic mapping using, aerial and satellite data - Landform analysis in natural resources and management case studies.

Different types of Geophysical Surveys, Electrical resistivity surveys, aeromagnetic surveys Electromagnetic surveys Seismic surveys, Planning Geophysical surveys using satellite data Applications of different types of geophysical surveys in resource mapping , case studies.

Introduction, Applications of Remote Sensing and GIS for Resource mapping, monitoring and management , Preparation of thematic layers , Integration of all relevant primary and secondary data using GIS in Surface and groundwater studies - Engineering Geology, Mineral exploration and Petroleum exploration, Disaster Management studies like Droughts, Floods-Case studies.

References:

1. Applications and Investigation in Earth science
Frederic k. lutgens, kennth G.pinzke and Edward j. tarbuck
2. Remote Sensing principles and interpretation
Sebins, F.
3. Engineering and General Geology
Parbin Singh
4. image interpretation in Geology
Drury, S.A.
5. Fundamentals of GIS,
Michael N.Demers

GI 538 DIGITAL PHOTOGRAMMETRY

Evolution of digital photogrammetry – Phases of Photogrammetry - comparison of analog, analytical & digital systems – advantages – automation – accuracy- representation of digital images B/W – RGB – HIS - image source – analog and digital cameras

Digital cameras- CCD camera- full frame, frame transfer, interline CCD camera - Time delay integration- spectral sensitivity of CCD sensor – geometric problem of CCD image – line jitter, blooming, warm up effect – trailing – types of CCD systems - Linear array line scanner – use of CCD scanner in high resolution satellites, SPOT, MOMS, IRS, IKONOS and Quickbird.

Image Generation - Data Compression - formats - Data procuring concepts – Georeferencing - Stereo viewing - Display modes - image matching techniques - Image measurements - symbol library - feature coding.

Review of space resection & intersection - interior & exterior orientation - Automatic tie point generation - Automatic Block triangulation, feature collection and plotting annotation - editing – various formats of map data.

DEM Generation - accuracy of DEMs, Orthorectification - regular & irregular data collection methods - contour generation - watershed delineation - satellite photogrammetry principles – missions - stereo image products - issues - stereo satellite missions.

References:

1. Digital Photogrammetry: A Practical Course Wilfried Linder,
2. Fundamentals of Computational Photogrammetry Ghosh, Sanjiv.k
3. Image Sensors and Signal Processing for Digital Still Cameras Junichi Nakamura,
4. Digital Terrain Modeling: Principles and Methodology Zhilin Li, Qing Zhu, Chris Gold,

GI 539 REMOTE SENSING AND GIS FOR AGRICULTURE & FORESTRY

Introduction , Spectral properties of crops in optical & TIR region, Microwave backscattering behavior of crop canopy , crops identification and crop inventory, crop acreage estimation, vegetation indices, Yield modeling , crop production forecasting through digital analysis, crop condition assessment , command area monitoring, land use and land cover analysis, Microwave RS for crop inventory , Case studies

Introduction, soil genesis, Soil morphological characters, Soil pedology, Soil survey, Types and methods of soil surveys, Soil classifications, Hydrological Soil grouping , Characteristics of saline & alkaline Soils , Factors influencing soil reflectance properties, principle component analysis and orthogonal rotation transformation, Soils mapping using RS data, Problem soil identification and mapping , land evaluation, Soil sedimentation & erosion, Soil loss assessment , Soil conservation , Case studies

Detection of pest & diseases, Flood mapping and Assessments of crop loss , Remote sensing capabilities & contribution for drought management, Land degradation due to water logging & Salinity, crop stresses reflectance properties of stressed plants and stress detection.

Introduction, Forest taxonomy , inventory of forestlands , forest types and density mapping using RS techniques, Forest stock mapping, factors for degradation of forest, Delineation of degraded forest - Forest change detection and monitoring , Forest fire mapping & damage assessment , LiDAR remote sensing for Forest studies.

Introduction, Integrated surveys for agriculture & forest development , RS & GIS for drawing out action plans, water shed approach , Rule of RS & GIS for watershed management , Land use planning for sustainable development, Precision farming, Case studies.

References

1. Wetland & Environmental application of GIS, John G. Lyon, Jack Mccarthy,
2. Hyper spectral RS of tropical and sub -tropical forest Margareb Kalacska, G. Arturosanchez,
3. Advances in land RS: System, modeling invention and applications Shunlin liang
4. Soil mineralogy with environmental application, Library of congress Joe Boris dixon

Open elective

GI 551 PROBABILITY AND STATISTICAL METHODS (GI-521)

One dimensional random variables: Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable, weighting of observations.

Two dimensional random variables: Joint distributions– Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

Estimation theory: Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines, Propagation of systematic and accidental errors, theory of least squares and its application to adjustment problems.

Testing of hypotheses: Covariance matrix – Correlation Matrix – Multivariate Normal density function – Principal components – Sample variation by principal components – Principal components by graphing. Multivariate analysis: Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

References :

Jay L. Devore, “Probability and statistics for Engineering and the Sciences”, Thomson and Duxbbury, Singapore

Dallas E Johnson et al., “Applied multivariate methods for data analysis”, Thomson and Duxbbury press, Singapore

Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineers”, Prentice – Hall of India, Private Ltd., New Delhi, 7th Edition, 2007.

Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 5th Edition, 2002.

GI 552 ADVANCED SOFT COMPUTING TECHNIQUES

Artificial Neural Systems – Perceptron – Representation – Linear separability – Learning – Training algorithm – The back propagation network – The generalized delta rule – Practical considerations – BPN Geomatic applications.

Hopfield nets – Cauchy training – Simulated annealing – The Boltzmann machine. Associative memory – Bidirectional Associative Memory Network – Geomatic Applications.

COUNTER PROPAGATION NETWORK AND SELF ORGANIZING MAPS: CPN building blocks – CPN data processing. SOM data processing - Adaptive Resonance Theory network - Geomatic Applications

FUZZY LOGIC: Fuzzy sets and Fuzzy reasoning – Fuzzy matrices – Fuzzy mebership functions – Operators Decomposition – Fuzzy automata and languages – Fuzzy control methods – Fuzzy decision making

NEURO – FUZZY MODELING: Adaptive networks based Fuzzy interface systems – Classification and Regression Trees – Data clustering algorithms – Rule based structure identification – Neuro-Fuzzy controls – Simulated annealing – Evolutionary computation - Geomatic Applications.

References:

1. James Freeman A. and David Skapura M., Neural Networks – Algorithms, Applications & Programming Techniques Addison Wesley

2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill, 1997.

3. Yegnanarayana B., Artificial Neural Networks, Prentice Hall of India Private Ltd.,New Delhi.

4. Lqurene Fausett, “Fundamentals of Neural Networks”, Prentice Hall, 1994.

5. Jang J.S.R., Sun C.T. and Mizutani E, “Neuro-Fuzzy and soft computing”, Prentice Hall

GI 553 GEOINFORMATICS IN URBAN MAPPING AND MANAGEMENT

Remote sensing for detection of urban features – Scale and resolution – Scope and limitations – Interpretation from Aerial and satellite images – Digital image processing techniques – Image fusion – Case studies. Classification and settlement – settlement structure – Segmentation of Built-up areas – Classification algorithms – Land use/ Land cover mapping – change detection – high resolution remote sensing – case studies.

Urban morphology – Housing typology – Population estimation from remote sensing – Infrastructure demand analysis – Urban renewal Land suitability analysis – Plan formulation – Regional, Master and detailed development – Use of remote sensing and GIS in plan preparation – Urban information system – Web GIS – case studies.

Mapping transportation network – Classification – Optimum route/ shortest route – Alignment planning – Traffic and parking studies – Accident analysis – case studies.

Urban growth modeling – Expert systems in planning – 3D city models – ALTM – Land use Transportation interaction models – Intelligent transportation systems – case studies

References:

1. Juliana Maantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.
2. Allan Brimicombe, GIS Environmental Modeling and Engineering, CRC; 1 edition , 2003.
3. Paul Longley, Michael Batty, Spatial Analysis: Modeling in a GIS Environment Wiley,1997.
4. Michael F. Goodchild, Louis T. Steyaert , Bradley O. Parks, Carol Johnston, David Maidment, Michael Crane , Sandi Glendinning, GIS and Environmental Modeling: Progress and Research Issues (Hardcover) by,Publisher: Wiley; edition, 1996.
5. Roland Fletcher, The Limits of Settlement Growth: A Theoretical Outline (New Studies in Archaeology) (First edition), Cambridge University Press; 2007.

GI 554 CONCEPTS OF DATABASE SYSTEMS

Relational Databases: Introduction to relational data models and SQL. Advanced SQL and Query languages. Database design, Database design and ER model, relational database design. Database storage and querying, Indexing and hashing Query processing and optimization, Database Transaction management Transactions, concurrency control and recovery system Spatial and temporal data and mobility, case studies on Oracle, IBM DB2 Universal database and Microsoft SQL server

References

Avi Silverschatz, Henry F. Korth, S. Sudrashan, Database system concepts. 6th edition, McGraw-Hill
Date, C.J., DBMS system concepts

GI 555 GEOINFORMATICS APPLICATIONS IN ENGINEERING PROJECTS AND UTILITY MANAGEMENT

Forestry: Resource inventory, Forest fire growth modeling – Land: Land use planning, watershed management studies – Water – Identification of ground water recharge – Resource information system – Wetlands Management, Wildlife habitat analysis.

Disaster management: Use of GIS in Risk assessment, mitigation, preparedness, Response and recovery phases of Disaster management – Utilities – Water utility applications – Electric utility Application – Telecommunication: Tower spotting, route optimization for meter reading for utilities – Other utilities.

Vehicle Tracking: Automatic vehicle location (AVL), Components of AVL: Invehicle Equipment, Various communication channels, Web server, Client – Vehicle tracking alarms used in Vehicle tracking, Fleet management – Vehicle navigation – Emergency call: Address geocoding, Distress call application.

Land information system (LIS) – Tax mapping – Mobile mapping - Other LIS applications – Web GIS: Architecture of Web GIS, Map server, Web GIS applications.

Business applications: Siting a new facility, Customer Loyalty studies, Market penetration studies – Health application: Disaster Surveillance, Health information system – Crime Mapping: Mapping Crime data, Hot Spot Analysis – 3D GIS.

References:

1. Paul Longley, Michael F. Goodchild, David J. Maguire, David W. Rhie, Geographic Information Systems and Science, John Wiley and Sons, 2005.
1. Uzair M. Shamsi GIS Tools for Water, Wastewater, and Stormwater Systems, ASCE Press, 2002.
2. Alan L. Melnick, Introduction to Geographic Information Systems for Public Health, Aspen Publishers, first edition, 2002.
3. Amin Hammad, Hassan Karimi, Telegeoinformatics: Location-based Computing and Services, CRC Press, 2004.
4. Allan Brimicombe, GIS Environmental Modeling and Engineering, Taylor & Francis, 2003.
5. Van Dijk, M.G. Bos, GIS and Remote Sensing Techniques in Land-And-Water-Management, Kluwer Academic Publishers, 2001.

GI 556 REMOTE SENSING AND GIS FOR DISASTER MANAGEMENT

Basic concepts and principles – Hydrological and geological disasters, characteristics crisis and consequences – Role of government administration, University research organization and NGOs- International disaster assistance – Sharing technology and technical expertise.

Needs and approach towards prevention – principles and components of mitigation Disaster legislation and policy – Insurance – Cost effective analysis – Utilisation of resource – Training – Education – Public awareness – Role of media.

Slope stability of Ghat roads – Structural safety of Dams, Bridges, Hospital, Industrial structures – Low cost housing for disaster prone areas – Cyclone shelter projects and their implications – Reconstruction after disasters: Issues of practices.

Remote sensing in Hazard evaluation – Zonation – Risk assessment – Damage assessment – Land use planning and regulation for sustainable development – Communication satellite application – network – Use of Internet – Warning system – Post disaster review – Case studies.

Information system management – Spatial and non-spatial data bank creation-Operational emergency management – Vulnerability analysis of infrastructure and settlements – Pre-disaster and post disaster planning for relief operations – Potential of GIS application in development planning – Disaster management plan – Case studies

References

1. Sisi zlatanova & Andrea Fabbri jonathanli, Geometrics solutions for Disaster management, Springer Verlag, 2007.
2. C. Emdad Haque, Mitigation of natural Hazards & disasters, Kluwer Academic publishers group, 2005.
3. Linda C. Bottersll & ponald A. wilhite, From Disaster response to Risk management. Kluwer Academic publishers group, 2005.
4. Gerard Blokdijk, Disaster recovery planning and services, Gennaio publishers, 2008.
5. Mohamed Gad Large scale disasters: prediction, control and mitigation, Cambridge university press, 2008.

14 DEPARTMENT OF CIVIL ENGINEERING

x) THERMAL ENGINEERING (M. Tech)

TH 511 ADVANCED MATHEMATICS

Complex Variables, Differentiation, analytic functions, Cauchy-Raimann equations, Conjugate functions and their application to two dimensional potential problems, Conformal transformation. Integration,

Cauchy's theory, Zero's and poles residues, applications of residue theorem in integration. Differential Equations, Partial differential equations, solution by separation of variables. Diffusion equation. Heat flow in a bar, Wave Equation, Vibration of strings, vibration of circular membrane, Numerical Methods in Engineering, Solution of Polynomial Equation, Newton Raphson, Graffes's Braistow methods for nearly equal roots. Solution of Differential Equations: Runge –Kutta method for first and second order equations. Adam Bash forth methods for corraator and predictor. Numerical methods for partial differential equations of parabolic and hyperbolic type. Applications. FEM, Variational Functionals, Euler Lagranges equation, Variational forms, Ritz method, Glarkin's method, discretization. Finite elements method for one dimensional problems. Laplace Transforms, Elementary Laplace Transforms and theorem, solution of linear differential equations with constant coefficients. Heavyside unit functions, Direc delta function, their Laplace transforms and application to practical problems, Fourier integrals.

References

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|----------------------|------------------------|
| 1. Engineering Maths | - Shrivastava & Dhavan |
| 2. Engineering Maths | - B.S. Grewal |

TH 512 ADVANCED THERMODYNAMICS

Laws of Thermodynamics, Differential Equations of Thermodynamics, Changes in States of Gases at their Transferences, Throttling process. Joule Thomson effect. Temperature of braking. Mixtures of ideal & real gases. Equilibrium of Thermodynamic System, Equations of states for real gases Vanderwaal's equation of state. Clayperon equations. Gibbs phase rule. Law of corresponding states. Fundamentals of Chemical Thermodynamics, First law of thermodynamics in thermochemistry. Heat effects of reaction. Hess's law. Kirchhoff's law. Chemical equilibrium. Bond energy

References

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|-------------------------------|-------------------------|
| 1. Engineering Thermodynamics | - Wan Wylene |
| 2. Engineering Thermodynamics | - G. Rogers & Y. Mayhow |

TH 513 ADVANCED HEAT & MASS TRANSFER

Transient Heat Conduction, Convection, Heat Transfer by Radiation, Boiling and Condensation, nucleate pool boiling and empirical correlations for pool boiling heat transfer, factors affecting pool boiling film coefficients, high heat flux boiling. Laminar film condensation on a vertical plate, turbulent film condensation, drop wise condensation. Numerical Solution of Conduction problems and Mass Transfer, Finite difference equations method of energy balance, finite difference formulation of unidirectional for Cartesian cylindrical coordinate of various kind of boundary conditions, heat conduction problems, numerical methods of solutions, numerical solution of transient heat diffusion problems. Convective mass transfer, equations for convective mass transfer, boundary layer mass transfer empirical correlations for convective mass transfer.

References

- | | |
|--------------------------------|---------------|
| 1. Principles of Heat Transfer | - Kreith Bohn |
| 2. Heat Transfer | - J.P. Holman |

TH 514 THERMAL ENGINEERING LABORAYORY

TH515 SEMINAR 1

Second semester

TH 521 - INSTRUMENTATION AND CONTROL

Theory and Experimentation in Engineering, Fundamentals of Measurement System, Performance Characteristics of Instruments:

Dynamic performance characteristics: dynamic response, system transfer function and frequency response. Elements of Measurement Systems, Signal conditioning, Data presentation systems, Pneumatic and Hydraulic systems, Applied Mechanical Measurements, Determination of count, events per unit time and time intervals, Measurement of stress and strain, Pressure, Temperature, fluid flow, motion, Humidity, Torque and power measurements.

References

1. Industrial Instrumentation - Al Seutko, Jenny D Frank
2. Instrumentation Measurements and Analysis - B.C. Nakva K. K. Chandhary

TH 522 - THERMAL ENVIRONMENTAL ENGINEERING

Thermodynamic properties of moist air, psychrometric chart and its applications. Thermal exchanges of body with environment. Physiological hazards resulting from heat exposure. Environmental requirements for various components (e.g. men, material, machinery, and processes) for a few important heavy industries. Various systems of refrigeration and their application to environmental control. Vapour compression refrigeration system, Multi evaporator multi compressor systems, Vapour absorption system, Evaporative Cooling, Desiccant cooling systems. Various system of ventilation for industry. Air conditioning load calculations, various systems of air conditioning for industries. Recommendations of ISO 140000 for thermal environment.

References

1. Refrigeration and Air Conditioning - Arora and Domkundwar
2. Refrigeration and Air Conditioning - C.P. Arora

TH523 - THEORY AND DESIGN OF HEAT EXCHANGERS

Classification, temperature distribution for parallel flow, counter flow, cross flow, heat exchanger, evaporators and condensers, concept of LMTD and overall heat transfer coefficient. Fouling of heat exchangers, NTU method for gauging exchanger performance, LMTD for parallel, counter and cross flow heat exchangers, effectiveness for parallel and counter flow exchangers. Important design considerations: material selection and optimization of heat exchangers, analysis of regenerative heat exchangers. Vibrations induced by flow, International Standards for heat exchangers. Thermal and Mechanical Design of Shell & tube heat exchangers, Double pipe, Extended surface, Condensers & evaporators, Boilers & feed water heaters, Air preheaters, Dictators, Heat exchanger for nuclear application.

References

1. Design of Heat Exchanger - Kern
2. Principles of Heat Transfer - Kreith Bohn

TH524 THERMAL ENGINEERING LABORATORY 2

TH525 SEMINAR 2

Department electives

TH 531 NUMERICAL HEAT TRANSFER

Introduction, Chemical thermodynamics and chemical kinetics. Conservation equations for multi-component systems. Premixed systems, Detonation and deflagration, laminar flames, effects of different variables on burning velocity, methods for measuring burning velocity, flammability limits, ignition and quenching turbulent pre-mixed flames. Non-premixed systems, Laminar diffusion flame jet, droplet burning. Combustion of solids, Drying, devolatilization and char combustion. Practical aspects of coal combustion.

References

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1. Combustion - Irvin Glassman
2. Introduction to combustion - Stephen Turns

TH 532 EXPERIMENTAL STRESS ANALYSIS

Stress and Strain, Principle stresses, Mohr's stress circle, Isoclinic, Isostatic, Isochromatic, Isopachic, stress strain relationship. Whole field method, laws, plane polariscope, circular polariscope, white light illumination, analysis of photoelastic data, stress coat and membrane analogy, Electrical wire resistance strain gauges. Strain Gauge Rosette, Types of rosette, four element rectangular rosette, Tee-delta rosette, rosette analysis. Application, Design of turbo machinery components such as steam turbine rotor, L.P. and H.P. cylinder diaphragm valve rotary compressors and its parts. Fatigue testing and vibration studies.

References

1. Experimental Stress Design - Daly and Reilly
2. Experimental Stress Design - Sadhu Singh

TH 533 MAINTENANCE OF THERMAL POWER PLANT EQUIPMENTS

Maintenance Management, Maintenance strategies, maintenance schedule, emergency maintenance procedure spare part management, Diagnostic Maintenance and Machine Health Monitoring, practical application of diagnostic maintenance to specific industrial machinery and plants. Various techniques of condition monitoring wear analysis, vibration and noise signature, thermography etc. Mechanism of Lubrication & Lubricants, Lubrication Regimes: Lubrication regimes, analysis and modes of lubrication in different bearings, squeeze films, fluid film, elasto-hydrodynamic and boundary lubrication. Failure Mechanisms and Analysis, Material failure and failure due to environmental effects, Design faults, analysis of engineering failures, failure due to abuse of machinery, failure of seals & packing, failure of bearings, failure of gears, fatigue failure, failure due to time – temperature effects (creep) corrosion etc. Maintenance of Power Plant Machinery, Predictive and preventive maintenance of steam turbine and its components. On load and off load cleaning of condenser tubes. Maintenance scheduling of cooling water plants, cooling towers.

References

1. Maintenance & Spare Parts & Management - P. Gopal Krishnan
2. Modern Power Station Practice - 10 Volumes in Reference
British Electricity Int. Ltd

TH 534 REFRIGERATION SYSTEM AND COMPONENT DESIGN

Introduction to various components. Thermal design of reciprocating, centrifugal and screw compressors. Capacity control methods. Thermal design of different evaporators–DX, flooded, etc. Thermal design of condensers–water-cooled and aircooled. Sizing of capillary. Selection of expansion valves and other refrigerant control devices. Components balancing. Testing and charging methods. Design of absorber and generator of vapor absorption systems. Design of cold storages, mobile refrigeration, refrigerators, commercial appliances.

References

1. Refrigeration and Air Conditioning - C.P. Arora C.P.
2. Principles of refrigeration - R.J. Dossat

TH535 THEORY AND DESIGN OF GAS TURBINES

Gas Turbine Plants, Axial Flow Compressor, Principle of operation, velocity triangles. Design procedure for single and multistage compressors. Three dimensional effect compressor performance. Description and problems of transonic and supersonic compressors. Impulse turbine. Single and multiwheel turbine

efficiency, Number of stages blade passages, Vortex design of turbine blades. Blade design & manufacture blade material and blade cooling, limiting factors in turbine design. Combustion in Gas Turbine and Turbine Characteristics

References

1. Gas Turbine - Cohan Rogers
2. Gas Turbine - Ganesan

TH 536 COMBUSTION

Introduction: Mathematical Background, Survey of Numerical Methods Used in Heat Transfer, Finite Difference Methods, Finite Element Methods, Simulation of Transport Process, Conduction Heat Transfer, Steady and unsteady state one & two dimensional problems. Explicit, Implicit and Crank-Nicolson scheme, ADI and ADE methods. Convection Heat Transfer, Boundary Layer Flows, Similarity solutions, Derived Variables, Patankar/Spalding Methods for two-dimensional flows. Elliptic Solutions, Control Volume formulation. Energy and other scalar equations, Momentum equations, Segregated Solution method; SIMPLE & SIMPLER schemes, Stream Function – Vorticity Transport method. Turbulence, Examples of turbulent flows, Stress relations, Reynolds stresses, turbulence model computations, Analogy between Heat Transfer and Momentum, Linearization of source terms.

References

1. Computational Fluid flow and Heat Transfer - K. Muralidhar, T. Sundarajan
2. Numerical Heat Transfer - S.V. Patankar

TH 537 VIBRATIONS AND ITS APPLICATION FOR DESIGN OF TURBO MACHINERY

Differential equations of motion for first order and second order linear systems. Transverse vibration of beams. Damped free vibration, viscous, coulomb damping dry friction logarithmic decrement. Forced vibration of single degree of freedom linear systems. Response of first order systems to harmonic excitation. Frequency response. Response of second order systems to harmonic excitation. Rotating unbalance, whirling of rotating shafts. Harmonic motion of the base, vibration isolation, transmissibility, force transmission to foundations. Vibration measuring instruments eg Seismic mass, vibrometer, Accelerometer. Energy dissipation. Forced vibration with coulomb hysteresis or structural & viscous damping. Equation of motion for a two degrees of freedom system. Torsional vibration of one, two and three rotor system. Equivalent shafting. Torsional vibration of a geared system. Torsional vibration with harmonic excitation, Critical speed of a shaft having a single disc with damping.

References

1. Mechanical Vibrations - G.K. Grover
2. Theory of Vibration with Application - Thomson

TH538 THEORY AND DESIGN OF BLOWERS AND COMPRESSORS AND INDUSTRIAL STEAM TURBINES

Energy interchange in fluid machinery, momentum-principle, streamline theory, momentum and circulation. Theory of centrifugal impeller for incompressible fluid, velocity triangle - impeller for approach and prerotation vortex theory. Blower casing volute, vaned and vaneless diffuser, thermodynamics of turboblowers. Dimensionless characteristic of turboblowers. Axial Flow Compressors. Two dimensional Cascade: Theoretical analysis of performance and experimental works. Howell's and Cartter's correlations for low speed. Effect of Reynolds and Mach numbers. Pitch line design of axial flow compressor. Radial equilibrium. Calculation of losses and stage efficiencies. Stresses in the discs and blades - interstage traversing, measurements of total and static pressures and vane angles.

Transonic and supersonic compressors. Industrial Steam Turbines. Type of Industrial Steam Turbines.

References

1. Turbines Fans and Compressors - S.M. Yahya
2. A Practical Guide to Steam Turbine Technology - Heinz P. Bloch

TH 539 GAS DYNAMICS AND FLOW THROUGH TURBOMACHINES

Fundamental Equations of Steady Flow, Euler's equation, Bernoulli's equation, Energy equation, Stream Function and Velocity Potential Potential Flow, Elementary potential flows, Uniform flow, Source, sink, vortex and doublet. Superposition of flow patterns. Flow over immersed bodies. Development of the aerofoil-lift and drag, Kutta-Joukowski Profile, pressure distribution over aerofoil blading. Viscous Flow, Navier Stoke's equation and exact solutions of steady flow problems. Flow through pipes, flow over flat plates. Laminar and turbulent boundary layers. Dimensional analysis. Compressible Flow of Gases, Fanno line and Rayleigh line flows. Flow with normal shock waves governing equations, Prandtl Meyer and Rankine Hugoniot relations, Moving normal shock waves. Cascade Tests, Fundamental equation of flow through turbo machinery. Radial equilibrium equation. Vortex flow through turbo machines. Surging and choking.

References

1. Fundamentals of Compressible Flows - Yahya
2. Compressible Fluid Flow - Michel A. Saad

Open electives

TH551 NON CONVENTIONAL THERMAL ENERGY SYSTEM

Energy sources & Availability, Solar Energy, Solar radiation data & solar charts, solar energy storage devices, application of solar energy solar cookers, solar still, solar refrigeration, active & passive heating system, Solar photovoltaic system – principle, main parts & modules. Solar Collectors, Design of flat plate collector-characteristics, loss-coefficient, heat transfer analysis. Solar water heating system. Biomass Energy, Utilisation of biogas – Gasifiers, direct thermal application of Gasifiers. Advantages & problems in development of Gasifiers, Other Energy Sources, Geothermal Energy: Status & estimates, geothermal sources, geothermal systems & their characteristics, Fuel Cells. Energy form thermo nuclear fusion, OTEC, hydrogen, thermoionic generation & tidal & waves.

References

1. Principles of Solar Energy - Duffy & Beckman
2. Solar Energy - S.P. Sukhatme

TH 552 THERMAL POWER PLANT ENGINEERING

Siting of Power Stations & Plant Layout, Power Plants Economics, Load curve, Load duration curve, Load factor and diversity factor. Effect of load curve and diversity factor on the performance of power plant. Duct Work, Piping and Insulation, Design and layout of ducting for air, fuel, Pipe insulation. Optimum and Economic thickness. Specification of insulation. Power Plant Components, Radiant superheaters and reheaters, economizer and preheaters. Plant Instrumentation, General & Special Instrumentation, centralized & automatic control equipment, types of controls. Supercritical Power Stations, principle of working, Power Plant Testing, Preliminary performance checks, acceptance tests for various components. Power Plant Management: Operation and Maintenance of Turbines: Starting, loading and stopping of turbine, normal operation checks, maintenance logging, parallel operation.

References

- | | |
|----------------------------|----------------------|
| 1. Power Plant Engineering | - Arora & Domkundwar |
| 2. Power Plant Engg | - P.K.Nag |

TH 553 POWER GENERATION SYSTEMS

Stator Design, Design of Casing & Diaphragms, Rotor Design, Rotor Stresses & Design, Design of turbine rotors. Rotors of constant strength and of constant thickness rotors with hyperbolic profile. Temperature stresses in rotors, Turbine Rotor Vibration, Critical speeds, balancing of rotors. Steam Turbine Systems, Design procedure for steam turbine stages. Blade erosion, Binary Vapour Cycle and Cogeneration. System of turbine governing, Overspeed tripping, design of the lubricating system. Engines Systems, Fuel Systems, S.I.Engine, CI Engines and Gas Turbines. Combustion: S.I. and C.I. Engine Combustion, and Gas Turbines & Combustion chamber design.

Gas Exchange Process, Alternative Technology, Alternative power Sources, Fuel cells

References

- | | |
|-------------------|------------|
| 1. Steam Turbines | - R. Yadav |
| 2. Steam Turbines | - Keerton |

xi) INDUSTRIAL DESIGN (M.Tech)

ID 511 COMPUTATIONAL METHODS

Various approaches in FEM, direct stiffness method, energy approach and Galerkin's approach, detailed method for structural analysis problems, various elements, development of element stiffness matrices. Applications to bar, beam, truss, spring, shaft problems. Two dimensional elements. Plane stress and plane strain problems. Three dimensional elements and their applications. Iso-parametric elements, plate bending and shell elements, Axi-symmetric problem, vibration problem,

Applications to fluid flow and heat transfer problems. Softwares such as IDEAS, ANSYS, Nastran used in FEM. Nonlinear FEA

References

1. Finite element method by O.C. Zienkiewicz.
2. Finite element method by C.S. Krishnamurthy
3. Finite element method by Logon
4. Finite element method by Heubner

ID 512 MECHANISM & SYNTHESIS

Mechanism, link, linkage and mechanism planar and spatial mechanisms, grubler's criteria for degree of freedom, equivalent mechanisms, inversions of four link chain, slider crank chain and double slider crank chain. Mechanism analysis: Relative velocity method, instantaneous' center methods of velocity, acceleration analysis including coriolis component of acceleration. Application to slider crank chain four bar chain, stone crusher mechanism sewing machine mechanism, quick return mechanisms wrapping m/c mechanism etc klein's construction, computer aided analysis of synthesis of mechanisms. Pole, relative pole, inversion overlay freudenstein and block methods least square technique. Application to four link mechanism and slider crank mechanism function generation, modification of timing of cam mechanism. Limit & dead center positions transmission angle, cognate linkages, coupler curves, euler savory equation.

ID 513 RELIABILITY ENGINEERING

Basic Concepts of Reliability, Design for reliability, Component Reliability & Hazard Models, System Reliability Models, Redundancy technique, System Design, Maintainability and Availability Concepts.

Reliability problems & measures of reliability. Reliability of non-maintained & maintained systems with & without redundancy allocation of failure & repair rates. Maintenance policies.

ID 514 DYNAMIC OF MACHINES LAB.

1. Rotor Balancing On Dynamic Balancing W/C
2. Hydrodynamic Journal Bearing Pressure Distribution.
3. Natural Frequency of Simple, Compound & Torsional Pendulums

ID515 SEMINAR

Second semester

ID 521 ADVANCED COMPUTER AIDED GRAPHICS

Introduction to application of computer graphics for visualizing concepts, introduction of hardware including operating systems, file management and hardware limitations introduction to the concepts of programming through by per media. Exploration of various packages for illustration, drawing, desk top publishing page composition and animation.

References

1. Mars Bell G.R. Computer Graphics In Application Prentice Hall
2. Kerlow L.V. And Rosebush J. Computer Graphics For Designers And Artists.
3. Grieman A. The Fusion of Technology And Computer Graphic Design – Hybrid Imagery Architecture, Design And Technology Press.

ID 522 STRESS & VIBRATION ANALYSIS

Introduction, Types of Strain Gauges, Selection of Various Compensations, Installation, D.C & A.C. Systems. Steady & Transient Vibration of Single & Multi – Degree Freedom Systems. Systems with Distributed Mass & Elasticity Structural Damping. Dynamics of Rotating & Reciprocating Machinery. Response of Systems to Random Vibrations. Vibration of Multi Rotor System Holzer’s Method, Self Excited Vibration, Criteria Of Stability.

References

ID 523 Advanced Product Design

The emphasis of the course is on individually planned design projects in different product areas. Selection of these projects is based on consideration like close human interaction with product, wide range or requirements of different users and possibilities of formal and structural innovations. Projects and with a comprehensive presentation through working mock up models design drawing and a report. This project work is supported by theoretical information and short supporting assignment in following topics: Role of creativity in problem solving, study of inhibitions, conformity and vertical thinking: assignments on using techniques like brain storming. Synectics to develop creative attitude and open mind. The development of modern design methods from craft evolution. Detailed discussion on stages in design process. Complimentary nature of systematic and creative thinking in various stages of design processes. Discussion on nature of synthesis. Methodology for visual analysis of products. Principles of value analysis, use esteem, time and exchange values and definition of function.

References

1. Jones J.C: Design Methods, Interscience
2. Buhl H.R. Creative Engineering Design Iowa State Univ. Pres.
3. Hill Percy H: The Science Of Engineering Design, Holt, Rinehart And Winston Inc,
4. De Bono Edward: Lateral Thinking Penguin 1972 William J.J. Gordon: Synectics, Collie Books 1968.

ID 524 CAD LAB.

1. Two Dimensional Drawings.

2. Three Dimensional Model of Product.
3. Working Drawings of Components and Assembly.
4. Mechanical and Aesthetic Design of Products.
5. Trying Various Aesthetic Shapes, Shapes, Colours Etc. of the Product by CAD.

ID525 SEMINAR

Department electives

ID 531 BEARING DESIGN & SELECTION

Lubrication, hydrostatic bearings, hydrodynamics lubrication full journal bearing, friction, pressure distribution, load carrying capacity thermal equilibrium, partial journal bearings influence of end leakage on behaviour of bearings, maximum oil pressure with end leakage, practical considerations in bearing design. Bearing – design, selection of ball & roller bearings

ID 532 DESIGN & DEVELOPMENT OF PROTOTYPE PRODUCT

Marketing: forecasting & market research for a new product. Purchasing and sales procedure. Demand analysis for new product. Intellectual property right :introduction to ipr laws, nature, types of property intellectual property, ip as an economic entity, development of ipr copyright, patents, design, trademarks, forms, global ip structure and iprs in india, infringement and remedies available, patent search, contractual agreements involving patents, case studies.

ID 533 COMPUTER AIDED FACILITY & PROCESS PLANNING

Element of plan design systematic layout planning, industrial component and its consideration. Objectives types, goal, design process and techniques of facility planning. Schematic technique, travel charting, sequence analysis systematic layout – planning mathematical models, optimizing heuristics algorithm, branch and board technique, quadramatic assignment techniques, traveling salesman problem, single goal improvement type models, single goal construction type models. Multiple facility design problem and construction type existing improvement type, multiple goal models and modifications, design problem solving technique. Estimation of distribution parameters. Empirical models, computer aided models. Estimation of distribution parameters in multi goal facilities design problem, computer aided techniques for finding optimum and sub optimum and sub optimum facilities design problem solution.

ID 534 ACCELERATED PRODUCT DESIGN & DEVELOPMENT

Introduction to rapid prototyping and manufacturing, photo polymerization, cationic photo polymerization, stereo lithography, lasers for rapid prototyping and manufacturing, solid modeling, slice process post processing – part removal, part cleaning, post curing and part finishing, case studies. Concurrent engineering: product design and product manufacturing merger is an intimate way to response competitiveness in design and manufacturing. Model of concurrent engineering correlating manufacturing, sales and distribution, market analysis, product design and production system design. Designing for lifetime use (life cycle engineering). Manufacturing decision and life cycle cost. Careful design decision in the area like material selection, selection of features, ease of assembly, product. Concurrent engineering beyond reducing manufacturing cost. More engineering effort. Rapid product development through concurrent engineering. Venders of suppliers a part of design team, Communication skill

ID 535 ELECTRONICS PACKAGING DESIGN

Electronics packaging introduction -packaging levels, mechanical packaging aspects of electronics packaging connectors, materials for electronics packaging, substrates sealing materials, packaging electronics, pcs, back panel, wire wrap bands cable connectors, wire insulation, electronic enclosures.

Thermal management, vibration and shock analysis, noise and control, emi/rfi/esd shielding, reliability & testing, packaging case studies.

ID 536 COMPLEX MECHANISM & GRAPH THEORY

Equivalent planar mechanisms, complex mechanisms of lower and higher degree of complexity and their analysis, basic concepts in graphs. Graph theory Application to detect isomorphic kinematic chains, graph representation of kinematic chain, adjacency, degree and distance matrices, string method, characteristics polynomial computerized methodology. Application to simple, multiple jointed and sliding pair kinematic chains. Detection of distinct mechanism of a kinematic chain: velocity graph method and other methods, complex mechanics & of graph theory for selection of interactive chains, mechanics, fixed input & output link location in multi-degree freedom linkages: mechanism selection and link location, application to partial, fractionated and total degree of freedom linkages.

ID 537 NATURE OF MATERIALS AND PROCESSES

Properties and usage of thermoplastic, thermosetting plastics, selection and use of plastics for engineering and consumer products. Design limitations and specific advantages of molding processes. Properties and use of rubber, ceramics and glass. Ferrous and non ferrous metals-various processes and assembly techniques. Concepts of structure and costing. Properties of natural materials like wood, bamboo cane leather cloth jute and paper and their use at craft and industrial levels.

References

1. Production Engineering Series. Plastic Forming. John D, Beadle, Product Treatment And Finishes
2. Macmillan. Heman H.Jorth, Basis Wood Working Process. The Bruce Publishing Co.

ID 538 DETAILED DESIGN OF ROTATING MACHINES

Component & assembly design, use of cad procedure for designing, application of optimization techniques, modeling and evaluation of components & assembly, specific examples to be taken such as centrifugal pump, wind turbines, machine tools etc. calculation of stresses and strengthening of blades.

ID 539 ADVANCED MACHINE DYNAMICS

Gear design: Spur, bevel, worm, balancing & vibration analysis. Gyroscope applications: Motor cycle, four wheel vehicle, aero plane, Naval ship rotor bearing system. Cam dynamics: analysis of an eccentric cam, jump speed analysis of cam, unbalance, spring surge & windup.

Reference

1. Dynamics of Machinery , Farazdak Haideri
2. The theory of machines: a text-book for engineering students, Thomas Bevan
3. Mechanics of mechanism Ghosh and Mallick
4. Theory of Machines S S Rattan
5. Kinematics and dynamics of machines, George Henry Martin

Open electives

ID 551 APPLIED ERGONOMICS

Human being in man-made world. Gross human anatomy, anthropometrics, static and dynamic, muscles and work physiology, static and dynamic work including maximum capacity. Biomechanics, environmental condition including thermal, illumination noise and vibration, biological transducers and nervous system including their limitations. Controls and displays psycho physiological aspects of design. Research techniques in ergonomic data generation. Interpretation and application as statistical methods. Case analysis. Project work involving ergonomic design research for product systems.

ID 552 CONCURRENT ENGINEERING

Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team. Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools. Quality by design: Quality Function Deployment methodology, Taguchi methods of robust design, Design for manufacturability: Virtual manufacturing, Introduction to Value Engineering, Value Engineering analysis and techniques, Design for assembly: Introduction to various DFA technologies.

Rapid Prototyping: Need and use of RP, various RP technologies, Design for Reliability: Reliability fundamentals and design for reliability principles, Design for Serviceability: Factors affecting serviceability, serviceability evaluation, Design for Maintainability and Economics.

References: -

1. John. R. Hartley, Susmu Okamoto. "Concurrent Engineering, shortening lead times, raising quality & lowering costs".
2. Don Clausing, "Total quality development, a step by step guide to world class concurrent engineering".
3. Thomas A. Salomone, "Concurrent engineering, what every engineer should know about series".

ID 553 - DESIGN OF COMPUTER AIDED ENGINEERING SYSTEM (CAE)

Over view of CAD, CAE system design and implementation processor requirements analysis, functional specifications, outline systems design, components of cae system, project management.

ID 554 GENERAL COMPUTER AIDED DESIGN

Computer Technology, Data Representation, Languages, Operating The Computer System, Introduction To Workstations, Graphic Terminals, Input/Output Devices Graphic Package, Fundamental Of CAD, Design Process, Database Constructing The Geometry, Wire Frame And Solid Model. Autocad Software Package And Its Applications, Use of Autolisp. CAD-CAM Integration. Introduction To Software Packages And Its Applications.

ID 542 PRODUCT DESIGN FOR MARKET

Elements of successful product design in their specialist market place. Study of engineering / marketing relationship, the buying motivation and perception of industrial buyers, individual customers, industry and government departments. Presentation of designs to potential customers. Accelerated product development, variety proliferation. Differentiated product "fast to market".

ID 555 DESIGN FOR FATIGUE & FRACTURE

Fatigue effect of size factor, design criteria against fatigue, linear elastic fracture mechanics – energy approach & stress intensity factor approach, general yielding fracture mechanics concept of crack opening displacement & integral fracture criteria evaluation of fracture mechanics parameters, fracture safe designing of structures & mechanical components, service failure analysis.

xii) MAINTENANCE ENGINEERING (M.Tech.)

First Semester

MT 511 STATISTICS AND PROBABILITY

Collection & Tabulatory data. 2 Measures of central Tendency, Mean, Median, Mode. Dispersion, range, Deviation, Coefficient of Dispersion , Moments. Probability: Additive law of probability, Compound events, Use of multinomial Expansion, theorem. Probability density function. Probability Distribution, Binomial, Poisson's and Normal weibill, experimental etc.

Sampling: Simple Sampling, Sampling distribution the sampling of variables, estimation, distribution, chi-square distribution. Interpolation: Newton's Forward and Back ward interpolation formula, central

difference interpolation formulae, Interpolation with unequal intervals. Numerical Differentiation Numerical integration Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8 rule, weddlesrule. Solution of Algebraic and Transcendental Equations, Method of false position, Newton Rap son method, Bisection method.

References:

- | | |
|--|---------------------|
| 1. Engineering Reliability Fundamental and Application | R. Rama Kumar |
| 2. Mechanical Survival | J.H. Bampas – Smith |
| 3. Mathematical Statistic | M. Ray |
| 4. Mathematical Statistic | Fruend |

MT 512 MAINTENANCE MANAGEMENT: POLICIES, STRATEGIES & OPTIONS

Introduction : Maintenance,Need of Maintenance Management, Maintenance Policies, Strategies and options in Maintenance management. Maintenance forms/actions and their inter relationships, Brief descriptions of various Maintenance actions. Maintenance Organisations: Prerequisites, factors determining effectiveness of a Maintenance organization, objectives of organization design, types of organization.

Maintenance Planning and Control: Establishing a Maintenance Plan-Preliminary considerations, Systematic method of Maintenance Plan and schedule planning and schedule of Plant shut downs

Maintenance practices on production machines- Lathe,Drilling,Milling,Welding,ShaperUse of computer in maintenance,Machine Reconditioning. Evaluation of Maintenance Management: Need for evaluation a to z objectives, criterion of evaluation. Spare Parts Management: Capacity utilization, cost reduction approach to spares, reliability and quality of spares, spare parts procurement, inventory control of spare parts.

References:

1. Maintenance Management Policies, Strategies and Options:July 27–29 , 2000, Lecture notes MACT, Bhopal.
2. Maintenance & Spare Parts Management. :P. Gopal Krishnan & A.K. Banerji
3. Hand Book of Reliability Engineering & Management :W. Grant Ireson and Clyde F – McGraw Hill
4. Maintenance Planning & Control:Anthony Kelley – East West Press.

MT513 LUBRICATION MANAGEMENT AND PRACTICES

Introduction: friction, wear and lubrication, Historical background, Purpose of lubrication, Lubrication regimes, Characteristics of lubricants - viscosity, viscosity index, oxidation stability, flash point and fire point, pour point and cloud point, carbon residue, ash content, iodine value, neutralization number, dielectric strength, Composition and classification of lubricants, Lubricating oils – oil refining, types, categories, grading, Grease - composition, function, characteristics, thickeners and additives, soap and its complexes, selection and its practices, solid lubricants, Functional additives – surface, performance enhancing, lubricant protective , Lubricants applications – tribological components and industrial machinery, Lubricants testing and test methods, Organisation and management of lubrication, lubricant storage and handling, Safety and health hazards, Environmental regulations.

References:

1. CRC Hand Book of Lubrication and Tribology Vol. I – Vol. III CRC Press Inc.
2. Maintenance Engineering Handbook : L.R.Higgins,Mcgraw Hills- Inc
3. Basic Lubrication Theory :A Cameron

Second semester

MT521 RELIABILITY AVAILABILITY AND MAINTAINABILITY ENGINEERING

Introduction to Reliability Availability and Maintainability (RAM), Development of RAM Engineering, Reliability Availability and Maintainability utilization factors, down time consequences.

Reliability engineering fundamentals and applications, Historical perspectives, Definition of Reliability, Role of Reliability evaluation, Reliability assessment, relationship between different Reliability functions, typical Hazard functions, Mean time to failure, Cumulative Hazard function and average failure rate,

Application of Probability distribution function in Reliability evaluation combinational Aspects of Reliability, Markov models optimization of system Reliability, Heuristic Methods applied to optimal system Reliability. Maintainability :

Definition and application of Maintainability Engineering, Factors affecting Maintainability. Maintainability design criteria, operating and down time categories, Maintainability and its quantification, Mean time to activity restore an equipment, Mean Maintenance man hours, Mean time for corrective and Preventive Maintenance, Replacement Policies. Availability, types of Availability, approaches to increase equipment Availability.

References:

1. SERC School on RAM Engineering for Manufacturing servicing and Process Industries. : April 14-25 , 1997, IIT, Delhi.
2. Reliability Engineering Fundamentals : R. Ramakumar and Applications.
3. Maintainability, Availability and : Dimitri Kececelogu Vol. - I Operational Readiness Engineering
4. Reliability Engineering : Govil
5. Reliability Engineering : Balguruswamy

MT522 FAILURE ANALYSIS & PREVENTION

Introduction: Engineering aspects of failure & failure analysis

Defects: Types and characteristics, Effects of defects on service properties General Procedures for Failure Analysis Basic Failure Mechanisms: Distortion Failures, Overload Failures, Fatigue Failures, Wear Failures, Corrosion Failures, Elevated Temperature Failures, Fractures.

Failure Analysis Techniques and Preventive Measures: Non Destructive Testing Techniques and Metallographic Techniques.

Component Failures: Bearings, Chain and Belt Drives, Gears, Lifting Equipments, Mechanical Fasteners, Pressure Vessel, Seals, Shafts, Springs

Failure Modes and Effect Analysis: Failure Modes, Categories of Failure Modes, Failure Effects, Sources of Information about modes and effects, failure consequences, Case Studies on failure Analysis

References :

1. Metals Hand Book 9th Edition, Vol. 11, Failure Analysis and Prevention.
2. Failure of materials in Mechanical Design: Analysis, Prediction and Prevention. ----Jacks A. Collins.
3. Metallurgy of Failure Analysis. ----A.K. Das.
4. CRC Hand book of lubrication Vol.I Application and maintenance. --E.R.Boosy

MT523 TPM, CBM AND RCM

Introduction: Definition concept of TPM, characteristics of TPM, Benefits of TPM, losses of TPM, implementing TPM. Philosophy of TPM. Indications of TPM.

TPM Development: Preparation phase, TPM introduction education, TPM Promotion organization, TPM policies and goods, TPM Master Plan TPM initiatives, Implementation phase; consolidation phase.

Measuring TPM effectiveness: Philosophy of setting goals Measuring TPM effectiveness Indicators topos, Plant effectiveness quelling and Energy saving Maintenance Measuring TPM Benefits.

Application of TPM in Process Industries Administrative & Support departments and other Industrial enterprises

Reliability Centred Maintenance (RCM): Introduction its place in Maintenance policies & Hierarchy aims of RCM, steps in RCM implementation, steps in RCM analysis, system selection, RCM effectiveness indicators. Maintenance informer and efficiency.

RCM tasks Proactive Maintenance, Preventive and Predictive tasks. Scheduled restoration and scheduled discard . The P-F interval and P-F curves, linear as non linear PF curves , Default actions, RCM Decision diagrams. Implementation of RCM. Condition Based Maintenance: Machine signatures, various techniques of signature analysis, temperature noise, vibration and wear particle analysis, on line and off line techniques.

References:

1. Seichi Nakajima TPM development :Productory Press 1989. Programme
2. Total Productive Maintenance :Vikas Bhaduri
3. Industrial / Maintenance & Management :S.K.Shrivastava.
4. Introduction to TPM – Total. :S Nakafiurea Productivity Productive Maintenance Press Coimbatore 1988

Department electives

MT 531 MAINTENANCE AUDIT

A Methodology for auditing the industrial maintenance function. The purpose and procedures of such auditing. An outline with examples of a full audit, a snapshot audit and a fingerprint audit. Information gathering strategy. Information gathering techniques: models, questionnaires, survey forms. An outline of an aide-memoire based on the audit methodology Methods of interviewing. Analysis of data: the analysis procedure, identification of problem areas, developing improved organisations and systems. Reporting: the report structure, the audit section, the proposal section. A major part of the course will be devoted to the discussion and analysis of actual audit reports. This will include use of audit data to identify problems, their causes and solutions.

References:

1. GIP Quality Audit Manual : Milton A. Anderson
2. ISO 14000 EMS Audit Hand book :Gregory P Johnson

MT 532 RISK ANALYSES AND SAFETY

Risk management and analysis during operation. Risk analysis and management during system procurement and installation. Role of maintenance and inspection in risk management. Risk minimization through operation and maintenance feed back in design. Strategies for safety of equipment and personnel and emerging trends in design of power plants to reduce fire risk. Risk and hazards in chemical industries. Risk and safety assessment in defence equipment. Risk management in EHV transmission systems. Risk man & Risk management in steel cord conveyors.

References:

1. Risk Analysis and Security Survey John F. Border
2. Fundamentals of Risk Analysis and Risk Management Vlasta Molar

MT533 CONCURRENT ENGINEERING

Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team.

Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools.

Quality by design: Quality Function Deployment methodology, Taguchi methods of robust design, Design for manufacturability: Virtual manufacturing, , Introduction to Value Engineering, Value Engineering analysis and techniques, Design for assembly : Introduction to various DFA technologies.

Rapid Prototyping: Need and use of RP, various RP technologies, Design for Reliability: Reliability fundamentals and design for reliability principles, Design for Serviceability: Factors affecting serviceability, serviceability evaluation, Design for Maintainability and Economics.

References: -

- 1.) John. R. Hartley, Susmu Okamoto. “Concurrent Engineering, shortening lead times, raising quality & lowering costs”.
- 2.) Don Clausing, “Total quality development, a step by step guide to world class concurrent engineering”.
- 3.) Thomas A. Salomone, “ Concurrent engineering, what every engineer should know about series”.

MT 534 MAINTENANCE AWARENESS IN DESIGN

Design activity: design modules, what makes for good design, design levels. Systems engineering. M+R parameters that can be usefully used in design. Design reviews. Design evaluation. Creative design. Design detail. Design contractual agreements. Decision analysis. Ergonomic considerations. Industrial case studies.

References:

1. Parking Structures Planning ,Design ,Construction,Maintenance and Repair : A.P.Chrest,Mary S. Smith
2. Asset Maintenance ManagementAguide to developing strategy and improving performance:A.Wilson

MT 535MAINTENANCE OF AGRICULTURAL AND EARTH MOVING MACHINERY

Maintenance scheduling, predictive and preventive maintenance, machine health monitoring systems, spare parts – inventory and maintenance.

Fault diagnosis, rectification servicing and repairs of various components/systems of agricultural equipments and earth moving machinery, fault diagnosis and manuals.

Special problems associated with heavy earth moving equipments and their solutions. Planning and design

References:

- 1.Hand book of Maintenance: Lindley R. Higgins

MT 536 BULK SOLIDS AND HANDLING

Nature of Bulk Solids, Flow of bulk solids – gases/solid flow in pipelines, Mechanical Handling – Screw Conveying, Belt Conveying, Bucket Elevators, Vibratory Conveyors, Components of Pneumatic Conveying Systems – Feeding devices, Pipeline, Engaging and Disengaging, Devices, Pneumatic Conveying System Design, Operational Problems, -- Erosive wear, Product Degradation, Moisture.

References:

- 1.HandBook of Pneumatic Conveying Vol. 1 2005 :D.Mills,Mark G.Jones,V.Agarwal
2. A Practical Guide to Pneumatic Conveying Problems :V.Agarwal

MT537 MAINTENANCE OF ELECTRICAL MACHINES

Principals and planning of maintenance, heating and ventilation of electrical machines, mechanical features of electric motors, lubrication system, possible faults, their causes and repairs in A.C. single phase induction motors and D.C. motors, transformers, installation and commissioning of transmission

lines and distribution lines, under ground cables, switch gears, house installation maintenance, importance of earthing, its testing and maintenance, fire fighting equipments, batteries.

References:

1. Parameter Estimation, Condition Monitoring and Diagnosis of Electrical Machines : P.Vas

MT538 MAINTENANCE OF POWER PLANT MACHINERY

Introduction to various systems of power plant e.g., boilers, fuel and ash handling equipments, steam turbine, condenser and feed heaters etc. Operation and maintenance of piping, plant, stokers, oil burners. Boiler tube corrosion and its prevention, maintenance of furnace and boiler accessories and mountings. Emergency actions, Boiler regulation/ inspection. Boiler operations and safety precautions. Operation and maintenance of coal handling, oil handling and ash handling plants. Predictive and preventive maintenance of steam turbine and its components. Erosion of blades and its prevention. Lubrication of bearings, valves etc. Steam path deposits, vibration monitoring, performance monitoring. Planned overhauls, general purpose steam turbine maintenance and repair, maintenance overview. Maintenance scheduling methods of detection of leaking and its prevention in the condensers, Condenser fault systems and its causes. On load and off load cleaning of condenser tubes, Maintenance scheduling of cooling water plants, cooling towers etc.

References:

- | | |
|---|---------------------------|
| 1. Plant Service and Operation Handbook | A.L. Kohan |
| 2. Practical Machinery Management for | H.P. Bloch & F.K. Geitner |
| 3. Maintenance Engineering hand Book | Lindley & Higgins |
| 4. Steam turbine -Operation & Maintenance | Kearton |

MT539 MAINTENANCE OF TRANSPORT MACHINERY

Introduction and classification – Passenger vehicles, heavy load carriers, moderate capacity vehicles. Light motor vehicles.

Fault diagnosis, rectification, servicing and repair of various components/system of transport vehicles e.g. engine fuels system lubrication, transmission, supervision and electrical system, fault diagnosis charts and service manuals. Maintenance scheduling predictive and preventive maintenance, machinery health monitoring systems, spare parts, inventory and maintenance, Social problems connected with public transport system.

Reference

1. Journal of Institute of Rail Transport : Institute of Rail Transport (India)
2. Handbook of National Accounting Tackling Transport :H.TrischlerS.Zeilinger

MT541 MECHATRONICS AND NDT IN MAINTENANCE ENGINEERING

Mechatronics:

Introduction, Mechatronic systems, closed and open loop measurement systems, The Mechatronics approach, Sensors microprocessors and transducers, displacement, position and proximity pickups. Mechanical and Electrical activation systems.

Measurement Systems: Measurement errors, modelling measurement systems, system Reliability, signal conditioning & processing, Data acquisition and processing systems, Data presentation.

Applied Instrumentation : Measurement of mechanical and process parameters. Measurement of force, torque, temperature, pressure and flow. Measurement of displacement velocity and acceleration. Measurement of noise and vibration.

Non Destructive Testing: Visual inspection, crack detection techniques like magnetic crack detection, dye penetrant, radio graphy, oil analysis, wear particle analysis, strain gauge technology, ultra sonic crack detection, Thermography.

Machine Health Monitoring: Signature analysis and their significance, machine signatures, temperature, vibration, wear particle and noise monitoring, acceptable standards, online and offline techniques, performance trending, potential failure (Pf) curves.

References:

1. Handbook of Condition Monitoring :BKN Rao
2. Non-Destructive Examination :K.G. Bowling
3. Non-Destructive Testing :R. Halmshaw
4. Mechatronics :W. Bolton
5. Mechanical Measurements :T.G. Beckwith, , R.D. Marangoni and J.H. Lienhard
6. Measurement and Instrumentation Systems :W. Bolton

MT542 MAINTENANCE OF CNC MACHINES

Introduction to DNC,FMS,CNC systems, failure in CNC systems, causes diagnosis and remedies. Failure in hydraulic systems, monitoring strategies, fluid contaminant monitoring techniques, particle characterization, lubricant analysis, operational parameters.

Electropneumatic systems – advantages of electropneumatic systems, valve failure, diagnostic displays. Introduction to Robotics, Maintenance of Robots. Black – out Industries.

Reference Books:

1. Handbook of condition monitoring BKN Rao (Elsevier advanced Tech.)
2. Maintenance Engg. Handbook Lindley R.Higgins

MT 543 RESTORATION REPAIRS & RETROFITTING

Restoration: . Scheduled restoration and scheduled discard tasks. . Restoration techniques for industrial equipments: Gear transmissions, key fittings, splines fitting, coupling & clutches, lead screw & nut, belt ,chain & sprocket wheels, bush bearing ball & roller bearings their shank & housings. . Restoration of parts by welding metallisation, chromium plating,maintainability for given restoration time with weibull times to restore distribution, time to restore for given maintainability with a weibull time to restore distribution,steady state mean times to actively restore, repair and /or replace components in an equipment,equipment restoration time, efficiency & consistency.

Repair: Repair cycle, repair complexity, Assembly & dessembly of machine& omponents, repair of cracks, reclamation of worn & damaged parts, economics of reconditioning, reconditioning Vs replacements. Repair of Industrial equipments: Machine spindle, Hydraulic machines, tailstock, three jaw chucks, repair of cracks in C.I. Body , special features of the repair of cranes, hammers power press.

Retrofitting: Retrofitting, objectives, classification of retrofitting, scope of retrofitting, Cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features &selection for retrofitting.

References:

1. Industrial maintenance H.P.Garg
2. Maintenance engineering hand book Lindley R Higgins
3. Reliability centered maintenance John moubray
4. Maintainability, availability & operational readiness engineering Dimitri Kececioğlu

MT 544 MACHINERY VIBRATION MONITORING ANALYSIS

Vibration of Rotating Machinery. Machine Faults And Frequency Range Of Symptoms. Localised and Distributed Faults. Impact Excited Resonance. Vibration Level Classification. ISO Standards. Peak and RMS Levels. Constant Percentage Bandwidth Spectra. Use of Phase. Cepstral Analysis. Envelope Detection. Time Domain Averaging. Rolling Element Bearings. Rotor Dynamics. Orbit Analysis. Static And Dynamic Balancing. Gearbox Vibration. Induction Motors. Reciprocating Engines and Compressors.

References:

1. Machinery Vibration –Measurement and Analysis : W. Victor
2. Rotating Machinery Vibration : Maurice L. Adams

MT 545 MAINTENANCE OF CHEMICAL PLANT MACHINERY

Maintenance scheduling, predictive and preventive maintenance, machine health monitoring systems, spare parts – inventory and maintenance.

Corrosion and corrosion problems in process equipments such as piping, pressure vessels, heat exchangers, process towers, chimneys, boilers etc. Corrosion and erosion control.

Maintenance problems associated with moving machinery such as blowers, pumps, gear drives, conveyors, electrical machines etc. And their rectification identification of special problems with different chemical plants and their solution.

Reference Books:

1. Fault Diagnosis in Complex Chemical Plants : J.C. Hoskins

Open electives

MT551 THEORY OF TRIBOLOGY ELEMENTS

Introduction to Tribology: Theoretical Back ground , engineering surface, laws of friction, sliding & rolling, dry and lubricated friction, lubricated friction. Wear, its types, abrasive, adhesive, corrosive, erosive, fretting, fatigue & cavitation wear, practical examples, wear reduction measures, prevention of wear, Lubrication Principle : Principle of lubrication, lubrication regimes, boundary lubrication, Hydrodynamic and Hydrostatic lubrication, Elasto hydrodynamic lubrication, types of lubricants, solid, liquid, semi solid and gaseous lubricants, lubricant additives.

Tribo Elements - I - Bearings : Bearings types, journal bearings, important parameters for better performance, special additives, rolling element bearings, their types and important parameters in their selection. Tribo Elements - II – Gears: Gears, gear types, gear drives, gear loces and reduction gears, selection of gear drives, gear lubrication and maintenance, gear failures. Chains for power transmission, types, service factors, maintenance and lubrication of chains.

Tribo Elements - III - Seals : Metallic and elastomeric seals, non contacting seals for rotating shafts, radial lip seals, mechanical face seals, selection of seal types for rotating shaft application. Seal failure, its analysis. Practical consideration in use of seals.

References:

1. Basic Lubrication Theory : A Cameron
2. Friction and Lubrication in Mechanical Design : A.A. Seireg
3. CRC Hand book of lubrication – Vol. II : Ed. E. Richard Booser
4. Hand Book of fluid sealing : Ed-R.V. Brink

MT552 MAINTENANCE ECONOMICS AND TURN GROUND MANAGEMENT

Objective: To introduce the concepts of economic theory and behavior for preparing the strategic financial models for maintenance investment decisions. Fundamentals concepts of economics: Scope, definition, characteristics of economic, relationship to the functional areas of business, theory of firm, its constraints and limitations, nature and function of profit, basics of demand and supply equilibrium.

Demand Analysis: Demand theory, demand estimation, simple multiple regression analysis, demand forecasting- qualitative forecasts; survey techniques, opinion polls, quantitative forecasts; time – series analysis, smoothing techniques input-output forecasting. Production and Cost Analysis: Production theory and estimation, production function, returns to scale, comparative advantage, cost theory and estimation, short-run and long run costs, plant size and economies of scale, learning curve, cost-volume profit analysis and operating leverages, cost estimation based on project cost, types of costs, inter-alia, design, installed capital, commissioning and decommission costs, operating costs maintenance and opportunity costs, life cycle costs, cost output analysis and maintenance cost history .

Product/project Life Cycle: Concepts of product/project life cycle capital assets, reliability and risk, life cycle costs and its economic consequences for strategic development. Project financing and capital structure, financial leverages, working capital and capitalization. Turnaround: Characteristics of the maintenance work load, critical path analysis and its use for the planning of large shutdowns, procedure of managing shut downs; Initiation, validation of work scope, organizing preparatory work , contractor packages, shutdown plan, manpower plan. A typical shutdown operation-administrative and resource structures, site logistics plan and its preparation, cost profile, safety and quality plans, executing and controlling the shutdown, review procedures.

References:

1. Managerial Economics Salvatore
2. Applied Economics for Engineers and Managers S.K. Jain
3. Engineering Economics Tarachan
4. Industrial maintenance management Srivastava

MT 553 COMPUTER AIDED MAINTENANCE MANAGEMENT

Introduction Definition Basic components of CMMS, Uses of Computers in Maintenance CAMSS Justification reasons for lack of CMMS effectiveness

Basic Hardware Components General Software categories, fundamentals of C, CH, Network Software, Networking CAMSS Softwares, Flowchart Algorithms & Programming.

Approach towards Computerization, selection of computer system, Master files, Maintenance files, Maintenance Module, classification records, Preventive and repair planning module, codification for Break down, job sequencing files/records.

Developing softwares:- Planning & Scheduling equipment & facilities control, work central Maintenance of spare parts and inventory centre performance reporting and other tools and techniques of Industrial engineering used in Maintenance Management.

Reference Books:

1. Maintenance Engineering Hand book Kindly IIndley and R Higgins
2. Engineering Maintenance Management , Benjamin W.Niebel
3. Industrial Maintenance Management S.K. Shrivastava.
4. Maintenance Planing & Central Anthony kelly

15 DEPARTMENT OF ELECTRICAL ENGINEERING

xiii) ELECTRICAL DRIVES (M. Tech.)

ED-501 : POWER CONTROLLER

Review of power semiconductor devices, series-parallel operation, Heat sink calculations, various firing/driving circuit, Analysis of 1- ϕ / 3- ϕ AC/DC bridge converter with and without freewheeling diode, source impedance, consideration of power factor improvement techniques, pulse width modulated converters, dual converters. Analysis & design of voltage commutated, current commutated and load commutated

choppers, Detailed analysis of 1- ϕ & 3- ϕ VSI (180° mode, 150° mode & 120° mode of conduction), harmonic reduction techniques, PWM inverters, 1- ϕ and 3- ϕ CSI. Circulating current and scheme, non-circulating current operation of 1- ϕ to 1- ϕ & 3- ϕ to 3- ϕ cycloconverter. Analysis of various 1- ϕ / 3- ϕ ac-ac regulator circuit.

Reference

1. Thyristorised Power Controllers - G.K.Dubey, Doradla, Joshi, Sinha
2. Power Electronics - C.W.Lander
3. Power Electronics – Rashid M.H.
4. Thyristorised power controlled converters & cycloconverters - B.R.Pelly

ED 502: ELECTRICAL DRIVES

Basics of Electrical Drives, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multiquadrant operation, Components of load torques. Selection of motor power rating, Energy conservation in ED. D. C. Drives: Speed control. Starting & Braking. Controlled Techniques, Transient Analysis. IM Drives: Analysis and performance. Operation with Unbalanced, Analysis of I.M. fed from Non-sinusoidal voltage supply. Starting, Braking, Transient analysis, Speed Control, Multi-Quadrant Drives and Field Oriented Control, Slip Power Control, Mathematical Modeling of IM Drives, Transient Response and Stability Analysis, Single Phase I.M., Close Loop Control of I.M. Drives. SM Drives, Cylindrical Rotor Wound Field Motor, Salient Pole Wound Field Motor, SRM, Hysteresis Synchronous Motor, Operation from Fixed Frequency Supply, Starting, Braking, SM Variable Speed Drives.

Reference

1. Power semi conductor controlled drives - G.K.Dubey
2. Fundamentals of Electrical Drives - G.K.Dubey
3. Electrical Machine & Power Electronics - P.C.Sen
4. Electrical Drives - S.A. Nasar

ED- 503: MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Review: Primitive machine, voltage and torque equation, Concept of transformation change of variables & m/c variables and transform variables. Steady state and transient analysis, equation of cross field commutator m/c. Induction Machine: Analysis of 1- ϕ & 3- ϕ Induction Motor. Synchronous Machine: Detail analysis, Operational Impedances, Reactances and Time Constants. Approximate Methods for Generator & System Analysis: The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis & Applications.

Reference Books:

1. Analysis of Electric Machinery - P.C.Krause
2. The General theory of Electrical Machines - B.Adkins
3. The General theory of AC Machines - B.Adkins & R.G.Harley
4. Generalised theory of Electrical m/c - P.S.Bhimbra

ED-504 : POWER QUALITY

Understanding Power quality, Sources of harmonics, Standards and Regulations, Causes and effects of harmonics, elimination/suppression of harmonic, passive and active solutions, topologies and their control methods, EMI Issues,

Reference

1. Power Quality – by R.C. Duggan
2. Power system harmonics – by A.J. Arrillga
3. Power electronic converter harmonics – by Derek A. Paice

ELECTIVE – I (i)

ED-511 : MICROCOMPUTER AND IT'S APPLICATIONS

Programmable Peripheral Devices: PPI 8255, various operating modes, fixing diagram, PIT 8253, programming and modes of operation, PIC 8259, operating modes. Interfacing:

Interfacing of peripherals, A/D & D/A converters, 8255, 8253, 8259 with 8/16 bit microprocessor/Data Acquisition system. Microcontroller - 8051 Architecture, Counter/Timers, Instructions, Programming, Interfacing, Applications, Comparison of 8085, 8086, 8057 etc. Programmable logic controller: PLC Architecture, programming, Counter/Timers and its applications. Applications of Microcontroller and PLC for Drives Control

Reference

1. Microprocessor Architecture programming & applications – Gaonkar
2. Microprocessors & interfacing – D.V.Hall
3. The 8051 Microcontroller – K.J.Ayala
4. Introduction to programmable logic controller – Gary Dunning

ELECTIVE – I (ii)

ED-512 : EVOLUTIONARY TECHNIQUES

Optimization: single objective, multi-objective and constraint problem, linear, non-linear and NP hard problem, combinatorial optimization, Conventional optimization method (lambda and differential). greedy optimization technique. Simple genetic algorithm, Multi-objective genetic algorithm. Artificial neural network. Fuzzy logic. Ant colony optimization. Particle swarm optimization. Basic simulated annealing. Basic tabu search method. Bacteria forging and Fish schooling optimization. Bee flying optimization.

Reference

1. J.M.Zurada, Introduction to Artificial Neural System, Jaico Publ. House Bombay.
2. V.Rao & H.Rao, C++ Neural Networks and Fuzzy Logic, BPS, Delhi.
3. Marco Dorigo and Thomas Stutzle, “Ant Colony Optimization”, Prantice-Hall of India New Delhi.
4. D.E. Goldberg, Genetic Algorithm in Search Optimization and machine learning, Addition Wesley Publication Co. INC, NY

ELECTIVE – I (iii)

ED-513: INSTRUMENTATION IN ELECTRICAL DRIVES

Transducers - Measurement of Displacement. Resistive potentiometers, strain gauges, differential transformer, synchros, induction potentiometers, piezoelectric, optical, Digital displacement transducers, Magnetic, speed, torque, voltage, current, power, frequency, power factor and phase angle measurement. Signal Conditioning - Necessity, Instrumentation amplifiers, chopper stabilized amplifiers, Impedance converters, Noise problems, shielding and grounding, Active & Passive filters, Dynamic compensation, Linearization, Concept of A/D and D/A Converters, Sample/hold amplifiers, Microprocessor applications in signal conditioning, Data Transmission & Recording, Microprocessor Based Measurement of Electrical Quantities, Computerized Data Acquisition System.

Reference Books:

1. Measurement systems, Application and Design by Ernest O.Docbelin.
2. Electrical and electronic measurement by A.K.Shawney.
3. Fundamental of microprocessor and microcomputers by B.Ram.

ELECTIVE – I (iv)

ED-514 : EHV AC & DC TRANSMISSION

Long line theory, corona power loss and audible noise. Reactive Power compensation of EHV AC lines, FACTs devices, Sequential impedances of AC systems EHVAC transmission overvoltages, insulation design of lightning and switching over voltages. High voltage testing of AC equipments, Comparison of EHV AC & DC transmission HVDC system configuration and components conversion and inversion, Analysis of three phase bridge converter and Performance equations, Control of HVDC system, Principle of DC link control, current and Extinction angle control, Transmission power control, alternative inverter

control modes, Harmonics and AC/DC filters, Interaction responses to DC and AC system faults. Modelling of HVDC system.

Reference

1. Begemudre R.D., “EHVAC Transmission Engineering – Willy Eastern Ltd.
2. P.Kundur “Power System Stability and Control” - Mc Graw Hill Publication.
3. Arrillaga J., “HVDC Transmission” - Peter Peregrinus Pub.
4. Rao S., “EHV AC & HVDC Transmission Systems” - Khanna Pub.
5. Padiyar K.R., “HVDC Power Transmission Systems” – Willy Eastern Ltd.

ED-551 : ADVANCED POWER ELECTRONICS

Review of 1-phase and 3-phase Controlled Converters, Harmonics and Power Factor Calculations, High Power Factor Converters, DC-DC Switch Mode converter, Power Supplies, Switching Mode Inverters, Multilevel Inverter, Resonant Converters, Design and selection of components.

Reference

1. Power Electronics : Converters, Applications & Design – N. Mohan
2. Power Electronics : Circuits Devices and Application – M. H. Rashid
3. Power Electronics – Joseph Vithythal
4. Power Electronics – Philip Kranes

ED-552 : ADVANCED CONTROL SYSTEM

Basic comparators, cascade compensation in time domain and frequency domain, feedback compensation, Different types of controllers, State variables, state space representation, Transfer matrix, state model for linear continuous time systems. Eigen values, eigen vectors, Diagonalization, Solution of state equation, concept of controllability and observability. Pole placement by state feedback, Time domain, representation & transformation analysis of discrete time systems, time domain approach and z domain approach. Pulse transfer function, Controllability and observability of discrete time systems stability analysis in z plane, Different types of nonlinearities, limit cycles, singular points, Basic non linear components phase plane methods, Describing functions, popov criterion, Liapunov functions, Introduction to adaptive control system, Principle of optimality, Linear optimal regulator problem, Hamilton Jacobi equation, Riceati equation (Algebraic & differential), steady state solutions (LQR), optimal state estimation, Kalman filter, Output feedback control (LQG).

Reference Books:

1. Digital Control Engineering - M.Gopal
2. Adaptive and Optimal Control - A.P.Sage & Landue
3. Optimal Control - A.P.Sage
4. Discrete Time Control System - Katsuniko Ogata

ED-553: DSP & ITS APPLICATIONS

Architectural Overview & Central Processing Unit, Memory map, CPU Architecture of TMS320F2812, Details of CPU Registers & Accumulator, Introduction to Interrupts of TMS320F2812, Emulation Logic, CPU Interrupts Overview, CPU Interrupt Vectors and Priorities, Maskable Interrupts, Nonmaskable Interrupts, Pipeline: Pipelining of Instructions, Instruction-Fetch Mechanism, Address Counters FC, IC, and PC, Pipeline Protection, Avoiding Unprotected Operations, Addressing Modes: Types of Addressing Modes, details of various Addressing Modes, Alignment of 32-Bit Operations. Assembly Language Instructions and emulation: Instruction Set Summary (Organized by Function), Register Operations, Overview of Emulation Features, Debug Interface, Applications of DSP for Power Electronics & Drives Control

Reference

1. Reference manual from Texas Instruments
2. www.ti.com
3. Digital Signal Processing - W.D.Stanley

4. Analog & Digital Signal Processing – Ashok Ambardar
5. Digital Signal Processing – S. Mitra

ED-554: TRACTION DRIVES

Introduction to Electric Traction Systems, preliminary investigations of energy consumption, Traction Drives rating, Traction Motors, Conventional DC & AC traction drives, Semiconductor converter controlled drives, Polyphase AC motors for traction drives, Battery operated vehicles for city service, Diesel-Electric Traction systems Conservation of Electrical energy.

Reference

1. Electric Traction by A.T.Dover
2. Thyristorised Power Controllers by G.K.Dubey, Dorodla, Joshi & Sinha.
3. Modern Electric Traction by Prakash.

ED-555: ADVANCED ELECTRICAL DRIVES

Introduction to Electrical Drives: Their dynamics & control, Induction Motor Drives. Starting & braking, VSI control, CSI control, Synchronous Motor and Brushless Dc Motor Drives, Brushless dc drive, Permanent Magnet SM Drive, control fundamentals, converter configuration, synchronization, trapezoidal and sinusoidal drive control structure, performance, Switched Reluctance Motors, performance characteristics, Stepper motor and switch reluctance motor drives, solar and battery powered drives.

Reference Books :

1. Power semi conductor controlled drives by G.K.Dubey
2. Fundamentals of Electrical Drives by G.K.Dubey
3. Power electronics and variable frequency drives by B. K. Bose

ELECTIVE II (i)

ED-561: REACTIVE POWER CONTROL AND FACTS

Fundamental concepts in Reactive Power, basic theory of power transmission, long distance reactive power transfer and difficulties, system and load compensation, uncompensated and compensated transmission lines, reactive power compensation, reactive power markets and pricing mechanism, reactive power management in distribution systems, static compensators, control strategies, Principle of operation, configuration and control of SVC, STATCOM, TCSC, SSSC and UPFC

Reference Books :

1. 'Reactive Power Control in Power Systems', T J E Miller, John Wiley, 1982
2. 'Power system Stability and control, Prabha Kundur
3. 'Understanding FACTS', N G Hingorani and L Gyugyi, IEEE Press, 2000
4. 'Flexible ac Transmission Systems (FACTS)', Y.H. Song and A.T. Johns, IEE Press, 1999
5. Operation of market oriented power systems, Yong-Hua Song and Xi-Fan Wang, Springer-Verlag London

ELECTIVE II (ii)

ED-562 : MICROCOMPUTER CONTROLLED DRIVES

DC Drives- Converters, Microcontroller hardware circuit, Performance characteristics of DC drive. Chopper fed DC Drives, hardware, circuits and waveforms. Performance Characteristic of AC Drives - Description and Performance behavior of 3-phase IM drive, Microcomputer controlled inverter fed AC drive Waveforms for 1-phase, 3-phase non PWM and 3-phase PWM inverter fed induction drives, Sampling techniques for PWM inverter. Mathematical modeling of frequency controlled induction drive, mathematical model of the system for steady state and dynamic behavior, Study of stability based on the dynamic model of the system. Close loop control of microcomputer based Drives.

Reference Books:

1. Power semiconductor controlled drives, Dubey G.K., Prentice-HALL 1989.
2. Power electronics and variable frequency drives, Bose B.K., IEEE Press 1997.
3. Control of electric drives, Leonard W, Springer Verlag, NY,1985.
4. Microcomputer control of power electronics and drive, Bose B.K.
5. Adjustable AC drive, Bose B.K.
6. Thyristor control of Electronic drive, V. Subramanyam.

ELECTIVE II (iii)

ED-563 SPECIAL MACHINES

Review of adjustable speed drives, permanent magnet materials and circuits. Square-wave, Sine-wave P.M. brushless motor drives - Principle, construction, operation and drive application. P.M. & synchronous-reluctance based motors - Principle, construction, operation and drive application. Switched reluctance motors, Linear induction motors, Stepper motors - Principle, construction, operation and drive application. Energy efficient motors.

Reference

1. Power electronics control of AC machine by J.M.P. Murphy.
2. Brushless Permanent-magnet and reluctance motor Drives by T.J.E. Miller
3. Power electronics and variable frequency drives edited by B.K.Bose
4. Linear induction machine by S.A.Nasar
5. Energy efficient electric motors by J.C. Andreas.

xiv) POWER SYSTEM (M.Tech)

PS-501: POWER SYSTEM ANALYSIS

Power system components and their representation & modelling, Power System studies, Optimal load flow studies and comparison of different methods, Demand Side Load Management & Load Forecasting, Introduction of Optimal system operation, Power system management under normal & abnormal conditions, Transmission issues and Effect in the New Market Environment, State Estimation & Contingency Analysis, Power system optimization.

Reference

1. Computer Methods in Power System Analysis - Glenn W. Stagg & Ahmed H. El-Abiad
2. Computer Methods in Power System Analysis - M.A. Pai
3. Computer Aided Power System Analysis - George L.Kusic
4. Electrical Energy Systems - O. Elgard

PS-502: ADVANCED POWER SYSTEM PROTECTION

Protective Relays : Relaying review, different types of electromagnetic and static relay characteristics, operating equations and their applications, comparators, generator protection, transformer protection, bus bar protection and transmission line protection. Features of 500 KV relaying protection, Modern trends in power system protection, Microprocessor based relays, auto-reclosures and frequency relays

Reference

1. Power System Protection and Switchgear, B.Ram – Tata Mc-Graw Hill Pub.
2. Switchgear and Protection, M.V.Deshpande - Tata Mc-Graw Hill Pub.
3. Power System Protection and Switchgear, R.Ravindra Nath and M.Chander – Willy Eastern Ltd.
4. Computer Relaying for power system by Arun G. Phadke and James S.Thorp – Johns willy.

PS-503 : EVOLUTIONARY TECHNIQUES

Optimization: single objective, multi-objective and constraint problem, linear, non-linear and NP hard problem, combinatorial optimization, Conventional optimization method (λ and differential). greedy optimization technique. Simple genetic algorithm, Multi-objective genetic algorithm. Artificial neural network. Fuzzy logic. Ant colony optimization. Particle swarm optimization. Basic simulated annealing. Basic tabu search method. Bacteria forging and Fish schooling optimization. Bee flying optimization.

Reference

1. J.M.Zurada, Introduction to Artificial Neural System, Jaico Publ. House Bombay.
2. V.Rao & H.Rao, C++ Neural Networks and Fuzzy Logic, BPS, Delhi.
3. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", Prantice-Hall of India New Delhi.
4. D.E. Goldberg, Genetic Algorithm in Search Optimization and machine learning, Addition Wesley Publication Co. INC, NY

PS-504 : EHV AC & DC TRANSMISSION

Long line theory, corona power loss and audible noise. Reactive Power compensation of EHV AC lines, FACTS devices, Sequential impedances of AC systems EHVAC transmission overvoltages, insulation design of lightning and switching over voltages. High voltage testing of AC equipments, Comparison of EHV AC & DC transmission HVDC system configuration and components conversion and inversion, Analysis of three phase bridge converter and Performance equations, Control of HVDC system, Principle of DC link control, current and Extinction angle control, Transmission power control, alternative inverter control modes, Harmonics and AC/DC filters, Interaction responses to DC and AC system faults. Modelling of HVDC system.

Reference

6. Begemudre R.D., "EHVAC Transmission Engineering – Willy Eastern Ltd.
7. P.Kundur "Power System Stability and Control" - Mc Graw Hill Publication.
8. Arrillaga J., "HVDC Transmission" - Peter Peregrinus Pub.
9. Rao S., "EHV AC & HVDC Transmission Systems" - Khanna Pub.

PS-511: ECONOMICS OF REGULATION AND RESTRUCTURING OF ENERGY INDUSTRIES

Introduction to economic regulation, principles of regulation, Monopoly, competition and its Regulation, Traditional regulation, rate of return regulation, problems with rate of return regulation, restructuring options and understanding restructuring issues, Transmission Network and Wholesale Market Institutions, Retail Competition and Customer Choice, The Economics and Politics of Government Ownership, Concept of economic regulation of energy industries.

Reference Books:

1. Hunt, S. 2002, Making competition work in electricity, John Wiley & Sons;
2. Hunt, S. and G. Shuttleworth, 1996, Competition and Choice in electricity, Wiley.
3. Newbery, DMG, 2000, Privatisation, restructuring and regulation of network Utilities, MIT Press
4. Viscusi, WK, JM, Vernon and JE Harrington, 2000, Economics of Regulation and Anti-trust, W. K. Viscusi, MIT Press, 3rd edition.

Elective –I (ii)

PS-512 : MICROCOMPUTER AND IT'S APPLICATIONS

Programmable Peripheral Devices: PPI 8255, various operating modes, fixing diagram, PIT 8253, programming and modes of operation, PIC 8259, operating modes. Interfacing: Interfacing of peripherals, A/D & D/A converters, 8255, 8253, 8259 with 8/16 bit microprocessor/Data Acquisition system. Microcontroller - 8051 Architecture, Counter/Timers, Instructions, Programming, Interfacing, Applications, Comparison of 8085, 8086, 8057 etc. Programmable logic controller: PLC Architecture, programming, Counter/Timers and its applications. Applications of Microcontroller and PLC for Drives Control

Reference Books:

5. Microprocessor Architecture programming & applications – Gaonkar
6. Microprocessors & interfacing – D.V.Hall
7. The 8051 Microcontroller – K.J.Ayala
8. Introduction to programmable logic controller – Gary Dunning

Elective –I (iii)

PS-513 : COMPUTER AIDED POWER SYSTEM ANALYSIS

Digital computers in power system simulations, Electric supply industry structure under Deregulation, Regulatory and policy developments, Power system components, Transformers, Concept of graph theory, Methods of load flow solutions, Thermal power plants, Transmission losses, Electric utility Restructuring, Transmission pricing and Congestion Management in Deregulated Market, Role of FACTS devices in competitive Power Market.

Reference

1. Electrical Energy Systems Theory by O.I.Elgerd
2. Computer Methods in Power system Analysis by A.H.El.Abiad
3. Understanding FACTS concept and Technology by Hingorani N.L.
4. Power System Restructuring and Deregulation Trading Performance and n IT by L.L. Lai, John Wiley & Sons Ltd. England

Elective –I (iv)

PS-514: POWER CONTROLLER

Review of power semiconductor devices, series-parallel operation, Heat sink calculations, various firing/driving circuit, Analysis of 1- ϕ / 3- ϕ AC/DC bridge converter with and without freewheeling diode, source impedance, consideration of power factor improvement techniques, pulse width modulated converters, dual converters. Analysis & design of voltage commutated, current commutated and load commutated choppers, Detailed analysis of 1- ϕ & 3- ϕ VSI (180° mode, 150° mode & 120° mode of conduction), harmonic reduction techniques, PWM inverters, 1- ϕ and 3- ϕ CSI. Circulating current and scheme, non-circulating current operation of 1- ϕ to 1- ϕ & 3- ϕ to 3- ϕ cycloconverter. Analysis of various 1- ϕ / 3- ϕ ac-ac regulator circuit.

Reference Books:

1. Thyristorised Power Controllers - G.K.Dubey, Doradla, Joshi, Sinha
2. Power Electronics - C.W.Lander
3. Power Electronics – Rashid M.H.
4. Thyristorised power controlled converters & cycloconverters - B.R.Pelly

Elective –I (v)

PS-515 : POWER QUALITY

Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances, Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics, Radio interference, supply standards, elimination/suppression of harmonics, classical solutions & their drawbacks, passive input filters, high power factor pre-regulator, switching control circuit, transformer connections, Elimination/suppression of harmonics using active power filters – topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter, Electro-magnetic compatibility

References Books:

1. Power Quality – by R.C. Duggan
2. Power system harmonics – by A.J. Arrillaga
3. Power electronic converter harmonics – by Derek A. Paice

Elective –I (vi)

PS-516: INSTRUMENTATION

Transducers - Measurement of Displacement. Resistive potentiometers, strain gauges, differential transformer, synchros, induction potentiometers, piezoelectric, optical, Digital displacement transducers,

Magnetic, speed, torque, voltage, current, power, frequency, power factor and phase angle measurement. Signal Conditioning - Necessity, Instrumentation amplifiers, chopper stabilized amplifiers, Impedance converters, Noise problems, shielding and grounding, Active & Passive filters, Dynamic compensation, Linearization, Concept of A/D and D/A Converters, Sample/hold amplifiers, Microprocessor applications in signal conditioning, Data Transmission & Recording, Microprocessor Based Measurement of Electrical Quantities, Computerized Data Acquisition System.

Reference Books:

4. Measurement systems, Application and Design by Ernest O. Doebelin.
5. Electrical and electronic measurement by A.K. Shawney.
6. Fundamental of microprocessor and microcomputers by B. Ram.

PS-551: MODERN TRENDS IN POWER SYSTEM OPERATION

Distribution automation: Supervisory Control and Data Acquisition (SCADA), Consumer Information systems (CIS), Geographical Information Systems (GIS), Advances in online control of Power System – Application of Internet and GPS in power system control, Deregulation of Electric Utilities, new environment, Competitive electricity market, Application of Artificial Neural Networks, Fuzzy, Neuro-fuzzy, Genetic Algorithms and Experts systems in Power System Control.

Reference Books:

1. ‘Power System Restructuring and Deregulation: Trading Performance and Information Technology’ - Loi Lei Lai, John Wiley, 2001
2. ‘Proceedings of IEEE’ February 2000
3. ‘Power System Economics’ - Steven Stoft, IEEE Press, 2002

PS-552 : ADVANCED CONTROL SYSTEM

Basic comparators, cascade compensation in time domain and frequency domain, feedback compensation, Different types of controllers, State variables, state space representation, Transfer matrix, state model for linear continuous time systems. Eigen values, eigen vectors, Diagonalization, Solution of state equation, concept of controllability and observability. Pole placement by state feedback, Time domain, representation & transformation analysis of discrete time systems, time domain approach and z domain approach. Pulse transfer function, Controllability and observability of discrete time systems stability analysis in z plane, Different types of nonlinearities, limit cycles, singular points, Basic non linear components phase plane methods, Describing functions, popov criterion, Liapunov functions, Introduction to adaptive control system, Principle of optimality, Linear optimal regulator problem, Hamilton Jacobi equation, Riccati equation (Algebraic & differential), steady state solutions (LQR), optimal state estimation, Kalman filter, Output feedback control (LQG).

Reference Books:

1. Digital Control Engineering - M. Gopal
2. Adaptive and Optimal Control - A.P. Sage & Landue
3. Optimal Control - A.P. Sage
4. Discrete Time Control System - Katsuniko Ogata

PS-553: POWER SYSTEM STABILITY AND CONTROL

Power System Structure and Operating states, Governors, Excitation system, Effect of exciter and governor, Control of Power and Frequency, Control of voltage and Reactive Power, Power system stability, Dynamic and transient stability analysis of single machine and multi-machine systems, Power system stabilizer design and analysis for stability problem, Techniques for the improvement of stability

Reference Books:

1. Prabha Kundur, “Power system stability and control”, Mc-Graw Hill Inc, New York, 1993.

2. Taylor C.W., "Power System Voltage Stability", Mc-Graw Hill Inc, New York, 1993.
3. Nagrath IJ, Kothari D.P., "Power System Engineering", Tata Mc-Graw Hills, New Delhi 1994.
4. Weedy B.M. "Electric Power System" John Wiley and Sons, 3rd edition.

PS-554: MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Review: Primitive machine, voltage and torque equation, Concept of transformation change of variables & m/c variables and transform variables. Steady state and transient analysis, equation of cross field commutator m/c. Induction Machine: Analysis of 1- ϕ & 3- ϕ Induction Motor. Synchronous Machine: Detail analysis, Operational Impedances, Reactances and Time Constants. Approximate Methods for Generator & System Analysis: The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis & Applications.

Reference Books:

1. Analysis of Electric Machinery - P.C.Krause
2. The General theory of Electrical Machines - B.Adkins
3. The General theory of AC Machines - B.Adkins & R.G.Harley
4. Generalised theory of Electrical m/c - P.S.Bhimbra

PS-555: POWER SYSTEM PLANNING AND MANAGEMENT

Introduction of power planning, Electricity Regulation, Electrical Forecasting, Generation planning, Transmission and distribution planning, Power system Economics, Power supply Reliability, online power flow studies, Computer aided planning, wheeling, Environmental effects, Optimal power system expansion planning.

Reference Books :

1. Modern Power System Planning Edited by X Wang, J R McDonald, MCGraw Hill
2. Electrical Power System Planning by A.S.Pabla – Machmillan India Ltd.
3. Power System Restructuring Engineering and Economics by M. Tillic, F.Faliana and L Fink, Kulwar Academic Publisher
4. Power system Restructuring and Deregulation by L.L. Lie, John Willey & Sons UK 2001.

ELECTIVE–II (i)

PS-561: ADVANCED POWER ELECTRONICS

Review of 1-phase and 3-phase Controlled Converters, Harmonics and Power Factor Calculations, High Power Factor Converters, DC-DC Switch Mode converter, Power Supplies, Switching Mode Inverters, Multilevel Inverter, Resonant Converters, Design and selection of components.

Reference Books :

5. Power Electronics : Converters, Applications & Design – N. Mohan
6. Power Electronics : Circuits Devices and Application – M. H. Rashid
7. Power Electronics – Joseph Vithythal
8. Power Electronics – Philip Kranes

ELECTIVE–II (ii)

PS-562: POWER SYSTEM TRANSIENTS

Origin and nature of transients and surges, Current chopping in circuit breakers, Control of transients, Lightning phenomena, Travelling waves in distributed parameter multi-conductor lines, Simulation of surge diverters in transient analysis, Bergeron methods of analysis and use of EMTP and EMTDC/PSCAD package, Insulation Coordination.

Reference Books:

1. Power System Transients by Vanikov

2. Power System Transients by C. S. Indulkar and D.P. Kothari
3. Power Circuit breaker theory and design by Flurschein C.H.
4. EMTP Rulebook

ELECTIVE-II (iii)

PS-563: REACTIVE POWER CONTROL AND FACTS

Fundamental concepts in Reactive Power, basic theory of power transmission, long distance reactive power transfer and difficulties, system and load compensation, uncompensated and compensated transmission lines, reactive power compensation, reactive power markets and pricing mechanism, reactive power management in distribution systems, static compensators, control strategies, Principle of operation, configuration and control of SVC, STATCOM, TCSC, SSSC and UPFC

Reference Books :

1. 'Reactive Power Control in Power Systems', T J E Miller, John Wiley, 1982
2. 'Power system Stability and control, Prabha Kundur
3. 'Understanding FACTS', N G Hingorani and L Gyugyi, IEEE Press, 2000
4. 'Flexible ac Transmission Systems (FACTS)', Y.H. Song and A.T. Johns, IEE Press, 1999

ELECTIVE-II (iv)

PS-564: DSP & ITS APPLICATIONS

Architectural Overview & Central Processing Unit, Memory map, CPU Architecture of TMS320F2812, Details of CPU Registers & Accumulator, Introduction to Interrupts of TMS320F2812, Emulation Logic, CPU Interrupts Overview, CPU Interrupt Vectors and Priorities, Maskable Interrupts, Nonmaskable Interrupts, Pipeline: Pipelining of Instructions, Instruction-Fetch Mechanism, Address Counters FC, IC, and PC, Pipeline Protection, Avoiding Unprotected Operations, Addressing Modes: Types of Addressing Modes, Details of various Addressing Modes, Alignment of 32-Bit Operations. Assembly Language Instructions and emulation: Instruction Set Summary (Organized by Function), Register Operations, Overview of Emulation Features, Debug Interface, Applications of DSP for Power Electronics & Drives Control

Reference Books:

6. Reference manual from Texas Instruments
7. www.ti.com
8. Digital Signal Processing - W.D.Stanley
9. Analog & Digital Signal Processing – Ashok Ambardar

ELECTIVE-II (v)

PS-565 : ADVANCED ELECTRICAL DRIVES

Introduction to Electrical Drives: Their dynamics & control, Induction Motor Drives. Starting & braking, VSI control, CSI control, Synchronous Motor and Brushless Dc Motor Drives, Brushless dc drive, Permanent Magnet SM Drive, control fundamentals, converter configuration, synchronization, trapezoidal and sinusoidal drive control structure, performance, Switched Reluctance Motors, performance characteristics, Stepper motor and switch reluctance motor drives, solar and battery powered drives.

Reference Books :

4. Power semi conductor controlled drives by G.K.Dubey
5. Fundamentals of Electrical Drives by G.K.Dubey
6. Power electronics and variable frequency drives by B. K. Bose

ELECTIVE-II (vi)

PS-566 : POWER SYSTEM ECONOMICS

Deregulation in Electricity market, Transmission Pricing, Economics and reliability, concept of customer worth of supply, Regulation approaches, revenue recovery and pricing of distribution services

Reference Books:

1. Power System Economics Designing Markets for Electricity - Steven Stoft, IEEE Press, 2002
2. Fundamentals of Power System Economics the nordic electricity market av Wangensteen, Ivar
3. Power System Economics by Daniel S. Kirschen and, Goran Strbac

xv) MATERIALS SCIENCE AND TECHNOLOGY (M.Tech)

First semester

MSME-601 CONCEPT OF MATERIALS SCIENCE

Phase rule, lever rule; Binary isomorphous systems -Equilibrium solidification, non-equilibrium, Cu-Ni alloys and Zone refining; Theory of nucleation -Kinetics of homogeneous, transient and heterogeneous nucleation; Diffusion controlled growth, Interface instability and Widmanstatten growth

Solidification -Nature and growth of solid-liquid interfaces, Rapid solidification, Glass transition, metallic glasses; Precipitation and Particle Coarsening; Binary Eutectic and Peritectic Systems -solidification of eutectic, hypo-eutectic, and hyper- eutectic alloys; solidification of peritectic, hypo-peritectic, and hyper-peritectic alloys; Binary Monotectic and Syntectic Systems

Ternary phase diagrams -Gibbs triangle, isothermal and vertical sections, poly-thermal projections, two-phase equilibrium, concept of tie lines, rules for construction of tie lines, four phase equilibria; Eutectoid growth, Massive transformation; Transformation Kinetics -Johnson-Mehl equation, Avrami model, Martensitic transformation - Nature of martensitic transformations, Bain distortion, Nucleation, and growth of martensite, A thermal, isothermal and burst transformations, Thermo-elastic martensitic; Spinodal Decomposition.

MSME-603 THERMODYNAMICS AND KINETICS IN MATERIALS

Introduction, First law of thermodynamics, Heat capacity, Enthalpy and Heat of Reaction, Second law of thermodynamics, Entropy, Free energy and third law of thermodynamics, Fugacity, Activity and Equilibrium constant, Inter-relation between thermodynamic variables, Solutions and Partial molar Quantities, Phase rule and Phase Diagrams, Free energy -Temperature diagrams. Pourbaix diagrams, Thermodynamics of interfaces, Defect structures in solids, Reaction Kinetics, Reaction rate, order and rate constant, Reaction rate of Homogeneous and Heterogeneous systems, Diffusion and mass transfer concepts. Electrochemical Concepts, Activation and Concentration polarization, Tafel's equation, over potential and limiting current.

MSME- 604 MECHANICAL BEHAVIOR OF MATERIALS

Stiffness, Strength, and Toughness, Types of mechanical behavior, Relevance, Macroscopic, continuum behavior, Physical mechanisms controlling behavior, Elasticity: Introduction, Stress, strain, compliance and stiffness tensors, Physical origin of elastic moduli, Theoretical shear strength, Dislocations and Burger's vector, Elastic properties and energy of dislocations, Partial dislocation and stacking faults, Dislocation-dislocation interactions, The Peierls-Nabarro Stress, Crystallography of Slip and Independent Slip systems, Slip plane rotation, Twinning and twin geometry, Twinning in HCP crystals, Work hardening, Solid solution strengthening, Point defect-dislocation interaction energy, Yield point phenomenon, Precipitation hardening, Dislocation-precipitate interactions

Fracture: Importance of Fracture Mechanics, Griffith Fracture Theory, Crack Driving Force & Energy Release Rate, Modes of fracture, Stress intensity factors, Similitude, Role of Crack-tip Plasticity--Plastic Zone Size & Shape, K-dominance, Fracture Toughness-Micro-structural Issues,

Fatigue: Total life approaches, Fatigue design approaches, HCF and LCF, Fatigue crack inhibition, Fatigue crack growth, Paris law and models, Threshold, Damage tolerant approach, Striations, Different stages of fatigue crack growth.

Creep: Characteristics of creep curve and steady-state creep, mechanisms and creep

Second semester

MSME-651NANO MATERIALS

Definition and Classification of Nanomaterials, Fundamental Properties of various primary material classes (Metals, ceramics and Polymers), isotropic, amorphous materials, Semiconducting materials, TGA, DTA Size dependent properties and various characterization techniques of Nanomaterials, XRD, Neutron diffraction. Electron diffraction. EBSD and their applications. Principles of microscopic techniques like TEM, HRTEM, SEM, OIM, SPM etc., and their applications. Nanometer scale design and fabrication using STM and AFM. Fundamentals of EPMA, ESCA, AES, SIMS, EELS etc., and applications.

Up and bottom process, Synthesis/Consolidation routes to produce Nanomaterials, Mechano-chemical synthesis to produce nano-sized precursor powders,

Mechanical Properties, Thermal properties, Tribological Properties, Biological Properties (Biomedical applications), Applications of bulk nanomaterials, Optical Properties, Electronic and electrical properties Critical issues related to understanding properties of nanomaterials.

MSME-652ADVANCE MATERIALS PROCESSING

Fundamentals of materials processing: deformation processing, fundamentals and application of plasticity, yielding, operations specially conditioned by friction, flow instability, draw ability, anisotropy, Thermally activated processes, dynamic recovery and recrystallization, modeling of materials processing, applications of deformation processing. Processing methods involving consolidation and sintering of powders .Structural size and its importance, bulk a nano-structured materials by Severe Plastic Deformation (SPD), unique features of SPD and properties, nano-structured materials prepared by solid state processing, properties, benefits and application of nano-crystalline microstructures in structural materials

MSME-653 RESEARCH TECHNIQUES IN MATERIAL SCIENCE

Brief Revision of computer programming, Algorithm, Flow chart, type of data variable, Flow control operations, Functions pointers, and storage classes. Computation and data Analysis by use of dedicated software such as Mat lab, mathematic etc. Work sheets, Cells, Formats, Sorting Functions, Formulas, Conditional formulas, References, Charts, Regression analysis, using macros, Anova technique. Study and solve the materials related problem in different fields such as structure of materials, Thermodynamic, Deformation of materials, fracture Mechanics, Properties comparison etc., and Application of Numerical methods in Problem solving.

Computer aided Drawing and Designing: Basic Operation in Drawing Orthographic Projections, Dimensioning, scale, Plotting; Application in Casting methoding from Component Drawing to Mould and Pattern Design; Application in Dies for casting, Forging.

Department electives

MSME- 611EXPERIMENTAL TECHNIQUE IN MATERIAL SCIENCE

X-ray diffraction, basic principle and application, XRF, EPMA, SEM, TEM, EDX, AFM, IR spectroscopy, Mossbauer spectroscopy, Spectro photometry, TG-TDA-DSC, particle size analysis, surface area analysis, zeta potential measurement

MSME -612 THEORY OF ALLOYS

Structure and physical properties of elements: Alloys formation: primary solid solution, intermetallic compounds, concept of atomic size factor, normal valance compounds, electron compounds in noble metals and transition metal systems, size compounds, borides, carbides and silicides of metals: Experimental methods for the study of alloying behavior of metals

MSME -613 X-RAY DIFFRACTION AND ELECTRON MICROSCOPY

Introduction to X-rays filters. Atomic scattering factors and structure factor. Intensity calculations. Reciprocal lattice. Ewald spehre construction. Techniques for structure determination. Point groups. Space groups. Systematic absences due to symmetry elements. Wyckoff notation. Fourier series methods. Phase problem. Patterson function. Heavy atom methods. Anomalous scattering. Finite size effects. Intensity distribution in reciprocal space. Particle size determination for polycrystalline samples. Introduction to electron microscopy, electrons and their interactions with the specimen, electron diffraction. TEM-construction, contrast mechanisms and some applications. Analytical microscopy. SEM.

MSME -614 SURFACE SCIENCE AND ENGINEERING

Theory of surface reconstructions, electronic properties of surfaces, interfaces and over layers. Characterization of surfaces by photons, electrons and ions as probes. The effect of substrate surface structure on the over layer properties. Theoretical and experimental evaluation of surface energies, solid liquid and solid-gas interfaces-surface potentials, colloids, sedimentation, adsorption and reaction on surfaces. Damage of the surfaces by corrosion and wear. Wear mechanisms and categories of wear. Surface modifications by diffusion, heat treatment and by coatings, Surface Processing laser, electrons and ions.

MSME615 STRUCTURAL CHARACTERIZATION TECHNIQUES AND THEIR APPLICATION

Hierarchy in structure -nano-to macro-scale, structural defects and structural property correlations, overview of characterization need and challenges. Physical phenomena and basic concepts: Waves particle beams, radiation-matter interactions, concepts likes resolution, lens defects, depth of focus, depth of field, detection limits etc. Neutron diffraction. XRD, electron diffraction. EBSD and their applications. Principles of microscopic techniques like TEM, HRTEM, SEM, OIM, SPM etc., and their applications. Nanometer scale design and fabrication using STM and AFM. Fundamentals of EPMA, ESCA, AES, SIMS, EELS etc., and applications. Case studies: Super alloys, HSLA, FGM, device structure, structural ceramics, high Tc superconductor, CNT, polymeric L-B films.

MSME -616 COMPUTER APPLICATION IN MINERAL ENGINEERING

Mass balancing, data reconciliation, problem solving with a material balance software package: Quantitative description of mineral processing units and its computer implementations: Introduction to a general purpose modular simulator for process analysis.

MSME-617 GRAIN BOUNDARY ENGINEERING

Grain boundary structure: Geometrical aspects, Degrees of freedom, Principles governing grain shape and size their orientation. Theoretical formulations: Structural units model, Plane matching model, O Lattice model, Special boundaries, CSL and DSC Lattice. Boundary energy and equilibria, Grain Boundary types, GB mobility and boundary- solute interactions. GB structure and Properties: mechanical strength wear, creep magnetic, electrical etc. Connectivity, density junction distribution, Character distribution.

Boundary Characterization Tools: X-ray, EBSD-OIM, CTEM, AEM, HRTEM, etc. Macro texture analysis: Pole figure measurement, X-ray diffraction, neutron diffraction methods. Micro texture analysis: Automated EBSD Kikuchi pattern, Hough's transform, SEM-OIM based TEM based, Schemes for representation of Data Prospective applications: Super plasticity. Creep resistance, Corrosion Resistance, Superconductivity, Electronic ceramics etc.

MSME -618 SCIENCE AND TECHNOLOGY OF MAGNETIC MATERIALS

Magnetic units: Magnetic moments: Dia, para and pauli-para magnetism: Molecular field: Ferro, antiferro and ferrimagnetisms: Alloying effect on transition metals and intermetallics: Stability of domain structure: Origin of magnetic anisotropy and its application: Effect of inclusions, internal stress, magnetostriction and preferred orientation on magnetization: Susceptibility and coercivity calculations: Magnetic thin films-amorphous and crystalline, soft and permanent magnets: Technological aspects of magnetic materials

MSME -619 OPTO-ELECTRONIC AND DEVICES

Optical properties of semiconductors: absorption & emission processes; Kramers-Kronig and Van Roosbroeck-Shockley relations; Radiative & non-radiative transitions, Photoluminescence and UV-VIS-NIR Spectroscopy. Photo conducting and non-photo conducting materials. Growth of III-V, II-VI and IV-VI semiconductors and nanostructures for optoelectronic applications--- MOVPE and MBE technology. Photo-detectors: photo conducting, photovoltaic, PIN, APD, gain band width criteria. Optical emission from semiconductors: LED physics and technology, conditions for laser action, DH, DFB & DBR lasers. Quantum Confinement: 2-D, 1-D and 0-D systems, Quantum well and quantum dot lasers, Quantum Cascade Laser (QCL), Quantum Well Infrared Photo detectors (QWIP). IR focal plane arrays and remote sensing. Solar cell: Device physics, p-n junction, polycrystalline and amorphous Si, CdS/CdTe, CIGS, Ge/GaAs/InGaP tandem structure, multi-Exciton generation, quantum dot solar cell, anti-reflection coating. Organic optoelectronic materials and devices

MSME-620 ADVANCED PHYSICAL AND MECHANICAL METALLURGY

Microstructure & Properties: solidification and solidification structures, interfaces, crystallographic texture, Residual stress, structure-property relations. Plasticity and work hardening: fundamentals, stress-strain behavior, fracture, creep & deformation mechanisms. Recovery, recrystallization, grain growth. Phase transformation: thermodynamic basics, nucleation and growth, spinodal decomposition, martensitic transformations

MSME-621 PLASTIC DEFORMATION AND MICROSTRUCTURE EVOLUTION

Molecular theory of deformation kinetics. Rate theory of plastic deformation. Micro-mechanistic approach for deformation behavior of single crystals and polycrystals. Low temperature deformation of metals and other crystalline solids. Dynamic strain ageing, creep, internal stress. Deformation of intermetallic compounds. Substructural evolution at large strains. Recovery, recrystallization and grain growth during high temperature deformation. Formation of cell boundaries, slip in a cell structure and composite model of time dependent flow

MSME-622 ENGINEERING APPLICATION OF DISLOCATION IN MATERIALS

Introduction to dislocation, disclinations, dispirations: Isotropic and anisotropic stress fields and energies of dislocations: Stability of dislocation in crystal structure: Interaction between dislocations, impurities, micro particles and related topics in deformation and relation of properties to microstructure

MSME-623 DIFFUSION IN SOLIDS

Diffusion equations and mathematical solutions: Phenomenological diffusion theories: Atomic theory of diffusion, theoretical and experimental investigation of diffusion phenomena: Diffusion in ionic solids and semiconductors: Grain boundary and surface diffusion, thermal and electro-diffusion

MSME-624 ORDER-DISORDER TRANSFORMATION

Occurrence of different types of ordering in metals and alloys, property changes due to ordering, statistical theory of ordering: Bragg-Williams and Bather theories of LRO and SRO, thermodynamics of order-disorder transformation, detection of order by X-ray, electron and neutron diffraction, anti-phase domains, long periods super lattices, kinetics of order-disorder transformation

MSME-625 ADVANCED MATERIALS

Conducting Polymers and organic materials: conduction in organic materials, doping effects and copolymerization, superconducting materials (metallic ceramic and inorganic polymer), Fullerenes and carbon based materials.

Composite and Biomaterials: Classification of composite materials, particulate composite, and dispersion strengthened composite and fiber composite, application of composite materials, Bio-functionality and Bio-compatibility.

Advanced Optical and Magnetic materials: Optical materials like fiber, application. Classification of magnetic materials, Magnetic domain and anisotropic effects, , magnetic memories and multilayered Smart material: Use of advanced materials in electrical, magnetic, structural, space automotive application etc. Processing of advanced materials. Shape memory alloy. Sensor,

Nanostructured Materials: Characterization Fabrication and application

MSME -661 MICRO STRUCTURAL EVOLUTION IN MATERIALS

Microstructures, defects, and structural evolution in all classes of materials. Solution kinetics, interface stability, dislocations and point defects, diffusion, surface energetic, grains and grain boundaries, grain growth, nucleation and precipitation, and electrochemical reactions. examples and applications based on metals, ceramics, electronic materials, polymers, and biomedical materials. Evolution of microstructure through experiments involving optical and electron microscopy, calorimetry, electrochemical characterization, surface roughness measurements, and other characterization methods. Structural transitions and structure-property relationships through practical materials examples

MSME -662 PHYSICAL METALLURGY , PROCESSING AND APPLICATIONS OF REFRACTORY METALS AND ALLOYS

Characteristics of Pure Refractory Metals- crystal structure, recrystallization behavior, Physical, chemical, mechanical and thermal properties of refractory metals; Mechanism of Deformation and Strengthening in Refractory Metals- solid-solution strengthening, dynamic strain aging, effect of dispersed second phases, thermomechanical treatment, grain size and grain-shape strengthening; Solidification processing, mechanical treatment, powder processing of refractory metals and alloys; Structure and Properties of Refractory Alloys- substitutional alloy, doped W and Mo, dispersion-strengthening alloys, tungsten heavy alloys, composites reinforced with refractory metal-fibers, refractory-metal cermets, amorphous refractory alloys; Application of Refractory Metals & Alloys:

MSME -663 NON-EQUILIBRIUM PROCESSING OF MATERIALS

Introduction to non-equilibrium processing Thermodynamics and kinetics of metastable phase formation; Rapid solidification: Under cooling. Phase diagram metastable states, Methods of rapid solidification, Microstructure formation by rapid solidification, Application for rapid solidification ; Mechanical

alloying: Process of mechanical alloying, Mechanism of alloying Energy criteria for mechanical alloying, Synthesis of non-equilibrium phases, Application of mechanical alloying, Metallic glass : Understanding of glass formation, thermal stability and glass forming ability

MSME -664 PARTICULATE MATERIALS

The particular state: attributes and morphology of particles: Distribution of particles in a single attribute: expectation as a measure of global properties of particular ensembles, Analysis of static and dynamic particulate systems by transformation in attributes and measures, Production of particles by mechanical and thermo-chemical means, Particulates in suspension, stability, Rheology and settling, Size analysis, Particles in natural phenomena and man- made processes

MSME -665 SOLID STATE TRANSFORMATIONS

Classification of transformation based on thermodynamics, mechanism and kinetics: Homogeneous transformation: Nucleation and growth phenomena: Spinodal decomposition: Crystallographic features of transformation.

MSME -666 WELDING SCIENCE AND TECHNOLOGY

Overview of welding processes, study of welding arc characteristics, metal transfer during arc welding, heat flow during welding, gas-metal and slag-metal reactions, weld pool solidification, effect of welding process parameters on the macro- and micro-structure of weld metal. Thermal cycles in the heat affected zone. Phase transformations in the weld metal and the heat affected zone. High power density processes such as laser and electron beam welding. Welding metallurgy under high cooling rates. Phenomena of hot-cracking and cold cracking. Residual stresses and distortion during and after welding. Application of above principles to welding of carbon and alloy steels, cast irons, stainless steels, aluminium and titanium alloys. Fatigue and fracture of weldments.

MSME -667 THIN FILMS

Surface science; experimental techniques to study surfaces; kinetics of surface processes -impingement of atoms, scattering, adsorption, sticking coefficient; Film nucleation and growth mechanisms, critical radius of nuclei, computer simulation of film growth, microstructure evolution; Film growth by evaporation, sputtering, chemical vapor deposition, atomic layer epitaxy, liquid phase epitaxy, sol-gel technique etc, Electrical, optical, magnetic and mechanical properties of thin films and their applications.

MSME -668 ADVANCED CHEMICAL METALLURGY

Structure, physical properties and thermodynamics of solutions: Ternary and multicomponent systems: High temperature physico-chemical measurements: Heterogeneous reaction equilibria at high temperatures: Stabilities of high temperature materials: Special topics: Theory of reaction rates and applications

MSME -669 MECHANICAL BEHAVIOR OF THIN FILMS

Elasticity basics: Stress and strain tensors, tensor transformations, Mohr's circle representation of stress and strain, constitutive equations. Origin of stresses in thin films: thermoelastic mismatch between film and substrate, lattice mismatch in heteroepitaxial films, recrystallization, phase transformation, incorporation of atoms and chemical reactions. Application of the above for designing structures with low stresses. Experimental techniques for measuring stresses/strains in thin films: Substrate curvature; Stoney's equation, methods for curvature measurement and X-ray diffraction

MSME -670 SOLIDIFICATION PROCESSING

Introduction to solidification, rapid solidification, Methods of rapid solidification, rapid quenching, bulk under cooling, Structure and properties of liquid, kinetics of liquid state, Nucleation-basic concept, steady state nucleation, Under cooled liquid properties, thermodynamics, kinetic parameters. Crystal Growth, growth equation, growth under rapid solidification, pure elements and dilute alloys (collision limited growth), microstructural modification, absolute stability, microstructural modification, absolute stability, solute trapping, eutectic solidification, peritectic solidification, Metastable phase diagrams, construction of principles, Metallic glasses or amorphous materials, criteria for glass formation, TTT and CCT curves for glass formation, Overview applications.

MSME -671 TRIBIOLOGY OF MATERIALS

Background and importance of Tri-biology; A system approach to Tri-biology; Characterization of tribo-surfaces; mechanics of solid contacts; theory of friction and frictional heat generation; role of contact temperature; Different modes of wear; Tri-biological testing techniques and analysis of the worn surfaces; Lubrication; Importance and properties of lubricants; Different wear resistant materials; Recent research results illustrating the performance of surface coatings, bulk materials and composite materials in tri-biological contacts.

MSME -672 ADVANCED STRUCTURAL CERAMIC

Fundamentals of Material Properties and the importance of Ceramic materials; Glass and glass-ceramic; Processing and properties of different ceramic monoliths- Fundamental Sintering mechanisms, various advanced sintering techniques (e.g. Hot Isostatic Pressing, Spark Plasma Sintering, Microwave sintering) Mechanical behavior of Structural ceramics-Brittleness of ceramics, Concept of fracture toughness and different toughness measurement techniques, Elastic modulus, Strength measurement and Weibull theory of strength variability, Concept of various toughening mechanisms.

Processing and Properties of ceramic composites- Examples of toughened particle reinforced composites, Whisker reinforced composites, and Fiber reinforced composites

MSME -673 CORROSION AND ITS PREVENTION

Advanced theory of electro-chemical kinetics and corrosion, theory of electro deposition and allied processes, stress corrosion behavior of materials (important- metals, alloys etc.) in various environments, corrosion testing: Metal-gas reaction at high temperatures, corrosion by liquid metals. Polymer degradation

Introduction experimental techniques: Oxide and defect structure: Thermodynamics, Ellingham diagrams, vapor species diagrams, isothermal stability diagrams: kinetics, rate laws, Wagner's theory of parabolic rate laws, mechanism of oxidation: Oxidation of pure metals, multiple scale formation, scale cracking, oxygen dissolution: Oxidation of alloys, internal oxidation, catastrophic oxidation, stresses in oxides: Hot corrosion, acid fluxing, basic, fluxing, High temperature materials, super alloys, intermetallics: Protection against oxidation, coatings, atmospheric control

MSME -674 STRUCTURAL MATERIALS FOR AEROSPACE APPLICATIONS

Design of gas turbine aero-engines: Creep, fatigue and corrosion as limiting factors for high-temperature application of materials: Development of Ni and Co based super alloys, special steels, Ti alloys, intermetallics, ceramics and their composites, New high strength-high modulus materials, ablative materials.

MSME -675 COMPUTATIONAL MATERIAL SCIENCE

Fundamentals of atomic level modeling of the structure and properties of materials. Specifically it will cover metals, semiconductors, oxides and other ionic crystals. Basics of the density functional theory and approximations in terms of pair potentials, embedded atom method and tight-binding. Programming and

data structure. The methods of computer modeling including molecular statics, molecular dynamics, Monte Carlo and lattice dynamics (phonons). Interpretations of results of such modeling in terms of structures, for example using the radial distribution function, thermodynamic and statistical physics analyses

MSME -676 COMPUTATIONAL METHODS FOR METAL FORMING ANALYSIS

Description of generalized stress / strain behaviour. Principal quantities; Mohrs circle; Elastic vs. plastic deformation. Theories of yielding; Analysis of metal forming processes by ideal work, upper bound and slab methods. Analytical modeling approach for simulating axi-symmetric deep drawing process. Concept of formability and forming limit strains. Applications of computational methods for metal forming analysis. Application of FE based programs for metal forming analysis. Experimental measurements of loads and strains during tensile and formability testing of variety of materials (low carbon steel, aluminum and stainless steel). Development of a computation model for tensile test simulation and its validation. Simulation of tensile and metal forming tests using computational programs based on finite element methods. Comparison of computed results with the experimentally measured data. Simulation and validation of industrial metal formed components.

MSME- 677 ELECTRONIC AND MAGNETIC PROPERTIES OF CERAMIC MATERIALS

Structure of oxides: Ionic diffusion in oxides: Defect structure of non-stoichiometric compounds: Conductivity dependence on partial pressure of oxygen: Macroscopic characterization of dielectric materials: Electronic, atomic dipole, space charge polarization: Relaxation phenomenon-Debye equations: Ferroelectrics: Diamagnetism, paramagnetism and ferromagnetism, exchange ferromagnetic domain: Structure and properties of ferrites

MSME- 674 MAGNETISM AND MAGNETIC MATERIALS

Magnetic order, Weiss molecular field, magnetism in metals and insulators, exchange and superexchange, magnetic anisotropy and magnetostriction, domain and domain walls, magnetic hysteresis and superparamagnetism. Soft and hard magnetic oxides (spinel, garnet, hexaferrite and perovskite), structure properties relations, soft and hard magnetic alloys and their properties, dc, low frequency, RF, microwave and recording applications of oxides and alloys, colossal magnetoresistance, and unconventional applications. Synthesis of single crystal, polycrystalline, nano size and amorphous magnetic materials, specific characterisation techniques for magnetic materials

MSME-675 MULTIFUNCTIONAL OXIDES: THIN FILMS AND DEVICES

Fundamentals of oxides: crystal structure, defect chemistry, and properties; focus on various material systems methods of fabrication e.g. solid state chemistry. Oxide thin films. polycrystalline versus epitaxial, main film deposition techniques: physical vapor and chemical deposition methods, PVD techniques: sputtering (fundamentals of glow discharge processes and film deposition RF and DC magnetron sputtering new approaches), laser ablation (basic science, applications, various approaches), science and technology of evaporation and molecular beam Epitaxy (MBE) Chemical processes basic and technological issues of sol-gel chemical vapor deposition atomic layer deposition; PVD visa- vis chemical processes; issues related to Epitaxy and case studies. Characterization methods

MSME-676 ANALYSIS OF PARTICULATE SYSTEM

Characterization and statistics of small particles: Distribution in single and multiple particles attributes: Transformation of attributes: Statistical, empirical, and series distribution and their statistical properties: Evolution of particulate spectra in size reduction, agglomeration, coagulation, crystal and grain growth, floatation, etc.: Moments, similarity and approximate methods for the solution to the particle population equation.

MSME-67 Powder Metallurgy

Basic powder metallurgy processing, advances in metal powder production, powder characterization, modern powder compaction methods, cold isostatic pressing, powder injection moulding, powder rolling, and sintering behavior of ferrous and non-ferrous materials, case studies, microwave sintering of materials

MSME-678 Noncrystalline Materials

Network structure of various oxide glasses, Stevel's parameters and kinetic criterion of glass formation. Role of oxides in glass composition. Melting, refining and forming of oxide glasses. Viscoelastic behavior and mechanical properties. Thermal, dielectric and optical properties of glasses. Colored and photosensitive glasses; glass fibre technology. Glass-ceramics and glasses for electronic applications. Preparation of metallic glasses by rapid solidification. Synthesis of amorphous alloys by mechanical alloying. Properties and applications of amorphous alloys. Microcrystalline and nanocrystalline materials.

MSME-679 Materials and Processes for Semiconductor Devices

Elemental and compound semiconductor materials, structural, electronic and optical properties. Theory of basic processing techniques: crystal growth, diffusion, oxidation, ion implantation, rapid thermal processing, epitaxy, chemical vapor deposition, physical vapor deposition, metallization, the physics and chemistry of nonequilibrium plasmas and plasma etching. The interrelationship between material properties, fabrication techniques and device performance

MSME-678 Superconductivity, Materials and Applications

Introduction to superconductivity, Meissner effect, Type-I and type-II superconductors, Correlation between TC, JC and BC. Basic concepts, Coherence length and penetration depth. Alloy and high TC oxide superconductors. Mono- and multi-layered cuprates. Structure, processing, properties and applications. Organic superconductors. Superconducting magnets. Josephson junctions. SQUID. Magnetic levitation.

MSME-679 Transport Phenomena

Review of fundamentals in fluid flow, heat transfer and mass transfer. Introduction to turbulent flow phenomena. Heat transfer with phase change. A few detailed examples of transport phenomena applications to materials processing

MSME-680 Polymer Blends & Composites

Background & perspective: Terminology, miscibility through specific interactions, phase equilibria & transitions, phase morphology. Polymer-polymer compatibility: Phase separation behavior of polymer-polymer mixtures: Solid state transition behavior of blends: Criteria for miscibility, solid state transition behavior of polymer blends. Rheology of polymer blends: Flow behavior of viscoelastic fluids. Rubber modifications of plastics: Background, methods of preparation, properties. Mechanical properties of multiphase polymer blends: Background, modulus-composition dependence, temperature dependence of modulus. Types of reinforcing materials: Fibers, whiskers & particles, methods of preparation & properties, nano-materials & their structures. Particulate composites: Processing, structure & properties.

MSME-681 Physico-chemical behaviors of materials at high temperature

Salient features of physico-chemical behavior of inorganic materials at high temperatures including interaction with environment, gas composition and pressure dependent phase stability diagrams for non-metallic and metal-nonmetal systems. Nonstoichiometry and defect equilibrium in oxides: Structure and physicochemical measurements at high temperatures: Vapour and plasma states: Reaction kinetics at high temperatures with specific emphasis on reactivity of solids

MSME-68 Interfacial Phenomena in metals and alloys

Phenomenology of solid surface free energy, Equilibrium shape: Wulff theorem: Gibb's adsorption isotherm, inter phase-interfaces in heterogeneous systems: Grain and twin boundary equilibria and multiphase equilibria: Determination of surface free energy: Temperature coefficients, interfaces fracture, interface embrittlement, grain boundary migration and sliding, sintering mechanism, solid liquid transition, nucleation and growth.

MSME-68 Texture in Metals and alloys

Concepts of texture: Pole figure, inverse pole figure, inverse pole figure and O.D.F. methods: Experimental techniques in texture analysis-Schultz reflection, transmission, offset quadrant, spherical specimen and neutron diffraction methods: Specimen preparation for texture measurements: Random samples and normalizing procedures: Origin and development of textures on mechanical, physical and magnetic properties: Industrial texture control

MSME-684 Material For Biomedical application

Introduction to basic concepts of Materials Science; Salient properties of important material classes; Property requirement of biomaterials; Concept of biocompatibility; cell-material interactions and foreign body response; assessment of biocompatibility of biomaterials, important biometallic alloys; Ti-based, stainless steels, Co-Cr-Mo alloys; Bioinert, Bioactive and bioresorbable ceramics; Processing and properties of different bioceramic materials with emphasize on hydroxyapatite; synthesis of biocompatible coatings on structural impant materials;

MSME-685 Nuclear Materials

Nuclear radiation, microscopic flux and microscopic cross-section, attenuation of radiation fission, elastic collision slowing down infinite multiplication constant: Fuel and breeder materials manufacture and properties: Structural materials: Radiation damage in fuel elements: Structural coolant and control rod materials: Nuclear power; present and future states

MSME-686 Multifunctional oxides : Thin Films and Devices

Fundamentals of oxides: crystal structure, defect chemistry, and properties; focus on various material systems methods of fabrication e.g. solid state chemistry. Oxide thin films. polycrystalline versus epitaxial, main film deposition techniques: physical vapor and chemical deposition methods, PVD techniques: sputtering (fundamentals of glow discharge processes and film deposition RF and DC magnetron sputtering new approaches), laser ablation (basic science, applications, various approaches), science and technology of evaporation and molecular beam epitaxy (MBE) Chemical processes basic and technological issues of sol-gel chemical vapor deposition atomic layer deposition; PVD visa- vis chemical processes; issues related to epitaxy and case studies. Characterization methods : Structural techniques- uses of X- ray diffraction, atomic force microscopy scanning and transmission electron microscopy, spectroscopic methods

SOFT TECHNOLOGY DIVISION

16 DEPARTMENT OF CHEMICAL ENGINEERING

xvi)DESIGN OF PROCESS PLANTS

CH-501 OPTIMIZATION TECHNIQUES IN CHEMICAL ENGINEERING

INTRODUCTION: Maximization and minimization problems- examples. Basic concept of optimization – Convex and concave functions, Necessary and sufficient conditions for stationary points. Degree of freedom.

FORMULATION: Economic objective function. Formulation of various process optimization problems and their classification.

OPTIMIZATION OF UNCONSTRAINED AND CONSTRAINED SEARCH: Optimization of one dimensional function, unconstrained multivariable optimization direct search methods. Indirect first order and second order methods, constrained multivariable optimization - necessary and sufficient conditions for constrained optimum.

LINEAR PROGRAMMING AND APPLICATIONS: Geometry of linear programs, Simplex Algorithm its applications.

NON- LINEAR PROGRAMMING WITH CONSTRAINED AND ITS APPLICATIONS: Quadratic programming, Generalized reduced gradients methods, Successive linear and successive quadratic programming, Dynamic programming, Integer and mixed integer programming.

APPLICATION OF OPTIMIZATION IN CHEMICAL ENGINEERING: Optimization of staged and discrete processes, Optimal shell-tube heat exchanger design, Optimal pipe diameter, Optimal design of an Ammonia reactor.

NONTRADITIONAL OPTIMIZATION TECHNIQUES: Introduction and application areas.

References

1. Edger T. F. and Himmelblau D. M., "Optimization of Chemical Process", McGraw-Hill, New York, 2001.
2. Beveridge G. S. and Schechter R. S., "Optimization Theory and Practice", McGraw-Hill, New York, 1970.
3. Reklaities F. V., Ravindan A. and Ragsdell K. M., "Engineering Optimization Methods and Applications", John Willy, New York, 1983.
4. Rao S., "Engineering Optimization", New Age International, New Delhi, 1996.

CH-502 ADVANCED TRANSPORT PHENOMENA

Summary of vector and tensor Notation: Vector operations from a geometrical view point. Vector operation from an analytical view point, the vector differential operations, second order tensors, vector and tensor components in curvilinear coordinates, differential operations in curvilinear coordinates.

Momentum Transport: Viscosity and the mechanism of momentum transport, Newton's law of viscosity

Energy Transport: Thermal Conductivity and the Mechanism of Energy Transport: Fourier's Law of heat conduction

Mass Transport: Definition of concentrations, velocities and mass fluxes, fick's law of diffusion, theory of ordinary diffusion in gases at low density, theory of ordinary diffusion in liquids. **Turbulence**

Phenomena: Basic theory of turbulence, time averaging, intensity and correlation coefficients, isotropic turbulence. Equations of continuity, motion and energy for turbulent condition. Reynolds stresses.

Phenomenological theories of turbulence, velocity profile in circular conduits. **Convective Transport:**

Free and forced convective heat transfer and mass transfer, interphase mass transport, mass transfer coefficients-individual and overall, mass transfer theories-film, penetration and surface renewal.

Macroscopic studies: momentum and heat balance equation, Kinetics energy calculation. Constant area and variable area flow problems. Flow through bends. Time determination for emptying of vessels.

References

1. Bird R B, Stewart W E and Light fort R N, "Transport Phenomena", John Wiley and Sons (2002).
2. Welty J R, Wilson R E and Wicks C E, "Fundamentals of Momentum, Heat and Mass Transfer", 4th ed, John Wiley and Sons (2001).
3. John C Slattery, "Momentum, Energy and Mass transfer in continua", McGraw Hill, Co. (1972).

CH-503 HETEROGENEOUS CATALYSIS AND REACTOR DESIGN

Solid Catalyst: Role of catalyst components and other constituents, characterization of catalyst and its support. **Heterogeneous Catalysis:** Mechanism and kinetic models of surface reactions, determination of kinetics parameters through experiments, analysis of complex reactions, synthesis of kinetic structure. External and Internal Transport Processes: Effect of heat and mass transfer, internal effectiveness factor, generalized effectiveness factor, point effectiveness, multiple reactions, transport criteria. Deactivation of Catalyst: Physical deactivation, surface diffusion. Sintering-mechanism and kinetics, chemical deactivation-types and kinetics, regeneration of catalyst. Selectivity and Stability: Effect of transport processes and deactivation on selectivity and stability of a single pellet Multiphase Reactions: Mass transfer coefficients, effect of transport and global rates. Design of Catalytic Reactors: Design and analysis of fixed bed reactors, autothermic operation and stability, fluidized bed reactors, two phase and multiphase models. Introduction to slurry reactors and trickle-bed reactors.

Books Recommended

1. Lee H. H., "Heterogeneous Reactor Design", Butterworth Heinman.1985
2. Carberry J. J. and Verma A., "Chemical Reaction and Reactor Engineering", CRC.1987
3. Doraiswamy L. K. and Sharma M.M., "Heterogeneous Reactions", Vol. 1 and 2, Wiley.1984
4. Ramchandran P. A. and Chaudhari R. V., "Three – Phase Catalytic Reactors", Gordon and Breach.1983
5. Froment G. F. and Bischoff K. V., "Chemical Reactor Analysis and Design", 2nd Ed., Wiley.1990
6. Jakobsen H. A., "Chemical Reactor modeling: Multiphase Reactive Flows", Springer.2008

CH-511POLYMER SCIENCE AND ENGINEERING

Chemistry of Polymerisation Reaction: Functionality, polymerization reactions, polycondensation, addition free radical and chain polymerization, copolymerization, block and graft polymerizations, stereo specific polymerization.

Polymerisation Kinetics: Kinetics of radial, chain and ionic polymerization and co-polymerisation systems.

Molecular Weight Estimation: Average molecular weight, number average and weight average, theoretical distributions, methods for the estimation of molecular weight

Polymerisation Processes: Bulk, solution, emulsion and suspension polymerization. Thermoplastic composites, fibre reinforcement fillers, surface treatment, reinforced thermoset composites-resins, fibers additives, fabrication methods.

Rheology: Simple rheological equations, simple linear viscoelastic models-Maxwell, Voigt; materials response time, temperature dependence of viscosity.

Books Recommended

1. Kumar A. and Gupta R., "Fundamentals of Polymer Engineering", CRC.2003
2. Billmayer Jr., F. W., "Textbook of Polymer Science", 3rd Ed., John Wiley .1984
3. Fried J., "Fundamentals of Polymer Science", Prentice Hall.2004.

CH-512 NANO TECHNOLOGY

Supramolecular Chemistry: Definition and examples of the main intermolecular forces used in supramolecular chemistry. Self-assembly processes in organic systems. Main supramolecular structures.

Physical Chemistry of Nanomaterials: Students will be exposed to the very basics of nanomaterials; a series of nanomaterials that exhibit unique properties will be introduced.

Methods of Synthesis of Nanomaterials. Equipment and processes needed to fabricate nano devices and structures such as bio-chips, power devices, and opto-electronic structures. Bottom-up (building from molecular level) and top-down (breakdown of microcrystalline materials) approaches.

Biologically-Inspired nanotechnology basic biological concepts and principles that may lead to the development of technologies for nano engineering systems. Coverage will be given to how life has evolved sophisticatedly; molecular nanoscale engineered devices, and discuss how these nanoscale biotechnologies are far more elaborate in their functions than most products made by humans.

Instrumentation for nanoscale characterization. Instrumentation required for characterization of properties on the nanometer scale. The measurable properties and resolution limits of each technique, with an emphasis on measurements in the nanometer range.

Books Recommended

1. Supramolecular Chemistry by Jean-Marie Lehn, Wiley VCH, 1995
2. Supramolecular Chemistry by Jonathan Steed & Jerry Atwood, John Wiley & Sons, 2004
3. Intermolecular and Surface Forces by Jacob Israelachvil, Academic Press, London, 1992.

CH-513 BIOPROCESS TECHNOLOGY

Introduction: Fermentation processes general requirements of fermentation processes – An overview of aerobic and anaerobic fermentation processes and their application in industry - Medium requirements for fermentation processes - examples of simple and complex media Design and usage of commercial media for industrial fermentation. Sterilization: Thermal death kinetics of micro-organisms - Batch and Continuous Heat-Sterilization of liquid Media - Filter Sterilization of Liquid Media and Air.

Enzyme technology, Enzymes: Classification and properties -Applied enzyme catalysis - Kinetics of enzyme catalytic reactions - Microbial metabolism - Metabolic pathways – Protein synthesis in cells.

Stoichiometry and Kinetics of substrate utilization and Biomass and product formation: Stoichiometry of microbial growth, Substrate utilization and product formation-Batch and Continuous culture, Fed batch culture Recovery and purification of products.

Bioreactor and product recovery operations: Operating considerations for bioreactors for suspension and immobilized cultures, Selection, scale-up, operation of bioreactors – Mass transfer in heterogeneous biochemical reaction systems; Oxygen transfer in submerged fermentation processes; oxygen uptake rates and determination of oxygen transfer rates and coefficients; role of aeration and agitation in oxygen transfer. Heat transfer processes in biological systems.

Introduction to Instrumentation and Process Control in Bioprocesses: Measurement of physical and chemical parameters in bioreactors - Monitoring and control of dissolved oxygen, pH, impeller speed and temperature in a stirred tank fermenter.

Books Recommended

1. M. L. Shuler and F. Kargi, " Bio-process engineering", 2nd Edition, Prentice Hall of India, New Delhi. 2002.
2. J. E. Bailey and D. F. Ollis, " Biochemical Engineering Fundamentals", 2nd Ed., McGraw-Hill PublishingCo. New York. 1986.
3. P. Stanbury, A. Whitakar and S. J. Hall, "Principles of Fermentation Technology" 2nd Ed., Elsevier-Pergamon Press, 1999.

CH-514 Pinch Technology

Pinch Location: Locating the pinch, significance of pinch, pinch in grid representation, Threshold problems, capital cost implication of the pinch.

Targeting: Heat exchanger networks, energy targeting, area targeting, unit targeting, shell targeting, cost targeting, super targeting, continuous targeting.

Pinch Methodology: Problem representation, temperature enthalpy diagram, simple match matrix. Heat content diagram, Temperature interval diagram, Heuristic approach & PDM, weighted flow rate specific heat method ((WFCPM), Tree searching.

Pinch Design and Optimization: Networks for maximum energy recovery, Pinch design method, Flexibility criteria of the pinch, cp table, the tick of heuristic, case studies, optimization of heat exchanger network optimality for a minimum area network, Sensitivity analysis.

Energy and Resource Analysis of various processes and Mass Exchange Network: Batch process, flexible process, distillation process, evaporation process, reaction process, process using mass separating agent. Heat pipes and Heat pumps, MEN Network, Waste minimization by using mass separating agents.

Books Recommended

1. V. Uday Shenoy "Heat Exchanger network synthesis" Gulf Publishing Co, USA, 1995
2. D.W. Linnhoff et al., "User Guide on Process Integration for the efficient use of Energy", Institution of Chemical Engineers, U.K., 1994.
3. James M. Douglas "Conceptual Design of Chemical Process", McGraw Hill, New York, 1988.
4. Anil Kumar, "Chemical Process Synthesis and Engineering Design", Tata McGraw Hill New Delhi, 1977.

CH-515 ADVANCED FLUID DYNAMICS

Properties of fluids and multiphase flow, fluids and fluid properties, Kinematics: Motion, streamlines, pathlines and streaklines, Newtonian, non-Newtonian and non-viscous fluids, Continuity equation in Cartesian, cylindrical and spherical coordinates, Derivation of general momentum equation for Newtonian fluids in Cartesian coordinates, Eulers equation, principles of rotational and irrotational flow, velocity potential, Bernoulli's equation, Laplace equations, stream function, vorticity, Cauchy –Rieman equation, Analytical solutions for simple two dimensional incompressible, irrotational fluid flows: flow along two inclined plates, point source or sink in an infinite fluid. Stokes law of viscosity, Navier-stokes equation, creeping flow around a solid sphere, expression for total drag, Turbulent flow: Transition to turbulence, Prandtl's mixing length, Turbulence models. Boundary layer on immersed bodies, two dimensional boundary layer equation, laminar boundary layer on flat plate (Blasius' exact solution), Von-Karman's integral momentum equation, boundary layer separation flow and pressure drag, Flow of compressible fluids, thermodynamic considerations, continuity and momentum equation for one dimensional compressible flow, one dimensional normal shock, flow through fluidized beds. Navier-Stokes equation and various approaches of simulation (stream velocity, primitive variable).

Books Recommended

1. R.W. Fox, A.T. Mc Donald, P.J. Pritchard, Introduction to Fluid Mechanics, Willey, 6th edition.
2. J.G. Knudsen and D.L. Katz, Fluid Dynamics and Heat Transfer, McGraw Hill, New York, 1958.
3. R.B. Bird, W.E. Stewart, and E.N. Lightfoot, Transport Phenomena, Second edition, John Wiley and Sons, 2002.

CH-516 BIOENERGY ENGINEERING

Biomass Sources, Characteristics & Preparation: Biomass Sources and Classification. -Chemical composition and properties of different biomass materials and bio-fuels – Sugar cane molasses and other sources for fermentation ethanol-Sources and processing of oils and fats for liquid fuels- Energy

plantations -Preparation of woody biomass: Size reduction, Briquetting of loose biomass, Drying, Storage and Handling of Biomass.

Biogas, Technology: Feedstock for biogas production, Aqueous wastes containing biodegradable organic matter, animal residues. Microbial and biochemical aspects- Operating parameters for biogas production. Kinetics and mechanism - Dry and wet fermentation.

Digesters for rural application - High rate digesters for industrial waste water treatment. Bio-Ethanol and Bio-Diesel Technology: Production of Fuel Ethanol by Fermentation of Sugars. Gasohol as a Substitute for Leaded Petrol. - Trans-Esterification of Oils to Produce Bio-Diesel.

Pyrolysis and Gasification of Biomass: Thermo-chemical conversion of ligno-cellulose biomass - Biomass processing for liquid fuel production - Pyrolysis of biomass – Pyrolysis regime, effect of particle size, temperature, and products obtained. Thermo-chemical gasification principles: Effect of pressure, temperature and of introducing steam and oxygen.

Design and operation of Fixed and Fluidized Bed Gasifiers. Combustion of Biomass and Cogeneration Systems: Combustion of Woody Biomass: Theory, Calculations and Design of Equipments. Cogeneration in Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration.

Books Recommended

1. Chakraverthy A, "Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes", Oxford & IBH publishing Co, 1989.
2. D. Yogi Goswami, Frank Kreith, Jan. F .Kreider, "Principles of Solar Engineering", 2nd Edition, Taylor & Francis, 2000, Indian reprint, 2003 [chapter 10]
3. Mital K.M, "Biogas Systems: Principles and Applications", New Age International publishers (P) Ltd., 1996.4.
4. Nijaguna, B.T., Biogas Technology, New Age International publishers (P) Ltd., 2002

CH-517 FOOD PROCESSING & TECHNOLOGY

Food Process Engineering - Fundamentals: Raw material and the process-Geometric, Functional and Growth properties of the raw material, Mechanization and the raw material, cleaning - contaminants in food raw materials, function of cleaning and cleaning methods, sorting and Grading of Foods.

Unit Operations in Food Processing: Fluid flow, thermal process calculations, refrigeration, evaporation and dehydration operations to food processing. Heat processing of foods – modes of heat transfer involved in heat processing of foods.

Food Canning Technology: Fundamentals of food canning technology, Heat sterilization of canned food, containers - metal, glass and flexible packaging, Canning procedures for fruits, vegetables, meats, poultry and marine produces.

Separation And Mixing Process In Food Industries: Conversion operations. Size reduction and screening of solids mixing and emulsification, filtration and membrane separation, centrifugation, crystallization, extraction.

Food Biotechnology: Food Biotechnology. Dairy and cereal products. Beverages and food ingredients. High fructose corn syrup. Single cell protein.

Books Recommended

1. R. T. Toledo , "Fundamentals of Food Process Engineering", AVI Publishing Co., New York, 1980.
2. J.M. Jackson & B.M. Shinn, "Fundamentals of Food Canning Technology", AVI Publishing Co., New York, 1978.

3. J.G. Bernnan, J. R .Butters, N.D. Cowell & A. E. V. Lilley, "Food Engineering Operations", 2nd Edn., Applied Science, New York, 1976.

CH-518 ADVANCE SEPARATION TECHNOLOGY

Introduction: Separation processes in chemical and biochemical industries, categorization of separation processes, equilibrium and rate governed processes.

Bubble and Foam Fractionation: Nature of bubbles and foams, stability of foams, foam fractionation techniques, batch, continuous, single stage and multistage columns.

Membrane Separation: Physical factors in membrane separation, osmotic pressure, partition coefficient and permeability, concentration polarization, electrolyte diffusion and facilitated transport, macro-filtration, ultra-filtration, reverse osmosis and electro-dialysis, gas separation using membrane structure and production.

Special Processes: Liquid membrane separation, critical extraction, pressure swing adsorption and freeze drying, pervaporation and permeation, nanoseparation.

Books Recommended

1. King C. J., "Separation Processes", Tata McGraw Hill. 1982
2. Seader J. D. and Henley E. J. "Separation Process Principles", 2nd Ed., Wiley-India. 2006
3. Basmadjian D., "Mass Transfer and Separation Processes: Principles and Applications", 2nd Ed., CRC. 2007
4. Khoury F. M., "Multistage Separation Processes", 3rd Ed., CRC. 2004
5. Wankat P. C., "Separation Process Engineering", 2nd Ed., Prentice Hall. 2006

MTH-501ADVANCED MATHEMATICS APPLICATIONS

The course content is the above subject is to be given by Mathematics Department as per the BOG guidelines.

CH- 541ADVANCED CHEMICAL ENGINEERING LAB

1. Determination of organic compounds using HPLC
2. Determination of heavy metals using AAS
3. Determination of microstructure using SEM
4. Determination of pollutant concentration using UV Spectro-photometer & other.

The course demands development of new methodology, experimental setup, and related theoretical background.

CH-542 SEMINAR-I

The student will be selecting their research topic in the Seminar-I.

CH-551 ADVANCED PROCESS DYNAMICS & CONTROL

Review of Systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Control valve types-linear, equalpercentage and quick opening valve. Design of valves. Transient response. Block diagrams. Stability Analysis: Frequency response, design of control system, controller tuning and process identification. Ziegler-Nichols and Cohen-Coon tuning methods, Bode-Nyquist Plots -Process modelling.

Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, selective controls, computing relays, simple alarms, Smith predictor, internal model control, theoretical analysis of complex processes.

Multivariable Control Analysis of multivariable systems, Interaction, examples of storage tanks. Review of matrix algebra, Bristol arrays, Niederlinski index - Tuning of multivariable Controllers.

Sample Data Controllers: Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers.

Books Recommended

1. D.R. Coughanour, 'Process Systems analysis and Control', McGraw-Hill, 2nd Edition, 1991.
2. D.E. Seborg, T.F. Edgar, and D.A. Millichamp, 'Process Dynamics and Control', John Wiley and Sons, 2nd Edition, 2004.
3. C.A. Smith and A.B. Corripio, 'Principle and Practice of Automatic Process Control', 3rd ed., John Wiley and Sons, 2005.
4. W.L. Luyben, 'Process Modelling Simulation and Control for Chemical Engineers', McGraw Hill, 2nd Edition, 1990.

CH-552 ADVANCE HEAT & MASS TRANSFER

Conduction: Steady and unsteady state heat conduction, Transient heating and cooling of solid objects.

Convection: Heat transfer coefficient, Dimensional analysis in convective heat transfer, Heat transfer during laminar and turbulent flow in closed conduits, empirical correlation, Heat transfer in laminar and turbulent flow over a flat plate, Heat transfer in liquid metals, Analogy between momentum and heat transfer, Heat transfer with phase change: Boiling and condensation heat transfer.

Recent developments in heat exchangers: Heat Transfer Augmentation, Recent developments in the design of compact heat exchangers, Introduction to Heat exchanger networks and Pinch technology.

Characteristic of Equilibrium stage and Flash calculations, Study of different types of equilibrium cascade configurations and its degrees of freedom analysis, Algebraic method to determine the number of equilibrium stages, Calculation of stage efficiency, tray diameter, pressure drop and mass transfer, Rate based method to design a packed column, Scale up of a column from laboratory data, Estimation of distillation column efficiency using performance data and to develop its empirical correlation, Scale up of distillation column, Rate based method for packed distillation column, Approximate methods for Multicomponent, multistage separations, Use of residue curve for the conceptual design of distillation columns, Pressure swing and azeotropic distillation, Rate based models for distillation, Modeling of batch distillation, Modeling and simulation of absorption and leaching processes.

Diffusion in non-ideal system and development of generalized Maxwell-Stefan formulation, Study of Generalized Fick's law, Estimation of binary and multicomponent Diffusion Coefficients, Study of interphase mass and energy transfer.

Books Recommended

1. J.D Seader, E. J. Henly, "Separation Processes and principles", John Willey, 2nd edition, 2006.
2. R. Taylor, R. Krishna. "Multicomponent Mass Transfer", John Wiley, 1993.
3. Jaime Bendaitez "Principles and Modern Applications of Mass Transfer Operations", Willey, 2002.
4. Ashim K. Datta, "Biological and Bioenvironmental Heat and Mass Transfer", C R C Press, 2002.

CH-553 ADVANCED THERMODYNAMICS IN CHEMICAL ENGINEERING

Review of Basic Postulates, Maxwell's relations, Legendre Transformation, Pure Component properties, Theory of corresponding states, real fluids Equilibrium, Phase Rule, Single component phase diagrams Introduction to Multicomponent Multiphase equilibrium, introduction to Classical Mechanics, quantum Mechanics, Canonical Ensemble, Microcanonical Ensemble, Grand Canonical Ensemble, Boltzmann, Fermi-dirac and Bose Einstein Statistics, Fluctuations, Monoatomic and Diatomic Gases,

introduction to Classical Statistical Mechanics, phase space, liouville equation, Crystals, Intermolecular forces and potential energy functions, imperfect Monoatomic Gases, Molecular theory of corresponding states, introduction to Molecular Simulations, Mixtures, partial molar properties, Gibbs Duhems equations, fugacity and activity coefficients, Ideal and non-ideal solutions, Molecular theories of activity coefficients, lattice models, multiphase Multicomponent phase equilibrium, VLE/SLE/LLE/VLLE, Chemical Equilibrium and Combined phase and reaction equilibria.

Thermodynamics of irreversible processes. Exergy analysis of Chemical Engg Processes.

Books Recommended

1. H. B. Callen, Thermodynamics and an Introduction to Thermostatistics, 2nd Edition, John Wiley and Sons, 1985.
2. J.M. Prausnitz, R.M. Lichtenthaler and E.G. Azevedo, Molecular thermodynamics of fluid-phase Equilibria (3rd edition), Prentice Hall Inc., New Jersey, 1996.
3. J.M. Smith. H.C.V. Ness and M.M. Abott, "Introduction to Chemical Engineering Thermodynamics" McGraw Hill International edition (5th ed.). 1996.

CH-561TEXTILE TECHNOLOGY

Classification of fibres: Natural fibres of vegetable origin: jute; hemp; sunn; Urena. The leaf fibres : Sisal, Abaca (manila); seed and fruit fibres; cotton. Natural fibres of animal origin: Wool; Mohair; Cashmere; Persion goat hatosilk; vicuna; fur fibres; Man made fibres; Rayon's Polyamide fibres; polyester fibres, polyvinyle derivative fibres; polyolefin & Polyurethane fibres.

Weaving: Various steps in weaving manufacturing for fibres, design and construction, and weaving fundamentals to the various modern methods of weaving slashing process calculations; woven fabric construction and weaving process calculation & problem solving.

Physical Testing of textiles : Introduction: Reasons for textile standardization of testing sampling, measurement errors; Effect of atmosphere on physical properties; Fibre tests; Fibre fitness; Fibre length; yarn tests; Linear density twist, yarn evenness; Hairness, friction, Strength tests; Definition; Load elongation curve.

Recycling Textile Wastes: Recycling and recovery strategies turning environmental concern into real profit Re-claimed fibres, the sources and usage; Industrial wastewater minimization and treatment. The fibre industry and water management; Production of high tenacity tapes from polypropyene. The role of process stabilizers in recycling polyoefins.

Modern Textiles: Challenges for Textile research & development in the 21st century; fibres textiles and materials for future military use; Development in man made fibre technology-airbages, Textiles in filterations; Textiles in medicine, defence, transport and geotextiles

Books Recommended

1. Gardon Cook- Handbook of Tesxtile Fibres Vol-I Natural Fibres, Vol-II Man-made fibres.
2. S. Adanur – Handbook of waving – Deptt of Textile Engg. Auburn University, U.S.A.
3. Dan J. Mc. Geight, James B. Bradshaw, Everett E. Back & Michael-Weavers Handbook of Textile Calculation – S. Hill Institute of Textile technology, USA.
4. B.P. Saville-Physical Testing of Textieles-Uni. Of Huddersfied, UK.

CH-562PETROLEUM ENGINEERING & TECHNOLOGY

Origin of Petroleum: Origin and occurrence of petroleum crude, status of petroleum refining in India, composition classification and physical properties of petroleum, evaluation of crude oil and petroleum products, future refining trends. Introduction to petroleum and petrochemical industries, structure of

petrochemical industry, product profile of petrochemicals, profile of Indian petrochemical industries, basic building blocks for petrochemical production.

Indian and Global Petroleum Industries: An overview, Raw materials for organic chemicals-coal, biomass, petroleum and natural gas, Evaluation of crude oil, Petrochemical feed stocks- Natural gas, NGL, Naphtha, Kerosene, and Pyrolysis gasoline.

Crude Oil Distillation Processes: Pretreatment of crude, atmospheric and vacuum distillation process.

Secondary Conversion Processes: Catalytic reforming, catalytic cracking, deep catalytic cracking, alkylation, isomerisation and polymerization, reformulated gasoline and oxygenates.

Heavy Residue Up-gradation Technologies: Hydro-treating, hydrocracking, hydro-visbreaking, visbreaking and delayed coking.

Lubricating Oil, Wax and Bitumen: Dewaxing, deasphalting, lube hydro-finishing, bitumen air blowing.

Sweetening: Desulfurization and hydro-desulfurisation of petroleum products.

Hydrogen: Production and management.

Aromatics Production: Catalytic reforming, aromatic separation, aromatic conversion processes, Cyclar process.

Books Recommended

1. Wauquier J. P., "Petroleum Refining: Separation Processes", Vol:1-5, IFP, Technip Ed.1998.
2. Meyers R. A., "Hand book of Petroleum Refining Processes", 3rd Ed., The McGraw-Hill Publication Data.2004.
3. Dawe R. A., "Modern Petroleum Technology- Part I", by Institute of Petroleum (IP), John Wiley.2002.
4. Lucas A. G., "Modern Petroleum Technology- Part II", by Institute of Petroleum (IP), John Wiley.2002.

CH-563 MULTIPHASE FLOW/CFD MULTIPHASE REACTOR

Flow past immersed bodies: Drag and drag coefficients, flow through beds of solids, motion of particles through fluids, fluidization, types of fluidization and applications.

Two-phase flow: Two-phase flow through pipes. Lockhart-Martinelli parameters and their application in analysis of two-phase flows.

Interaction of fluids: Mixing of a single fluid; degree of segregation, early and late mixing of fluids, models for partial segregation, mixing of two miscible fluids. Gas-liquid flow phenomenon, Types of regimes formation – trickle, pulse, bubble, dispersed bubble, spray regime etc.

Types of Multiphase-Reactors: Various types of multiphase reactors. eg. Packed bed, packed bubble column, trickle bed reactor, three phase fluidized bed reactor, slurry bubble column, stirred tank reactor. Characteristics of above mentioned reactors such as; fluid flow phenomena and flow regimes, flow charts/ correlations, pressure drop, liquid hold up etc. Reactors involving Newtonian and non-Newtonian fluids.

RTD in Multiphase Flow systems: Non Ideal Flow: Residence time distribution of fluid in vessel, E, F & C Curve, Mean and variance, the Dirac delta function, residence time, linear and non-linear processes, models for non ideal flow, dispersion model, N tanks in series model, model for small deviations from plug flow and long tails, conversion in a reactor using RTD data, diagnosing ills of operating multiphase reactors, models for multiphase reactors. Two parameter model; PD model; three parameter models; PE Model.

Books Recommended

1. Levenspiel O, "Chemical Reaction Engineering", 3rd Ed , John Wiley & Sons, Singapore (1999).

2. Fogler H Scott, "Elements of Chemical Reaction Engineering", 3rd ed, Prentice Hall Inc. (1999).
3. Shah Y.T., "Gas-Liquid-Solid Reactor Design", McGraw Hill Int. New York, 1979.
4. Westerterp K.R., van Swaaij W.P.M., and Beenackers A.A.C.M., "Chemical Reactor Design and Operation", John Wiley & Sons, 1993.

CH-564 POLLUTION CONTROL & ENGINEERING AND SAFETY

Introduction: Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards for ambient air, noise emission and effluents. **Pollution Prevention:** Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization, Fugitive emission/effluents and leakages and their control-housekeeping and maintenance. **Air Pollution Control:** Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers. **Water Pollution Control:** Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation. **Biological Treatment:** Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying. **Solids Disposal:** Solids waste disposal – composting, landfill, briquetting / gasification and incineration. **Process Safety:** Process safety, accident and loss statistics, nature of the accident/hazardous process, hazardous substance classification and hazardous substance rules; Factories Act.

Books Recommended

1. "Pollution Control Acts, Rules, Notifications issued there under" CPCB, Ministry of Env. and Forest, G.O.I., 3rd Ed. (2006).
2. Vallero D., "Fundamentals of Air Pollution", 4th Ed., Academic Press. (2007).
3. Eckenfelder W. W., "Industrial Water Pollution Control", 2nd Ed., McGraw Hill. (1999).
4. Kreith F. and Tchobanoglous G., "Handbook of Solid Waste Management", 2nd Ed., Mc Graw Hill. (2002).

CH-565 MODELING & SIMULATION OF CHEMICAL ENGG. SYSTEMS

Introduction to modeling, a systematic approach to model building, classification of models. Conservation principles, thermodynamic principles of process systems.

Development of steady state and dynamic lumped and distributed parameter models based on first principles. Analysis of ill-conditioned systems.

Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.

Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method. R-K method, shooting method, finite difference methods. Solving the problems using MATLAB/SCILAB.

Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods.

Sequential modular, simultaneous modular and equation oriented approaches; Partitioning and tearing; Simulation examples of fluid flow, heat transfer, mass transfer and reaction processes; Monte Carlo simulation.

Books Recommended

1. K. M. Hantos and I. T. Cameron, "Process Modelling and Model Analysis", Academic Press, 2001.
2. W.L. Luyben, "Process Modelling, Simulation and Control for Chemical Engineers", 2nd Edn., McGraw Hill Book Co., New York, 1990.
3. W. F. Ramirez, "Computational Methods for Process Simulation", 2nd ed., Butterworths, 1997.
4. Mark E. Davis, "Numerical Methods and Modelling for Chemical Engineers", John Wiley & Sons, 1984.

CH-566 INDUSTRIAL CATALYSIS

Review of Heterogeneous Catalysis: Role of catalyst components and other constituents, characterization of catalyst and its support. Transport Processes: Analysis of external transport processes in heterogeneous reactions in fixed bed, fluidized bed and slurry reactors. Intrapellet mass transfer, heat transfer, mass transfer with chemical reaction and simultaneous mass and heat transfer with chemical reaction. Catalyst Selectivity: Effect of intrapellet diffusion on selectivity in complex reactions, effect of external mass transfer on selectivity. Catalyst Deactivation: Modes of deactivation – poisoning, fouling and sintering. Determination of deactivation routes, combined effect of deactivation and diffusion on reaction rates, effect of deactivation on selectivity. Reactor Design: Design calculation for ideal catalytic reactor operating at isothermal, adiabatic and non-adiabatic conditions. Deviations from ideal reactor performance. Design of industrial fixed-bed, fluidized bed and slurry reactors. Thermal stability of packed bed and fluidized bed reactors, Overview of various areas of Green chemistry, Successful approaches to Green Chemistry education.

Text/Reference Books:

1. Smith, J. M., "Chemical Engineering Kinetics," 3rd ed., McGraw-Hill, 1981.
2. Carberry, J. J., "Catalytic Reaction Engineering," McGraw-Hill, 1977.
3. Lee, H. H., "Heterogeneous Catalytic Reactors," Butterworth.
4. Tarhan, M. O., "Catalytic Reactor Design," McGraw-Hill, NY, 1983.

CH-567 PHARMACEUTICAL TECHNOLOGY

Practice of the following unit operation in pharmaceutical industries: Heat transfer, evaporation, distillation, dry, mixing size reduction, crystallization, filtration, size separation, conveying, humidification, air conditioning and refrigeration.

Formulation, development of sterile dosage forms. Production facilities, environmental control and personnel in the production of sterile dosage form, compounding, processing, filtration, sealing, sterilization, packing and labeling of sterile dosage forms. Quality control tests like sterility, pyrogen, clarify, safety and leakage testing.

Types of tablets. Manufacturing of tablets by wet granulation, dry granulation and direct compression. Tablet processing problems and defects, tablet standardization: hardness, friability, weights variation, disintegration, dissolution and content uniformity tests.

Capsules: Hard gelatin capsule, capsule size, formulation and preparation of filled hard gelatin capsules, soft gelatin capsule, soft gel – manufacturing procedures. Quality control of capsule. Cosmetics and Toiletries: Introduction, factors to be considered in the formulation of facial cosmetics, dentifrice's, deodorant, antiperspirants, shampoos, hairdressing and hair removers.

Pharmaceutical packing: Packing components, types of packing containers and closures, materials used for and their pharmaceutical specification, method of evaluation, stability aspects of packaging materials.

Books Recommended

1. Leon Lachman, H.A. Lieberman, J.L.K. – The Theory and Practice of Industrial Pharmacy – Verghese Publishing House, Hind Rajasthan Building Dadar, Mumbai – 40001.
2. Ganderton – Unit Process in Pharmacy.
3. D. Hershey, Ed – Chemical Engineering in Medicine And Bology – Plenum Press, New York.
4. Chemical Engineering in Medicine – Chern. Engg. Prpgrer Syrn Series No. c 66, Vol 62.

CH-568 ADVANCED ENVIRONMENTAL BIOTECHNOLOGY

General effluent treatment – nature of sewers, sewage; Methods adopted in effluent treatment; Legal Consideration – Royal Commissions. Current situation in laying of charging ownership, regulations, legislation; Activated sludge process equipment, plant kinetics, CSTR modeling. PFR modeling, recycle stability, washout; Advanced Process – Trickling fitter, moving medium system; Biology of effluent treatment process: Roles of bacteria, fungi and protozoa.

Extracellular Polymers, films, flocs, Analysis of effluent; Nutrition, Carbon removal, influences of loading ratio, retention times, season on kinetics and performance, Nitrogen and Phosphorous requirement for adequate plant performance. Nitrification and De-nitrification Anoxic process, extended aeration, high rate process; Sludge disposal methods; Anaerobic processes. Sludge digestion (contact digester), Management of digester sludge. Aerobic effluent treatment. Gas production and utilization, related problem.

Books Recommended

1. M.J. Waites, N.L. Morgan, J.S. Rockey, and G. Higton , Industrial Microbiology, Wiley Blackwel, 2001
2. W. Grueger and A. Crueger, Biotechnology a Text book of Industrial Microbiology, Mc Graw Hill, 1990
3. J E Bailey and D F Ollis, Biochemical Engineering Fundamentals, Mc Graw-Hill, 2005.

CH-569 CORROSION ENGINEERING

Basic concepts: Definition and importance; Electrochemical nature and forms of corrosion; Corrosion rate and its determination.

Electrochemical thermodynamics and kinetics: Electrode potentials; Potential-pH (Pourbiax) diagrams; Reference electrodes and experimental measurements; Faraday's laws; Electrochemical polarization; Mixed potential theory; Experimental polarization curves; Instrumentation and experimental procedure.

Galvanic and concentration cell corrosion: Basic concepts; Experimental measurements, and determination of rates of galvanic corrosion; Concentration cells.

Corrosion measurement through polarization techniques: Tafel extrapolation plots; Polarization resistance method; Instrumental methods and Errors in measurement of polarization resistance; Commercial corrosion probes; Other methods of determining polarization curves.

Passivity: Basic concepts of passivity; Properties of passive films; Experimental measurement; Applications of Potentiostatic Anodic Polarization; Anodic protection.

Pitting and crevice corrosion: Basic concepts; Mechanisms of pitting and crevice corrosion; Secondary forms of crevice corrosion; Localized pitting. Metallurgical features and corrosion: Inter-granular corrosion; Weldment corrosion; De-alloying and dezincification.

Environmental induced cracking: Stress corrosion cracking; Corrosion fatigue cracking; Hydrogen induced cracking; Some case studies; Methods of prevention and testing; Erosion, fretting and Wear.

Environmental factors and corrosion: Corrosion in water and Aaqueous Ssolutions; Corrosion in sulphur bearing solutions; Microbiologically induced corrosion; Corrosion in soil; Corrosion of concrete; Corrosion in acidic and alkaline process streams.

Atmospheric and elevated temperature corrosion: Atmospheric corrosion and its prevention; Oxidation at elevated temperatures; Alloying; Oxidising environments. Prevention and control of corrosion: Cathodic protection; Coatings and inhibitors; Material selection and design.

Books Recommended

1. Fontana, M.G., "Corrosion Engineering", McGraw-Hill.
2. Jones, D.A., "Principals and Protection of Corrosion", Prentice-Hall

CH-591 Software Laboratories

Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB.

CH-592 Seminar-II

The student will be selecting their research topic in the Seminar-II.

17 DEPARTMENT OF COMPUTER SCIENCE

Mathematical foundations of Computer Science - CS-C501

Logic: Basics of propositional and first order logic, Completeness and compactness results;

TOC: Universal Turing Machines, undecidability, Rice's theorems for RE sets, Post machines, Basics of Recursive function theory. Equivalence, Church's thesis, Computational complexity, Space and Time complexity of Turing Machines, Relationships, Savage's theorem, Complexity classes, Complete problems, NP-completeness, Cook- Levin theorem.

References:

1. J. E. Hopcroft, J. D. Ullman, Introduction to Automata Theory, Languages and Computation, Addison-Wesley, Indian addition available from NORASA.
2. Raymond M. Smullyan, First-Order Logic Publisher, Springer-Verlag.
3. J.L. Balcazar, J. Diaz, J. Gabarro, Structural Complexity, Springer- Verlag.

Advanced Data Structures - CS-C502

Review of algorithm analysis, Optimal Binary search trees, Balanced binary search trees, Binary heaps, Advanced heap structures, Binomial heaps, Fibonacci heaps. Amortized analysis, Splay trees. Dictionaries, Disjoint set structures. Data Structures for External Memory, External sorting, String matching. Introduction to Randomized Data structures and algorithms.

References:

1. Introduction to algorithms by Cormen and Rivest
2. Randomized algorithms by R.Motwani and P. Raghavan.

Advanced Computer Networks - CS-C503

Review of networking concepts: Network models, Addressing, Data rate limits, Bandwidth, throughput, Latency, Data link control, Multiple Access, Wired LAN, Wireless LAN, VLAN, SONET, ATM, QoS in ATM, ATM applications, IP addressing, forwarding, and routing, IPv4, IPv6, IP Security, Virtual Private Networks, Transport layer protocol, congestion control,

Multimedia Networks: Voice/Video over IP, IP Telephony, Voice over ATM, AAL2, Network management, Optical Networks.

Advanced Software Engineering- CS-E511

Software Project Management, Metrics and measurement, Software Configuration management, Software risk management, Requirements Engineering, Software quality assurance, software reliability models.

Object oriented design, object oriented programming (with C++), Formal specifications, Formal verification of programs, Jackson method for design, CASE tools and technology, Clean room method for software development, Information system design, Real-time software specification and design.

Enterprise architectures, Zachman's Framework, Architectural styles, Design Patterns, Architecture Description Languages, Product-Line architectures, Component Based Development.

References:

1. Pankaj Jalote. An integrated approach to Software Engineering, 2nd Edition, Narosa Publishing house.
2. Roger Pressman. Software Engineering: A Practitioner approach, 4th Edition, McGraw-Hill Publishing.
3. Len Bass, Paul Clements, Rick Katzman, Ken Bass Software Architecture in Practice.
4. L. Pfleeger. Software Engineering, Macmillan Publishing Company, 1987
5. Ghazzi, Frank Buschmann, Regine Meunier Hans Rohnert, Peter Sommerland, Miachel
6. Stal, Douglas Schmidt Pattern Oriented Software Architecture, Volumes 1 & 2
7. George T.Heineman, William T.Councill. Component Based Software Engineering

CAD of Digital Systems - CS-E512

Basic Mathematical Concepts, Introduction to design methodologies, Design automation tools, Algorithmic graph theory and computational complexities, Computational Approaches and methods for combinatorial optimization, Design of digital hardware and HDLs, Introduction to logic circuits, Implementation technologies, Verilog Programming concepts, Gate level modelling , Data flow modelling , Behavioural modelling, Combinational circuit design, Flip-flops, registers, counters and processor, Sequential circuits design, Tasks and functions, Timing and Delays ,Data Structure in VLSI design , Layout, placement and partition, floor planning, routing, Logic Synthesis, Model Optimization, Verification and Testing , Simple Microprocessor Design .

Text Books:

1. Algorithm for VLSI Design automation, Sabih H. Gerez, John Wiley & Sons
2. Fundamental of Digital Logic with Verilog Design, Brown & Vranesic, TMH
3. Verilog HDL, Samir Palnitkar, Pearson Education
4. Digital VLSI Design with Verilog, John Williams, Springer
5. DIGITAL VLSI SYSTEMS DESIGN, Dr. S. Ramachandran, Springer

Reference Book:

1. Logic synthesis and Verification Algorithm, Hachtel and Somenzi

2. Verilog HDL synthesis, J Bhaskar, BS Publication
3. Algorithms for VLSI Physical Design Automation., N.A. Sherwani

Distributed Computing - CS-E513

Introduction to Distributed System: Goals, Hardware concepts, Software concepts, and Client-Server model. Example of distributed systems. Communication: Layered protocols, Remote procedures call, Remote object invocation, Message-oriented communication, Stream-oriented communication. Inter process communication in UNIX/LINUX. Processes: Threads, Clients, Servers, Code Migration, Software agent. Naming: Naming entities, locating mobile entities, removing un-referenced entities. Synchronization: Clock synchronization, Logical clocks, Global state, Election algorithms, Mutual exclusion, Distributed transactions.

Consistency and Replication: Introduction, Data centric consistency models, Client centric consistency models, Distribution protocols, Consistency protocols. Fault Tolerance: Introduction, Process resilience, Reliable client server communication, Reliable group communication. Distributed commit, Recovery. Security: Introduction, Secure channels, Access control, Security management. Distributed File System: Sun network file system, CODA files system, Google File System.

References:

1. A. Taunenbaum, Distributed Systems: Principles and Paradigms.
2. G. Coulouris, J. Dollimore, and T. Kindberg, Distributed Systems: Concepts and Design, Pearson Education

Digital Image Processing - CS-E514

Introduction to Image Processing Systems, Digital Image Fundamentals:- Image model, Relationship between Pixels, Imaging geometry, Camera model. Image Sensing and Acquisition. Sampling and quantization. Image Enhancement and in spatial Domain: Point processing, Neighbourhood Processing, High pass filtering , High boost filtering, zooming. Image Enhancement based on Histogram medelling. Image Enhacement in frequency domain: 1D& 2D Fourier transform, Low pass frequency domain filter, High pass frequency domain filters, Homomorphics filtering. Image Segmentation:- Detection of discontinuation by point detection, line detection, edge detection. Edge linking and boundary detection:- Local analysis, global by graph, theoretic techniques. Thresh-holding. Morphology, Representation and description. Discrete image transform. Image Compression. Wavelet transformation.

References:-

1. “ Digital Image Processing” by Gonzalez & Wood
2. “ Digital Image Processing” by A.K.Jain
- 3.”Image Processing”, Dhananjay k.Techkedath.

Data Mining and Warehousing - CS-E515

Basic concept of Data ware house, OLAP and Data mining. OLTP vs. OLAP. Data Warehouse Design - Identifying facts & dimensions, designing fact tables, dimension tables, star flake schema query redirection. OLAP operations Data ware house architecture, Multidimensional schemes:- partitioning strategy, aggregation, data marting, metadata. Capacity planning, tuning

the data warehouse testing the data warehouse: developing test plan, testing operational environment Distributed and virtual data warehouses.

Data Mining: Basic concept, A statistical perspective on Data Mining-point estimation, models based on summarization, Bayes theorem, Hypothesis Testing, Classification issues, statistical-based algorithms, distance-based algorithms, decision tree-based algorithms and rule based algorithms. Clustering - similarity and distance measures, outliers' hierarchical algorithms, partition algorithms, clustering large databases. Association Rules, large item sets, Apriori algorithm, sampling algorithm, partitioning, parallel and distributed algorithms, data parallelism task parallelism. Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. Spatial Mining, Special data overview, Special data mining primitives, generation and specialization, spatial rules, spatial classification algorithms. Temporal Mining modelling temporal events, time series, pattern detection Sequences, temporal association rules. Privacy issues with respect to invasive use.

Books:

1. Building the data warehouse by W.H Inmon, John Wiley & Sons.
2. Data mining concepts and techniques by Jimali Han and Micheline Kamber.
3. Data Mining Introduction and Advance Topic, Margaret H. Dunham and S. Sridhar, Pearson Education

Computer & Network Security - CS-E516

Introduction to computer and network security. Basic concepts, threat models, common security goals, Cryptography and cryptographic protocols, including encryption, authentication, message authentication codes, hash functions, one-way functions, public-key cryptography, secure channels, zero knowledge in practice, models and methods for security protocol analysis. Malicious code analysis and defense. Viruses, Worms, spyware, rootkits, botnets, etc. and defenses against them, Detecting Attackers. Software security. Secure software engineering, defensive programming, buffer overruns and other implementation flaws. Language-based security: analysis of code for security errors, safe languages, and sandboxing techniques. Operating system security. Memory protection, access control, authorization, authenticating users, enforcement of security, security evaluation, trusted devices, digital rights management. Network security. Network based attacks, Kerberos, X.509, firewalls, intrusion detection systems, DoS attacks and defense. Case studies: DNS, IPSec. Web security. Securing Internet Communication, XSS attacks and defenses, etc. Advanced topics. Security monitoring, surreptitious communication, data remanence, trusted devices, privacy and security of low-powered devices (RFID) electronic voting, quantum cryptography, penetration analysis, digital rights management and copy protection, security and the law.

References:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall, New Jersey.

Embedded Systems - CS-E517

Introduction, Hardware & electronics fundamentals, Peripherals, Program Design and Analysis, Processes and Operating system, Real time Operating system Memory, Interfacing, Examples of Embedded systems: Digital Camera Examples, Smart card application, Embedded database applications, etc State Machine and Concurrent Process Models, Control Systems Verilog programming, Programming of mobile and Hand-held devices. IC Technology Full-Custom (VLSI) IC Technology, Semi-Custom (ASIC) IC Technology, Programmable Logic Device (PLD) IC Technology, FPGA. Hardware Software Partitioning, Hardware/Software Co-Simulation, Intellectual Property Cores, Low Power design

References:

1. Embedded system Design, Frank Vahid, Tony Givargis, John Wiley & Sons
2. Computer as Components, Wayne Wolf, Elseviere
3. 8051 Microcontroller an Application Based introduction, Braithwaite Cowan,Parchizadeh , Eksevier
4. 8051 Microcontroller & Embedded Systems, Rajiv Kapadia, Jaico Books
5. The 8051 Microcontroller & Embedded Systems, Mazidi & Mazida, Pearson education

Graph Theory and Network Algorithms - CS-E518

Mathematical Background: Convex Optimization, Stability of Dynamical Systems and Discrete-time Markov Chains, Utility Maximization and Resource Allocation in the Internet, Statistical Multiplexing and queues, delay and packet loss analysis in queues.

Graph Theory: graphs and digraphs, Spanning Trees, Connectivity and Flow, Planar Graphs, Graph Coloring, factorizations, eulerian and hamiltonian graphs, Minimum Connector Problem, Marriage Problem, Assignment Problem, Network Flow Problem , Committee Scheduling Problem, Four Color Problem, Traveling Salesman Problem.

Scheduling in High-Speed Switches: Switch Architectures and Crossbar Switches, Head-of-Line (HOL) Blocking and Virtual Output Queues, Capacity Region and Max Weight Scheduling.

Scheduling in Wireless Networks: Scheduling in Wireless Networks, Channel-Aware Scheduling in Cellular Networks, The MaxWeight Algorithm for the Cellular Downlink , MaxWeight Scheduling Ad Hoc P2P Wireless Networks.

Network Flow Algorithms : Introduction, Distance Network algorithms, Computational analysis and Optimality conditions of Distance Network Algorithms, Maximum flow algorithms, Minimum Cost Flow algorithms, Cycle canceling and Out of-kilter algorithm,

Network Utility Maximization: Utility Maximization for Joint Congestion Control, Routing and Scheduling , Stability and Convergence, Ad Hoc P2P Wireless Networks, Internet versus Wireless Formulations. Distributed Algorithms for Network Communications: Data distribution algorithms, Request-Reply algorithms, Search and traversal algorithms, breaking symmetry and election algorithms, Topology

discovery. Routing, Building and maintaining trees, Synchronization. Fault tolerance and recovery, Complexity of distributed algorithms.

Technical Foundation for e-commerce - CS-E519

Introduction: Electronic commerce, technology and prospects, forces behind e-commerce, advantages and disadvantages, architectural framework, e-commerce strategy, e-commerce emerging issues and implementation issues, e-commerce law, government policies and agenda.

E-Commerce Infrastructure: Internet and Intranet based e-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN,FRAME RELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile information device, mobile computing applications , security issues in m-commerce. Electronic Payment System: Overview, electronic payment mechanisms and protocols, SET protocol, payment gateway, certificate, digital tokens, smart card, credit card, magnetic strip card, electronic money, electronic contracts, micro-payments, e-checks, e-cash Credit/Debit card based EPS, e-commerce payments security, online banking. electronic data interchange and its applications. Internet Advertising. Models of Internet advertising, sponsoring contents, corporate website, weaknesses in Internet advertising, web auctions and trading mechanism. Securing Business on Network. Security policies, procedures and practices, site security, firewalls, securing web service, transaction security, cryptology, cryptological algorithms, public key algorithms, authentication protocols, digital Signatures, virtual private network, security protocols for web commerce. Advanced Topics. Electronic commerce optimization algorithms, decision support systems for e-commerce, data mining for e-commerce, intelligent techniques for e-commerce.

Optimization Techniques (Open Elective 1) - CS-O511

Introduction: Engineering application of Optimization, Formulation of design problems as mathematical programming problems, General Structure of Optimization Algorithms ,Constraints, The Feasible Region, Branches of Mathematical Programming ,Gradient Information, The Taylor Series, Types of Extrema, Necessary and Sufficient Conditions for Local Minima and Maxima, Classification of Stationary Points , Convex and Concave Functions, Optimization of Convex Functions, General Properties of Algorithms ,An Algorithm as a Point-to-Point Mapping,An Algorithm as a Point-to-Set Mapping Closed Algorithms , Descent Functions, Global Convergence, Rates of Convergence.

Unconstrained Optimization: One dimensional optimization techniques: Dichotomous Search, Fibonacci Search ,Golden-Section Search, Quadratic Interpolation Method ,Cubic Interpolation, The Algorithm of Davies, Swann, and Campey, Inexact Line Searches , Multidimensional Gradient Methods ,Steepest-Descent Method, Newton Method Gauss-Newton Method, Conjugate-Direction Methods: Conjugate Directions, Basic Conjugate-Directions Method, Conjugate-Gradient Method, Minimization of Non-quadratic Functions, Fletcher-Reeves Method, Powell's Method, Partan Method. Quasi-Newton Methods: The Basic Quasi-Newton Approach, Generation of Matrix S_k ,Rank-One Method, Davidon-Fletcher-Powell Method, Broyden-Fletcher-Goldfarb-Shanno Method, Hoshino Method, The Broyden Family, The Huang

Family, Practical Quasi-Newton Algorithm, Applications of Unconstrained Optimization, Nonlinear Least Squares Problem and Algorithms.

Linear Programming: Graphical method, Simplex method, Duality in linear programming (LP), Sensitivity analysis, Interior-Point Methods, Primal-Dual Solutions and Central Path, Primal Affine-Scaling Method, Primal Newton Barrier Method, Primal-Dual Interior-Point Methods.

Nonlinear Constrained Optimization: Constrained Optimization, Constraints, Classification of Constrained Optimization Problems, Simple Transformation Methods, Lagrange Multipliers, First-Order Necessary Conditions, Second-Order Conditions, Convexity, Duality Quadratic and Convex Programming: Convex QP Problems with Equality Constraints, Active-Set Methods for Strictly Convex QP Problems, Interior-Point Methods for Convex QP Problems, Cutting-Plane Methods for CP Problems, Ellipsoid Methods.

Minimax Methods: Minimax Algorithms, Improved Minimax Algorithms,

References:

1. Practical Optimization Algorithms And Engineering Applications, by Andreas Antoniou, Springer publication.
2. An Introduction To Optimization by EDWIN K. P. CHONG & STANISLAW H. ZAK, Wiley publication.

Object-oriented Design and Modeling (Open Elective1) - CS-O512

Object Orientation, OMT Methodology, Object and Class, Link and Association, Generalization, Aggregation Multiple Inheritance, Packages. Object Meta modelling, Metadata and Metamodels, Functional Modelling. Pseudocode, Pseudocode with the Object Navigation Notation, ONN Constructs, combining ONN Constructs. Analysis: Object Model, Data Dictionary, Dynamic Model, Functional Model, System Design: Devising an Architecture, Database Management Paradigm, Object Identity, Policies for Detailed Design Dealing with temporal data. Detailed Design:- Object Model Transformations, Elaborating the Object Model, Elaborating the Functional Model, Evaluating the Quality of a Design Model.

References:

1. Object-Oriented Modeling and Design by Michael Blaha / William Premerlani, Prentice Hall

MTECH (CSE)II SEMESTER

Architecture of Large Systems - CS-C504

Pipeline processor principles and design, Instruction set architecture; Memory addressing; Instruction composition; Instruction-level parallelism. Hazards: dynamic scheduling, branch prediction; Memory hierarchy; Processor case studies; Multiprocessor introduction: Shared-memory architectures and their synchronisation and consistency issues, Advanced multi-core topics; Transactional Memory; Interconnection networks.

References: :

1. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann, fourth edition, 2006.
2. David Culler, J.P. Singh and Anoop Gupta, Parallel Computer Architecture: A Hardware/Software Approach, Morgan Kaufmann, first edition, 1998.
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill, first edition, 1992.

Operating System Design - CS-C505

Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems, Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and microkernels.

Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies, Memory management, virtual memory concept, virtual machines, I/O management, File and disk management, Operating system security.

Distributed Operating system: architecture, Design issues, Distributed mutual exclusion, distributed deadlock detection, shared memory, Distributed scheduling.

Multiprocessor operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.

References:

1. Advanced concept in operating system: M. Singhal, N.G Shivratri
2. Operating system internal and design principles: William Stallings

Soft Computing - CS-C506

Introduction to neural networks, Working of an artificial neuron, Perceptron, Back propagation algorithm, Adalines and Madalines. Supervised and unsupervised learning, Counter-propagation networks, Adaptive Resonance Theory, Kohonen's Self Organizing Maps, Neocognitron, Associative memory, Bidirectional Associative Memory.

Introduction to fuzzy logic and fuzzy sets, fuzzy relations, fuzzy graphs, fuzzy arithmetic and fuzzy if-then rules, Process control using fuzzy logic, Decision-making fuzzy systems, Applications of fuzzy logic, Hybrid systems like neuro-fuzzy systems.

Evolutionary Computation: Population-based Search: genetic algorithms and evolutionary computation, Genetic Programming. Swarm optimization, Ant colony optimization. Search techniques like Simulated Annealing, Tabu search etc.

References:

1. Soft Computing and Intelligent Systems Design by F.O.Karray and C.De Silva,Pearson Publication
2. Neural Networks, Fuzzy Logic and Genetic Algorithms by Rajsekaran and Pai, PHI Publication.

Information Theory and Coding - CS-E521

Information and entropy information measures, Shannon's concept of information. Channel coding, channel mutual information capacity (BW) , theorem for discrete memory less channel, information capacity theorem , error detecting and error correcting codes,

Types of codes: block codes, hamming and Lee metrics, description of linear block codes , parity check codes ,cyclic code. Masking techniques.

Compression : loss less and lossy, Huffman codes, LZW algorithm, Binary image compression schemes, run length encoding, CCITT group 3 1-D compression, CCITT group 3 2D compression, CCITT group 4 2D Compression. Convolutional codes, sequential decoding. Video image compression: CITT H 261 Video coding algorithm, audio (speech) compression. Cryptography and cipher.

References:

1. R Bose, "Information Theory, Coding and Crptography", TMH 2007
2. Multimedia system Design by Prabhat K Andleigh and Kiran Thakrar(PHI Publications).
3. Multimedia Communications by Fred Halsall(Pearson Publications).

Simulation and Modelling - CS-E522

Introduction: Systems, modelling, general systems theory, Concept of simulation, Simulation as a decision making tool, types of simulation.

Random Numbers and Queuing Theory: Pseudo random numbers, methods of generating random variables, discrete and continuous distributions, testing of random numbers, Concepts of Queuing theory.

Design of Simulation Experiments :Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

Simulation Languages: Comparison and selection of simulation languages, study of these simulation language.

Case studies: Development of simulation models using simulation language studied for systems like queuing systems, Production systems, Inventory systems, maintenance and replacement systems and Investment analysis.

References:

1. Geoffrey Gordon, "System Simulation", 2nd Edition, Prentice Hall, India, 2002.
2. Narsingh Deo, "System Simulation with Digital Computer, "Prentice Hall, India, 2001.

Randomized Algorithms - CS-E523

Introduction to randomized algorithms. Game Theoretic Techniques. Probabilistic Method, Markov Chains and Random Walks. Randomized Data Structures: Treaps, skip lists, Hash tables. Geometric algorithms and linear programming, Graph algorithms, Approximate Counting, Online Algorithms.

References:-

1. Randomized Algorithm by Motwani and Raghavan, Cambridge press.

Parallel Algorithms CS-E524

Parallel algorithms: Introduction, Terminology, Pipelining & data parallelism, Control parallelism, scalability.

PRAM algorithms: Serial and Parallel computation; Processor arrays, Multiprocessors & Multi-computers, Flynn's taxonomy, Speedup Scaled Speedup and Parallelizability.

Parallel Programming Languages, Mapping & Scheduling;

Matrix Multiplication Algorithm: Sequential, Processor arrays, Multi-computers.

Fourier transform: Introduction, Discrete, Inverse discrete, Fast Fourier transform.

Sorting algorithms, Dictionary operation, Graph algorithm, Combinatorial Search

References:

1. Parallel computing by Michael J. Quinn.
2. The Design of Parallel and Analysis Algorithms by Selim G. AkM.

Web Search and Information Retrieval - CS-E525

Information retrieval model, Information retrieval evaluation, Searching the web, Document Representation, Query languages and query operation, Metadata search, Indexing and searching, Scoring and ranking feature vectors, Ontology, domain specific search, Parallel and distributed information retrieval, Text and multimedia languages, Social networks

References:

1. Manning, C., Raghavan, P., and Schutze, H. (2007), An introduction to Information Retrieval, Cambridge University Press
2. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman

Wireless Communication and Mobile Computing -CS-E526

Introduction to wireless communication, and future trends, Wireless Generations and Standards, Wireless Physical Layer Concepts, fundamentals of antennas, Cellular Concept and Cellular System Fundamentals. Spread Spectrum Modulation Techniques, Coding and Error Control, Multiple Access Technique for Wireless Communications, OFDM. Wireless LAN Technologies, Wireless IEEE Standards, Mobile Network Layer (Mobile IP). Mobile Transport Layer (Mobile TCP), Mobile Data network (GPRS), WAP Model and architecture, Introduction to Ad hoc networks, Sensor networks, Bluetooth networks and Wireless Mesh networks.

References :

1. Wireless Communications and Networking by William Stallings, Pearson Education
2. Wireless communication: Principles and Practice, T. S. Rappaport, PHI Publications
3. Mobile Communications by Schiller, Pearson Education
4. Principles of Wireless Networks: A Unified Approach by Pahalvan, K. and Krishnamurthy, Pearson Education.

Distributed Databases - CS- E527

Introduction: Distributed Data processing, Distributed database system (DDBMSS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture

Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation.

Semantic Data Control: View Management, Data security, Semantic Integrity Control

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing

Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction

Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms.

Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management.

Database Interoperability: Database Integration, Query processing

References:

1. Principles of Distributed Database Systems, Second Edition, M.Tamer Ozsu Patrick Valduriez
2. Distributed Databases principles and systems, StefanoCeri,Giuseppe Pelagatti,TatamcGrawHill

Cloud Computing (Open Elective 2) - CS-O521

Cloud Computing: Introduction, Working of cloud computing, benefits;

Understanding Cloud Computing: Developing cloud computing services, Discovering cloud services; Cloud Computing for Everyone: Centralizing email communications, Cloud computing for community; Cloud Computing for the Corporation: Managing Schedules, Managing Projects; Using Cloud Services: Collaborating on Calendars, Schedules, and Task Management, Collaborating on Project Management. Outside the Cloud: Other Ways to Collaborate Online: Collaborating via Web-Based Communication Tools, Collaborating via Social Networks and Groupware.

References:

1. Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009.
2. Implementing and Developing Cloud Computing Applications by DAVID E.Y. SARNA, CRC Press

Cluster and Grid Computing (Open Elective 2) - CS-O522

Cluster Computing: Introduction, Hardware for cluster computing, Software architectures for cluster computing based on shared memory (OpenMP) and message-passing (MPI/PVM) models, Performance evaluation tools, Configuring and Tuning Clusters.

Grid Computing: The Evolution Grid Technologies, Programming models - A Look at a Grid Enabled Server and Parallelization Techniques, Grid applications, Grid architecture, Grid relationship to other Distributed Technologies, Computational and Data Grids, Semantic grids, Grid Management systems: Security, Grid-Enabling software and Grid enabling network services, Virtualization Services for Data Grids; Case Study, Setting up Grid, deployment of Grid software and tools.

References:

1. R. Buyya, High Performance Cluster Computing , Prentice Hall, USA, 1999.
2. Parallel Programming with MPI by Peter Pacheco, Morgan Kaufmann, 1998.
3. I. Foster and C. Kesselman, The Grid : Blueprint for a New Computing Infrastructure , Morgan Kaufmann Publishers , 1999.

M.Tech. IS I Sem. Syllabus

Computer and Network Security IS-C501

Introduction to computer and network security. Basic concepts, threat models, common security goals, Cryptography and cryptographic protocols, including encryption, authentication, message authentication codes, hash functions, one-way functions, public-key cryptography, secure channels, zero knowledge in practice, models and methods for security protocol analysis. Malicious code analysis and defense. Viruses, Worms, spyware, rootkits, botnets, etc. and defenses against them, Detecting Attackers. Software security. Secure software engineering, defensive programming, buffer overruns and other implementation flaws. Language-based security: analysis of code for security errors, safe languages, and sandboxing techniques. Operating system security. Memory protection, access control, authorization, authenticating users, enforcement of security, security evaluation, trusted devices, digital rights management. Network security. Network based attacks, Kerberos, X.509, firewalls, intrusion detection systems, DoS attacks and defense. Case studies: DNS, IPSec. Web security. Securing Internet Communication, XSS attacks and defenses, etc. Advanced topics. Security monitoring, surreptitious communication, data remanence, trusted devices, privacy and security of low-powered devices (RFID) electronic voting, quantum cryptography, penetration analysis, digital rights management and copy protection, security and the law.

References:

2. William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall, New Jersey.

Cryptography IS-C502

Introduction to cryptography. Security Attacks, mechanism and Services. Cryptosystems, Conventional encryption model and techniques, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stream and block ciphers. Block ciphers principals, feistel structure, SPN, DES, triple DES, AES, IDEA encryption and decryption, key distribution. finite field: Introduction to group, ring and field, modular arithmetic, Fermat's and Euler's theorem, Euclid's Algorithm, Chinese Remainder theorem, Entropy and Huffman's coding, Comparison of symmetric and public-key cryptographic systems, Principals of public key crypto systems, RSA algorithm, Diffie-Hellman key exchange algorithm, Message Authentication and Hash Function: security of hash functions and MACS, MD5 message digest algorithm, secure hash algorithm (SHA). Digital Signatures.

Reference Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall, New Jersey.
2. Cryptography Theory and Practice by Douglas R. Stinson.

Cyber Crime and Information Warfare IS-C503

Introduction of cyber crime, challenges of cyber crime, categorizing cyber crime, cyber terrorism, virtual crimes, perception of cyber criminals: hackers, insurgents and extremist groups, interception of data, surveillance and protection, criminal copy right infringement, cyber stalking. Hiding crimes in cyberspace and methods of concealment. Anonymity and markets, privacy and security at risk in the global information society. Privacy in cyber space, web defacements and semantic attacks, DNS attacks, code injection attacks. Information Warfare concept, information as an intelligence weapon, attacks and retaliation, attack and defence. An I-War risk analysis model, implication of I-WAR for information managers, Perceptual Intelligence and I-WAR, Handling Cyber Terrorism and information warfare, Jurisdiction.

References:

1. Principles of Cyber crime, Jonathan Clough Cambridge University Press
2. Information Warfare : Corporate attack and defense in digital world, William Hutchinson, Mathew Warren, Elsevier

Advanced Software Engineering - IS-E511

Software Project Management, Metrics and measurement, Software Configuration management, Software risk management, Requirements Engineering, Software quality assurance, software reliability models. Object oriented design, object oriented programming (with C++), Formal specifications, Formal verification of programs, Jackson method for design, CASE tools and technology, Clean room method for software development, Information system design, Real-time software specification and design. Enterprise architectures, Zachman's Framework, Architectural styles, Design Patterns, Architecture Description Languages, Product-Line architectures, Component Based Development.

References:

1. Pankaj Jalote. An integrated approach to Software Engineering, 2nd

2. Edition, Narosa Publishing house.
3. Roger Pressman. Software Engineering: A Practitioner approach, 4th
4. Edition, McGraw-Hill Publishing.
5. Len Bass, Paul Clements, Rick Katzman, Ken Bass Software Architecture in Practice.
6. L. Pfleeger. Software Engineering, Macmillan Publishing Company, 1987
7. Ghazzi, Frank Buschmann, RegineMeunier Hans Rohnert, Peter Sommerland, Miachel
8. Stal, Doughlas Schmidt Pattern Oriented Software Architecture, Volumes 1 & 2
9. George T.Heineman, William T.Councill. Component Based Software Engineering

Advanced Data Structures - IS-E512

Review of algorithm analysis, Optimal Binary search trees, Balanced binary search trees, Binary heaps, Advanced heap structures, Binomial heaps, Fibonacci heaps. Amortized analysis, Splay trees. Dictionaries, Disjoint set structures. Data Structures for External Memory, External sorting, String matching.Introduction to Randomized Data structures and algorithms.

References:

1. Introduction to algorithms by Cormen and Rivest
2. Randomized algorithms by R.Motwani and P. Raghavan.

CAD of Digital Systems IS-E513

Basic Mathematical Concepts, Introduction to design methodologies, Design automation tools, Algorithmic graph theory and computational complexities, Computational Approaches and methods for combinatorial optimization. Design of digital hardware and HDLs, Introduction to logic circuits, Implementation technologies, Verilog Programming concepts, Gate level modelling, Data flow modelling, Behavioural modelling. Combinational circuit design, Flip-flops, registers, counters and processor,Sequential circuits design, Tasks and functions, Timing and Delays. Data Structure in VLSI design, Layout, placement and partition, floor planning, routing Logic Synthesis, Model Optimization. Verification and Testing.Simple Microprocessor Design

References:

1. Algorithm for VLSI Design automation, Sabih H. Gerez, John Wiley & Sons
2. Fundamental of Digital Logic with Verilog Design, Brown &Vranesic, TMH
3. Verilog HDL, Samir Palnitkar, Pearson Education
4. Digital VLSI Design with Verilog, John Williams, Springer
5. DIGITAL VLSI SYSTEMS DESIGN, Dr. S. Ramachandran, Springer
6. Logic synthesis and Verification Algorithm, Hachtel and Somenzi
7. Verilog HDL synthesis, J Bhaskar, BS Publication
8. Algorithms for VLSI Physical Design Automation., N.A. Sherwani

Distributed Computing IS-E514

Introduction to Distributed System: Goals, Hardware concepts, Software concepts, and Client-Server model. Examples of distributed systems. Communication: Layered protocols, Remote procedures call, Remote object invocation, Message-oriented communication, Stream-oriented communication. Inter process communication in UNIX/LINUX Processes: Threads, Clients, Servers, Code Migration, Software agent. Naming: Naming entities, locating mobile entities, removing un-referenced entities. Synchronization: Clock synchronization, Logical clocks, Global state, Election algorithms, Mutual exclusion, Distributed transactions. Consistency and Replication: Introduction, Data centric consistency models, Client centric consistency models, Distribution protocols, Consistency protocols. Fault Tolerance: Introduction, Process resilience, Reliable client server communication, Reliable group communication. Distributed commit, Recovery. Security: Introduction, Secure channels, Access control, Security management. Distributed File System: Sun network file system, CODA files system, Google File System.

References:

1. A. Taunenbaum, Distributed Systems: Principles and Paradigms.
2. G. Coulouris, J. Dollimore, and T. Kindberg, Distributed Systems: Concepts and Design, Pearson Education

DATA MINING AND WAREHOUSING IS-E516

Basic concept of Data ware house, OLAP and Data mining. OLTP vs. OLAP. Data Warehouse Design - Identifying facts & dimensions, designing fact tables, dimension tables, star flake schema query redirection. OLAP operations Data ware house architecture, Multidimensional schemes:- partitioning strategy, aggregation, data marting, metadata. Capacity planning, tuning the data warehouse testing the data warehouse: developing test plan, testing operational environment Distributed and virtual data warehouses.

Data Mining: Basic concept, A statistical perspective on Data Mining-point estimation, models based on summarization, Bayes theorem, Hypothesis Testing. Classification issues, statistical-based algorithms, distance-based algorithms, decision tree-based algorithms and rule based algorithms. Clustering - similarity and distance measures, outliers' hierarchical algorithms, partition algorithms, clustering large databases. Association Rules, large item sets, Apriori algorithm, sampling algorithm, partitioning, parallel and distributed algorithms, data parallelism task parallelism. Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. Spatial Mining, Special data overview, Special data mining primitives, generation and specialization, spatial rules, spatial classification algorithms. Temporal Mining modeling temporal events, time series, pattern detection Sequences, temporal association rules. Privacy issues with respect to invasive use.

References:

1. Building the data warehouse by W.H Inmon, John Wiley & Sons.
2. Data mining concepts and techniques by Jimali Han and MichelineKamber.

3. Data Mining Introduction and Advance Topic, Margaret H. Dunham and S. Sridhar, Pearson Education

EMBEDDED SYSTEMS IS-E517

Introduction, Hardware & electronics fundamentals, Peripherals. Program Design and Analysis, Processes and Operating system, Real time Operating system Memory, Interfacing Examples of Embedded systems: Digital Camera Examples, Smart card application, Embedded database applications, etc. State Machine and Concurrent Process Models, Control Systems. Verilog programming, Programming of mobile and Hand-held devices. IC Technology Full-Custom (VLSI) IC Technology, Semi-Custom (ASIC) IC Technology, Programmable Logic Device (PLD) IC Technology, FPGA. Hardware Software Partitioning, Hardware/Software Co-Simulation, Intellectual Property Cores, Low Power design

References:

1. Embedded system Design, Frank Vahid, Tony Givargis, John Wiley & Sons
2. Computer as Components, Wayne Wolf, Elseviere
3. 8051 Microcontroller an Application Based introduction, Braithwaite Cowan,Parchizadeh , Eksevier
4. 8051 Microcontroller & Embedded Systems, Rajiv Kapadia, Jaico Books
5. The 8051 Microcontroller & Embedded Systems, Mazidi&Mazida, Pearson education

ADVANCE COMPUTER NETWORKS IS-E518

Review of networking concepts: Network models, Addressing, Data rate limits, Bandwidth, throughput, Latency, Data link control, Multiple Access techniques, Wired LAN, Wireless LAN, VLAN, SONET, ATM, QoS in ATM, ATM applications. IP addressing, forwarding, and routing, IPv4, IPv6, IP Security, Virtual Private Networks. Transport layer protocol, congestion control. Multimedia Networks: Voice/Video over IP, IP Telephony, Voice over ATM, AAL2. Network management, Optical Networks

Graph Theory and Network Algorithms IS-E519

Mathematical Background: Convex Optimization, Stability of Dynamical Systems and Discrete-time Markov Chains, Utility Maximization and Resource Allocation in the Internet, Statistical Multiplexing and queues, delay and packet loss analysis in queues.

Graph Theory: graphs and digraphs, Spanning Trees, Connectivity and Flow, Planar Graphs, Graph Coloring, factorizations, eulerian and hamiltonian graphs, Minimum Connector Problem, Marriage Problem, Assignment Problem, Network Flow Problem , Committee Scheduling Problem, Four Color Problem, Traveling Salesman Problem.

Scheduling in High-Speed Switches: Switch Architectures and Crossbar Switches, Head-of-Line (HOL) Blocking and Virtual Output Queues, Capacity Region and Max Weight Scheduling.

Scheduling in Wireless Networks: Scheduling in Wireless Networks, Channel-Aware Scheduling in Cellular Networks, The MaxWeight Algorithm for the Cellular Downlink

,MaxWeight Scheduling Ad Hoc P2P Wireless Networks. Network Flow Algorithms : Introduction, Distance Network algorithms, Computational analysis and Optimality conditions of Distance Network Algorithms, Maximum flow algorithms, Minimum Cost Flow algorithms, Cycle canceling and Out of-kilter algorithm.

Network Utility Maximization: Utility Maximization for Joint Congestion Control, Routing and Scheduling , Stability and Convergence, Ad Hoc P2P Wireless Networks, Internet versus Wireless Formulations. Distributed Algorithms for Network Communications: Data distribution algorithms, Request-Reply algorithms, Search and traversal algorithms, breaking symmetry and election algorithms, Topology discovery. Routing, Building and maintaining trees, Synchronization. Fault tolerance and recovery, Complexity of distributed algorithms.

Optimization Techniques IS-O511

Introduction: Engineering application of Optimization, Formulation of design problems as mathematical programming problems, General Structure of Optimization Algorithms ,Constraints, The Feasible Region, Branches of Mathematical Programming ,Gradient Information, The Taylor Series, Types of Extrema, Necessary and Sufficient Conditions for Local Minima and Maxima, Classification of Stationary Points , Convex and Concave Functions, Optimization of Convex Functions, General Properties of Algorithms ,An Algorithm as a Point-to-Point Mapping,An Algorithm as a Point-to-Set Mapping Closed Algorithms , Descent Functions, Global Convergence, Rates of Convergence. Unconstrained Optimization: One dimensional optimization techniques: Dichotomous Search, Fibonacci Search ,Golden-Section Search, Quadratic Interpolation Method ,Cubic Interpolation, The Algorithm of Davies, Swann, and Campey, Inexact Line Searches , Multidimensional Gradient Methods ,Steepest-Descent Method, Newton Method Gauss-Newton Method, Conjugate-Direction Methods: Conjugate Directions, Basic Conjugate-Directions Method, Conjugate-Gradient Method, Minimization of Non-quadratic Functions, Fletcher-Reeves Method, Powell's Method, Partan Method. Quasi-Newton Methods: The Basic Quasi-Newton Approach, Generation of Matrix S_k ,Rank-One Method, Davidon-Fletcher-Powell Method, Broyden-Fletcher-Goldfarb-Shanno Method, Hoshino Method, The Broyden Family, The Huang Family, Practical Quasi-Newton Algorithm,Applications of Unconstrained Optimization,Nonlinear Least Squares Problem and Algorithms. Linear Programming: Graphical method, Simplex method, Duality in linear programming (LP),Sensitivity analysis, Interior-Point Methods, Primal-Dual Solutions and Central Path, Primal Affine-Scaling Method, Primal Newton Barrier Method, Primal-Dual Interior-Point Methods. Nonlinear Constrained Optimization: Constrained Optimization, Constraints, Classification of Constrained Optimization Problems, Simple Transformation Methods ,Lagrange Multipliers , First-Order Necessary Conditions, Second-Order Conditions, Convexity , Duality Quadratic And Convex Programming: Convex QP Problems with Equality Constraints, Active-Set Methods for Strictly Convex QP Problems , Interior-Point Methods for Convex QP Problems, Cutting-Plane Methods for CP Problems, Ellipsoid Methods. MinimaxMethods:Minimax Algorithms, Improved Minimax Algorithms,

REFERENCES

1. Practical Optimization Algorithms And Engineering Applications, by Andreas Antoniou, Springer publication.

2. An Introduction To Optimization by EDWIN K. P. CHONG & STANISLAW H. ZAK, Wiley publication.

Technical Foundation for E-Commerce IS-O512

Introduction: Electronic commerce, technology and prospects, forces behind e-commerce, advantages and disadvantages, architectural framework, e-commerce strategy, e-commerce emerging issues and implementation issues, e-commerce law, government policies and agenda.

E-Commerce Infrastructure: Internet and Intranet based e-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN,FRAME RELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile information device, mobile computing applications , security issues in m-commerce. Electronic Payment System: Overview, electronic payment mechanisms and protocols, SET protocol, payment gateway, certificate, digital tokens, smart card, credit card, magnetic strip card, electronic money, electronic contracts, micro-payments, e-checks, e-cash Credit/Debit card based EPS, e-commerce payments security, online banking. electronic data interchange and its applications. Internet Advertising. Models of Internet advertising, sponsoring contents, corporate website, weaknesses in Internet advertising, web auctions and trading mechanism. Securing Business on Network. Security policies, procedures and practices, site security, firewalls, securing web service, transaction security, cryptology, cryptological algorithms, public key algorithms, authentication protocols, digital Signatures, virtual private network, security protocols for web commerce. Advanced Topics. Electronic commerce optimization algorithms, decision support systems for e-commerce, data mining for e-commerce, intelligent techniques for e-commerce.

M.Tech. IS II Sem. Syllabus

Database Security and Access control IS-E504

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control(DAC), Non-Discretionary Access Control , Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations, Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy, Biba's integrity model, Clark-Wilson model, Domain type enforcement model , mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system, Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multiline Insurance Company. Smart Card based Information Security, Smart card operating system-fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR,PPS Security techniques- user identification , smart card security, quality assurance and testing , smart card life cycle-5 phases, smart card terminals.

References

1. Role Based Access Control by David F. Ferraiolo , D. Richard Kuhn , Ramaswamy Chandramouli.

Biometrics IS-E506

Introduction: Definitions, biometric modalities, benefits of biometric versus traditional authenticated methods. Key biometric terms and processes.

Authentication technologies: storage tokens, dynamic tokens, token usability.

Design of a Biometric System: Building blocks, Modes of operation.

Biometric technologies: Passive & active biometric. user acceptance Ease of use ,technology cost, deployability, Invasiveness of the technology , maturity of the technology.

Fingerprint verification: Minutiae Based Fingerprint Matching, Non-minutiae Based Representations, finger print component, algorithms for interpretation. Fingerprint Enhancement, and Fingerprint Classification.

Face Recognition:- Introduction, Authentication vs. Identification, Challenges in Face recognition, Algorithms for face recognitions.

Iris Recognition: Introduction, devices for capturing Iris, Iris representation schemes, Iris recognition algorithms.

Hand Geometry Recognition , Gait Recognition, The Ear as a Biometric, Voice Biometrics, A Palmprint Authentication System. On-Line Signature Verification. 3D Face Recognition. Automatic Forensic Dental Identification, DNA.

Introduction to Multibiometrics.- Multispectral Face Recognition.- Multibiometrics Using Face and Ear.- Incorporating Ancillary Information in Multibiometric Systems. Multimodal Biometrics: Limitations of unimodal systems, multibiometric scenarios, levels of fusion, system

design, score fusion techniques, score normalization, user-specific parameters, and soft biometrics.

The Law and the Use of Biometrics.- Biometric System Security.- Spoof Detection Schemes.- Linkages between Biometrics and Forensic Science.- Biometrics in Government Sector.- Biometrics in the Commercial Sector.- Biometric Standards.- Biometrics Databases
Case Study Presentations: Biometrics in Banking Industry, Biometrics in Computerized, Patient Records, Biometrics in Credit Cards, Biometrics in Mass Disaster Victim, Identification Forensic Odontology

References:

1. Biometrics for network security, Paul Reid, hand book of Pearson
2. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition, Springer Verlag, 2003.
3. A. K. Jain, R. Bolle, S. Pankanti (Eds.), BIOMETRICS: Personal Identification in Networked Society, Kluwer Academic Publishers, 1999.
4. J. Wayman, A.K. Jain, D. Maltoni, and D. Maio (Eds.), Biometric Systems: Technology, Design and Performance Evaluation, Springer, 2004.

Information Theory and Coding (IS-E521)

Information and entropy information measures, Shannon's concept of information. Channel coding, channel mutual information capacity (BW) , theorem for discrete memory less channel, information capacity theorem , error detecting and error correcting codes, types of codes : block codes, hamming and Lee metrics, description of linear block codes ,parity check codes ,cyclic code, masking techniques. Compression : loss less and lossy, Huffman codes, LZW algorithm, Binary image compression schemes, run length encoding, CCITT group 3 1-D compression, CCITT group 3 2D compression, CCITT group 4 2D Compression. Convolution codes, sequential decoding. Video image compression: CITT H 261 Video coding algorithm, audio (speech) compression. Cryptography and cipher.

References:

1. R Bose, "Information Theory, Coding and Crptography", TMH 2007
2. Multimedia system Design by Prabhat K Andleigh and KiranThakrar(PHI Publications).
3. Multimedia Communications by Fred Halsall(Pearson Publications).

Simulation and Modelling (IS-E522)

Introducion: Systems, modelling, general systems theory, Concept of simulation, Simulation as a decision making tool, types of simulation.

Random Numbers and Queuing Theory: Pseudo random numbers, methods of generating random variables, discrete and continuous distributions, testing of random numbers, Concepts of Queuing theory.

Design of Simulation Experiments : Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

Simulation Languages: Comparison and selection of simulation languages, study of these simulation language.

Case Studies: Development of simulation models using simulation language studied for systems like queuing systems, Production systems, Inventory systems, maintenance and replacement systems and Investment analysis.

References:

1. Geoffrey Gordon, "System Simulation", 2nd Edition, Prentice Hall, India, 2002.
2. Narsingh Deo, "System Simulation with Digital Computer, "Prentice Hall, India, 2001.

Operating System Design (IS-E523)

Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems, Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and microkernels.

Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies, Memory management, virtual memory concept, virtual machines, I/O management, File and disk management, Operating system security.

Distributed Operating system: architecture, Design issues, Distributed mutual exclusion, distributed deadlock detection, shared memory, Distributed scheduling.

Multiprocessor operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.

References:

1. Advanced concept in operating system: M. Singhal, N.G Shivratri
2. Operating system internal and design principles: William Stallings

Architecture of large system (IS-E524)

Pipeline processor principles and design, Instruction set architecture; Memory addressing; Instruction composition; Instruction-level parallelism; Hazards; dynamic scheduling, branch prediction; Memory hierarchy; Processor case studies; Multiprocessor introduction: Shared-memory architectures and their synchronization and consistency issues, Advanced multi-core topics; Transactional Memory; Interconnection networks.

References :

1. J. L. Hennessy and D. A. Patterson, Computer Architecture: A quantitative Approach, Morgan Kaufmann, fourth edition, 2006.
2. David Culler, J.P. Singh and Anoop Gupta, Parallel Computer architecture: A Hardware/Software Approach, Morgan Kaufmann, first edition, 1998.
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill, first edition, 1992.

Wireless Communication and Mobile Computing (IS-E525)

Introduction to wireless communication, and future trends, Wireless Generations and Standards, Wireless Physical Layer Concepts, fundamentals of antennas, Cellular Concept and Cellular System Fundamentals.

Spread Spectrum Modulation Techniques, Coding and Error Control, Multiple Access Technique for Wireless Communications, OFDM.

Wireless LAN Technologies, Wireless IEEE Standards, Mobile Network Layer (Mobile IP), Mobile Transport Layer (Mobile TCP), Mobile Data network (GPRS), WAP Model and architecture. Introduction to Ad hoc networks, Sensor networks, Bluetooth networks and Wireless Mesh networks.

References:

5. Wireless Communications and Networking by William Stallings, Pearson Education
6. Wireless communication: Principles and Practice, T. S. Rappaport, PHI Publications
7. Mobile Communications by Schiller, Pearson Education
8. Principles of Wireless Networks: A Unified Approach by Pahalvan, K. and Krishnamurthy, Pearson Education.

Cloud Security (IS-E526)

INTRODUCTION: The Evolution of Cloud Computing, Definition , SPI Framework for Cloud Computing, Traditional Software Model, Cloud Services Delivery Model, Cloud Deployment Models, Key Drivers to A adopting the Cloud, Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing adoption in the Enterprise ; INFRASTRUCTURE SECURITY : Network Level, Host Level, Application Level; DATA SECURITY AND STORAGE :Aspects of Data Security , Data Security Mitigation , Provider Data and Its Security; IDENTITY AND ACCESS MANAGEMENT(IAM) : Why IAM, Definitions, Challenges, Architecture ,Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud ,Cloud Authorization Management; SECURITY-AS-A-[CLOUD] SERVICE : Origins ,Today's Offerings, Potential Threats of Using CSPs , Security in Cloud Computing, Program Guidance for CSP Customers, Future of Security in Cloud Computing .

References:

1. Cloud Security and Privacy by Tim Mather, SubraKumaraswamy, and ShahedLatif, O'REILLY.
2. Michael Miller, " Cloud Computing", Pearson Education, New Delhi, 2009

Intrusion Detection System (IS-E527)

Introduction to Intrusion Detection And Defense, IDS Location, Honey Pots, Security Zones and Levels of Trust, IDS Policy ,Case Study of IDS Such As Snort, NIDS, Nnid And HIDS, Components of IDS, Dealing With Switches ,TCP Stream Follow Up ,Supported Platforms, IDS Protection, IDS Architecture, Examine And Classify Intrusion Detection Systems ,Network-Based IDS: Unauthorized Access, Network Monitoring, Profiling, And Privacy Preservation, Data/Resource Theft, Dos, Sensor-Based And Distributed Network-Node Architectures, Network Signatures, Benefits And Challenges of Network-Based Intrusion Detection. Host-Based IDS: Abuse of Privilege Attack Scenarios, Critical Data Access And Modification, Centralized Host-Based And Distributed Real-Time Architectures, Agent less Host-Based Intrusion Detection, Benefits And Challenges of Host-Based Intrusion Detection.IDS Detection Techniques: Signature and anomaly Based, Implementation And Deployment of IDS, Security

And IDS Management, Intrusion Detection And Trace back In Wireless Networks, Emerging Challenges In Intrusion Detection:

Reference:

1. Rehman, R., Intrusion Detection with SNORT: Advanced IDS Techniques Using SNORT, Apache, MySQL, PHP, and ACID, Prentice Hall, 2003, ISBN: 0-13-140733-3
2. Stamp, M., Information Security: Principles and Practice, Prentice Hall, 2005, ISBN: 0-471-73848-4
3. Crothers, T., Implementing Intrusion Detection Systems: A Hands-On Guide for Securing the Network, Wiley Press, 2002, ISBN: 0-7645-4949-9
4. Endorf, C.,Schultz, G., Mellander, J., Intrusion Detection & Prevention, McGraw Hill, 2004 ISBN: 0072229543

Digital Forensics (IS-O521)

Introduction to legal issues, context, and digital forensics. Digital Evidence - Sources of digital evidence, evidence gathering methods: - Imaging, Forensics copy, selection and extraction, auditing logging, evidence correlation and preservation. Evidence analysis techniques: keyword searches, timelines, hidden data.

Computer Forensics and investigations as a profession, understanding computer investigations, Data Acquisition, processing Crime and Incident Scenes Digital Forensics Models. Working with Windows and DOS Systems, Current Computer Forensics Tools, Macintosh and Linux Boot Processes and Disk Structures, Computer Forensics Analysis and Validation Recovering Graphics Files, Network Forensics, E-Mail Investigations, Cell Phone and Mobile Devices

References:

1. Computer Forensics and Investigations, Nelson Phillips, Enfinger,Steuart , Cenage Learning
2. Computer Evidence Collection and Preservation, Christopher L.T.Brown, Firewall Media Software Forensics, Robert M. Slade , Tata McGraw-Hill

Cluster and Grid Computing (IS-O522)

Cluster Computing: Introduction, Hardware for cluster computing, Software architectures for cluster computing based on shared memory (OpenMP) and message-passing (MPI/PVM) models, Performance evaluation tools, Configuring and Tuning Clusters.

Grid Computing: The Evolution Grid Technologies, Programming models - A Look at a Grid Enabled Server and Parallelization Techniques, Grid applications, Grid architecture, Grid relationship to other Distributed Technologies, Computational and Data Grids, Semantic grids, Grid Management systems: Security, Grid-Enabling software and Grid enabling network services, Virtualization Services for Data Grids; Case Study, Setting up Grid, deployment of Grid software and tools.

References:

4. R. Buyya, High Performance Cluster Computing , Prentice Hall, USA, 1999.
5. Parallel Programming with MPI by Peter Pacheco, Morgan Kaufmann, 1998.

6. I. Foster and C. Kesselman, The Grid : Blueprint for a New Computing Infrastructure , Morgan Kaufmann Publishers , 1999.

Object Oriented Modelling, Analysis and Design (IS-O523)

Object Orientation, OMT Methodology, Object and Class, Link and Association Generalization, Aggregation Multiple Inheritance, Packages. Object Meta modelling, Metadata and Metamodels, Functional Modelling. Pseudocode, Pseudocode with the Object Navigation Notation, ONN Constructs, combining ONN Constructs. Analysis: Object Model, Data Dictionary, Dynamic Model, Functional Model. System Design: Devising an Architecture, Database Management Paradigm, Object Identity, Policies for Detailed Design Dealing with temporal data. Detailed Design:- Object Model Transformations, Elaborating the Object Model, Elaborating the Functional Model, Evaluating the Quality of a Design Model

References:

1. Object-Oriented Modeling and Design by Michael Blaha / William Premerlani, Prentice Hall

EN 501: RENEWABLE ENERGY SOURCES

Introduction, Solar Energy, Principle of Wind Energy Conversion. Tidal and geothermal Energy. Bio-Energy: Classification, Characteristics of biomass, Biomass conversion processes, Gasifiers. Biomethanation, Basics of anaerobic processes, Environmental significance, Biogas production mechanism; Hydel Energy : Types, Hydrological analysis, Water Ways – Fourbay, trashtacks, intake gates, air inlets, power canal, surges in power canal and penstocks. Types & working of surge tanks; Hydraulic Turbines – Types, working, Governing and controls

EN -502 ENERGY CONSERVATION AND AUDIT

Energy audit: Energy Accounting & Analysis, Heating, Ventilation & Air Conditioning audit, Building system energy audit, Energy management, Energy efficient motors. Tariffs and power factor improvement in power system, Load curve analysis and load management.

Thermodynamics of Energy Conservation. energy efficient house keeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation. Maintenance – friction, lubrication, Predictive and preventive maintenance.

Reference Books:

- 1 Hand book of Energy Audits by Albert Thuman, P.E.,C.E.M.
- 2 Energy management by Paul'Callaghan

EN-503 ENERGY ECOLOGY AND ENVIRONMENT

Origin of the earth. Earth's temperature and atmosphere. Sun as a source of energy, nature of its radiation. Biological processes, photosynthesis. Food chains Marine ecosystem. Ecosystem

theories. Autecology, sources of energy, classification, quality and concentration of an energy source, characteristics temperature. Fossil fuels : coal, oil, gas, geothermal, tidal and nuclear energy. Solar, wind, hydropower, biomass. Resources of energy and energy use pattern in different regions of the world. Environmental degradation, primary and secondary pollutants. Thermal and radioactive pollution, air and water pollution. Micro climatic effects of pollution. Pollution abatement methods.

EN-551 WIND ENERGY & ITS UTILIZATION

Introduction: Historical developments, latest developments, state of art of wind energy technology, Characteristics of wind: Nature of atmospheric winds; wind resource characteristics and assessment; anemometry; wind statistics; speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography Aerodynamics of blade and rotor; Wind turbine design; Control Mechanisms: Wind turbine dynamics ; Wind farm: design, Planning

Books and References:

1. Paul Gipe, *Wind Energy Comes of Age*, John Wiley & Sons Inc.
2. L.L.Freris, *Wind Energy Conversion System*, Printice Hall.

EN-552 SOLAR ENERGY & ITS UTILIZATION

Solar radiation spectrum; The Photo Voltaic effect; Spectral response; p-n junction; different types; characteristics; Effect temperature; insolation level & tilt angle; Fabrication and costs of PV cell. Photovoltaic modules; Battery storage; Charge regulators, System Performance. Principles of applied heat transfer, Solar thermal collectors applications : solar ponds; dryers; distillation; solar cooker. Passive Solar design.

EN-553 ENERGY ECONOMICS, POLICY & PLANNING

Energy and Environment Basic Issues:Criteria for Economic Growth; Energy-Economy-Environment Linkages; Emissions Inventories: Assessment and Policy Relevance.

Issues for Developing Countries: Energy and Environment Policies from Urban and Rural perspectives. Analysis Methodologies: Scenarios and Models, Global and Local Environmental Issues: Climate Change Negotiations Technological Options: Energy-Efficiency and New Energy Technologies; Renewable Energy: Issues, Prospects and Policies

EN-511 INSTRUMENTATION & CONTROL

Introduction to instrumentation and controls of energy systems, display instruments, Recorders. Transducers, sensors, actuators and Transmitters such as pressure, temperature, velocity, speed, volume, torque and solar flux measuring devices, current, voltage and power factor. Gas analysers, power plants and industrial instrumentation and pollution monitoring devices. Signal conditioning of Inputs, Single channel and multichannel Data Acquisition System, Computer based DAS, D/A and A/D converters, Data loggers, Supervisory control. Data Transmission systems, Time division multiplexing, Pulse Modulation, Digital Modulation.

EN-512 ENERGY STORAGE TECHNOLOGY

Technology Types– Batteries, flywheels, electrochemical capacitors, SMES, compressed air, and pumped hydro; Theory of Operation– Brief description of the technologies and the differences between them; State-of-the-art – Past demonstrations, existing hurdles and performance targets for commercialization; Cost and cost projections: – Prototype cost vs. fully commercialized target

EN-513 INTELLECTUAL PROPERTY RIGHTS

Introduction to IPR, Importance, need of IPR, Intellectual assets and value realization, Forms of IPR, Patent, Copyright, Trademarks, Protection of IC layout designs, geographical indicators, Protection of undisclosed information, control of anti-competitive practices and Industrial design. International treaties; WTO: International jurisdictions, National Treatment, Technical barriers, Introduction to dispute settlement mechanism of WTO, Indian position in Global IPR structure, Facilitating Technology Transfer and Capability building.

EN-561 POWER PLANT ENGINEERING

Types of thermal power stations. Steam power stations based on fossil fuels. Economy and thermal scheme of the steam power stations. Thermal power plant equipment : boilers, superheaters, economizers, condensers, combustion chamber and gas loop, turbines etc. Gas turbine power stations, steam gas power stations, peak load generating sets. Hydro Electric Stations : Selection of site, Essential features and elements, Elements of nuclear power plant. Load curves, load factor, diversity factors and their significance, Economic scheduling of power stations.

EN-562 SOLAR PASSIVE ARCHITECTURE

Passive heating of buildings- Methods and Techniques of heating buildings naturally, Study of building examples of passive heating. Passive cooling of buildings - Methods and techniques of cooling building naturally. Earth bermed design of buildings. Study of building examples of passive cooling. Study of daylight integrated buildings. Methods and techniques of innovative daylight design. Study of Solar energized buildings. Scope and extent of use of photovoltaic cell for building operations and services.

EN-563 ENERGY EFFICIENT ELECTRIC DRIVES

Introduction of Electrical Drives, D.C. Motor Drives & their classification, Design considerations of thyristorised drives. Induction Motor Drives parameters of speed control stator & rotor side control, Analysis & performance, Harmonic effect & analysis. Design aspects of AC Drives. Vector Control of I.M. Transients in electrical drives, Transient analysis during starting braking & speed control of DC & AC Drives, calculation of energy loss. Energy conservations in Elect. Drives, Selection of Drives for Industrial application.

EN-514 GREEN BUILDINGS

Need of energy in buildings. Role of building design and building services to evaluate the energy performance in buildings. Study of Climate and its influence in building design for energy requirement. Environmental science of buildings. Study of Thermal environment and visual environment. Heat gain and heat loss phenomenon of buildings. Role of building enclosures, openings and materials in thermal environment. Energy efficient light design of buildings.. Design for visual environment. Energy rating of buildings.

EN-515 POWER CONVERSION TECHNIQUES

Introduction to power electronics devices. Power diodes, SCRs, Triacs, GTOs, Power Transistors, P-Mosfets, CMOS and other devices. Converters : A.C. to D.C. Rectifiers and Inverter operations. Choppers & Inverters; A.C. to A.C. Regulators: Voltage control, frequency control. Use of triacs, static switches. Trigger and Controller Circuits: Trigger devices UJT, Optocouplers. Typical firing angle control circuits.

EN-566 INTEGRATED ENERGY SYSTEMS

System Aspects of Integration : voltage effects, thermal effects, fault level. Islanding. Stand Alone Systems : Network voltage and system efficiency, Energy storage methods, Lead-Acid Batteries, Battery charger, case studies of stand alone system. Hybrid Energy Systems and its economic evaluation. Mathematical modeling of Integrated Energy Systems. Technological aspects of power electronic systems connection to the grid

EN-567 ENERGY FROM WASTE

Waste as a Renewable Energy Source, Waste-to-Energy Conversion: Thermochemical Conversion, Biochemical Conversion, Physico-chemical Conversion, Factors affecting Energy Recovery from waste, Agricultural Residues, Animal Waste, Industrial Wastes, Forestry Residues, Municipal Solid Waste (MSW), Converting Waste Heat to Electricity, Bio energy as by product of waste processing, Environmental significance, Introduction to anaerobic digestion, Process fundamentals and design considerations, Process analysis and reactor configurations, Methane production, Energy assessment, Biomethanation from sludge digestion, Types of reactors

GT 501: RENEWABLE ENERGY SOURCES

Introduction, Solar Energy, Principle of Wind Energy Conversion. Tidal and geothermal Energy. Bio-Energy: Classification, Characteristics of biomass, Biomass conversion processes, Gasifiers. Biomethanation, Basics of anaerobic processes, Environmental significance, Biogas production mechanism; Hydel Energy : Types, Hydrological analysis, Water Ways – Fourbay, trashlocks, intake gates, air inlets, power canal, surges in power canal and penstocks. Types & working of surge tanks; Hydraulic Turbines – Types, working, Governing and controls

Books

1. Khan, B H, Non Conventional Energy, TMH.
2. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, Narosa Publication.
3. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication

GT 502 ENERGY CONSERVATION AND AUDIT

Energy Scenario : Commercial and Non-commercial energy, Primary energy resources, commercial energy production, Energy Management & Audit : Definition, need and types of Energy Audit. Energy Management approach-understanding energy costs, Energy Action Planning : Key elements, force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Financial Management : Investment-need, appraisal and criteria.

Reference Books:

1 Hand book of Energy Audits by Albert Thuman, P.E.,C.E.M.

2 Energy management by Paul'Callaghan

GT 503 ENERGY MODELING & SIMULATION

Energy Models. Surveys, Steady-State Computer Models, Dynamic Models: advantages and disadvantages, Interdependence of energy-economy-environment; Modeling concept, and application . Quantitative methods Basic concept of econometrics and statistical analysis; The 2-variable regression model; The multiple regression model; Tests of regression coefficients and regression equation; Econometric techniques used for energy analysis with case studies form India Input – Output Analysis Basic concept of Input-output analysis; concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy;

1. Johnson, R.A. (1999). *Miller & Freund's Probability and Statistical for Engineers*. Prentice-Hall of India Pvt. Ltd.: New Delhi.
2. Kottogoda, N.T. and Rosso, R. (2008). *Applied Statistics for Civil and Environmental Engineers*. McGraw-Hill, International Edition.
3. Kreyszig, E. (1999). *Advanced Engineering Mathematics*. John Wiley & Sons, Inc, India
4. L.I. Sedov (1991) *Similarity and dimensional methods in mechanics*. Mir publ. Moscow
5. *Renewable Energy in India- A Policy Analysis* by Ravindranath Rao, Usha, Natarajan
6. *Energy Planning and Economics-* A.V. Desi

GT-551 SOLAR THERMAL AND PV SYSTEM

Solar radiation spectrum; The Photo Voltaic effect; Spectral response; p-n junction; different types; characteristics, Effect of temperature; insolation level & tilt angle; Fabrication and costs of PV cell. Photovoltaic modules; Battery storage; Charge regulators, Solar PV systems.

Principles of applied heat transfer, Solar thermal collectors applications : solar ponds; dryers; distillation; solar cooker. Passive Solar design.

GT-552 WIND ENERGY & SMALL HYDRO POWER

Wind energy technology, Historical developments, latest developments, Indian scenario and worldwide developments, present status and future trends, wind power plant economics- installation cost, operation cost and cost of energy. Types of wind turbines and their characteristics, Wind turbine dynamics, multiple stream tube theory, vortex wake structure; tip losses; rotational sampling, aerodynamic loads, transient and extreme loads. Types and characteristics of generators used in WECS Hydrology: Water power development : Rainfall and its measurement, average rainfall consisting of rainfall data, Runoff and infiltration indices, river gauging, flood hydrograph analysis, investigation of sites, potential of a river or a basin, pondage Estimation of available power. Types of hydro power plants and their schemes, Elements of hydro power plant

Books

1. 'Wind Energy Comes of Age' by Paul Gipe , John Wiley & Sons Inc.
2. 'Wind Energy Conversion System' by L.L.Freris,, Printice Hall.
3. 'Wind energy Hand Book' by Tony Burton et al, John Wiley & Sons Inc.

GT-553 CARBON SEQUESTRATION AND EMISSION TRADING

Climate Change Diagnostics and baseline determination Climate change strategy & adaptation Greenhouse emissions information management systems Risk assessments & mitigation Verification & auditing Carbon accounting Carbon sequestration (forest sinks) Energy efficiency opportunities Carbon abatement, emission reduction strategies and processes Emission trading Kyoto compliance analyses Biofuels feasibility studies and business design Behavioural change strategies

GT-551 INSTRUMENTATION & CONTROL

Introduction to instrumentation and controls of energy systems, display instruments, Recorders. Transducers, sensors, actuators and Transmitters such as pressure, temperature, velocity, speed, volume, torque and solar flux measuring devices, current, voltage and power factor. Gas analysers, power plants and industrial instrumentation and pollution monitoring devices. Signal conditioning of Inputs, Single channel and multichannel Data Acquisition System, Computer based DAS, D/A and A/D converters, Data loggers, Supervisory control. Data Transmission systems, Time division multiplexing, Pulse Modulation, Digital Modulation.

GT-552 ENERGY STORAGE TECHNOLOGY

Technology Types– Batteries, flywheels, electrochemical capacitors, SMES, compressed air, and pumped hydro; Theory of Operation– Brief description of the technologies and the differences between them; State-of-the-art – Past demonstrations, existing hurdles and performance targets for commercialization; Cost and cost projections: – Prototype cost vs. fully commercialized target

GT-553 INTELLECTUAL PROPERTY RIGHTS

Introduction to IPR, Importance, need of IPR, Intellectual assets and value realization, Forms of IPR, Patent, Copyright, Trademarks, Protection of IC layout designs, geographical indicators, Protection of undisclosed information, control of anti-competitive practices and Industrial design. International treaties; WTO: International jurisdictions, National Treatment, Technical barriers, Introduction to dispute settlement mechanism of WTO, Indian position in Global IPR structure, Facilitating Technology Transfer and Capability building.

GT 554 HYDROGEN ENERGY AND FUEL CELLS

Hydrogen Energy & Applications Hydrogen: Its merit as a fuel; Applications. Hydrogen Economy: Hydrogen and fuel cell; Suitability of Hydrogen as a fuel and fuel cell as energy conversion device Hydrogen Production Methods Production: from fossil fuels, electrolysis, thermal decomposition, photochemical, photo catalytic, hybrid; Hydrogen Storage and Transport Storage: Metal hydrides, Metallic alloy hydrides, Carbon nano-tubes; Sea as the source of Deuterium. Transport: Road, railway, pipeline, and ship. Fuel Cell: Basics Fuel cell definition, difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cell,

performance characteristics of fuel cells Types of Fuel Cells Fuel cell types: alkaline fuel cell, , polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, Geometries of solid oxide fuel cells: planar, tubular,

Books:

1. Wolf, Edmond L. (2004) Nanoparticles and nanotechnology: An introduction to modern concepts of nanoscience, John Wiley and sons, Canada.
2. O'Hayre R., Cha S., Colella W., Prinz F B(2006) Fuel Cell Fundamentals, John Wiley and Sons, New York.
3. Sorensen, B. (2005) Hydrogen and Fuel Cells, Elsevier Academic Press, USA
4. Narayan R, and B Viswanathan(1998) Chemical and Electrochemical Energy Systems, University Press(India) Ltd.

GT-561 POWER PLANT ENGINEERING

Types of thermal power stations. Steam power stations based on fossil fuels. Economy and thermal scheme of the steam power stations. Thermal power plant equipment : boilers, superheaters, economizers, condensers, combustion chamber and gas loop, turbines etc. Gas turbine power stations, steam gas power stations, peak load generating sets. Hydro Electric Stations : Selection of site, Essential features and elements, Elements of nuclear power plant. Load curves, load factor, diversity factors and their significance, Economic scheduling of power stations.

GT-562 GEOTHERMAL, TIDAL & OCEAN ENERGY

Introduction of Geothermal Energy, Geothermal resources; definition and classification, Hydrothermal system, Hot dry rock systems, Geopressured reservoirs, Magma energy, Dry rock and hot aquifer analysis Utilization of geothermal resources, Direct utilization; Swimming bathing & balneology, space conditioning, district heating, Geothermal heat pump; basic concept of heat pump, air conditioner, heating and cooling mode in heat pump, Heat pump with geothermal resources; typical GHP loop configuration Ocean Thermal: Introduction, OTEC history and technology progress, working principle, resources & site requirement ,Tidal Energy: Introduction, causes and working principle, Tidal power calculation, Basic modes of operations, current status of Tidal power. ,Wave Energy: Introduction, basics of wave motion, wave energy generation, wave energy conversion devices, Advantages and disadvantages of wave energy.

Books:

1. Khan, B H, Non Conventional Energy, TMH.
2. Kothari, Singhal & Rajan, Renewable Energy Sources and Emerging Technologies, PHI Learning.
3. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, Narosa Publication.
4. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
5. Tester, Sustainable Energy-Choosing Among Options, PHI Learning.

GT-563 ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

Electrical System : Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit,.Electric Motors : Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motor.. Fans and blowers : Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities .Lighting System : Light source, choice of lighting, luminance requirements, and energy conservation avenues. Diesel Generating system: Factors affecting selection, energy performance assessment of diesel conservation avenues. Energy Efficient Technologies in Electrical Systems : Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters

GT-564 ENVIRONMENTAL IMPACT ASSESSMENT

CONCEPTUAL FACTS OF EIA: Introduction, Definition and Scope of EIA, Objectives in EIA, Basic EIA Principles, Classification of EIA BASELINE DATA ACQUISITION: Environmental Inventory, Data Products and Sources: thematic data, topographical data, collateral data and field data.. PLANNING AND MANAGEMENT OF IMPACT STUDIES: Conceptual Approach for Environmental Impact Studies, Proposal Development, Interdisciplinary Team Formations, Team Leader Selection and Duties, General Study Management, Fiscal Control. OPERATIONAL ASPECTS OF EIA:Screening: Application for Prior Screening for Environmental Clearance, Screening Criteria; METHODS FOR IMPACT IDENTIFICATION: Background Information, Interaction-Matrix Methodologies: simple matrices, stepped matrices, development of a simple matrix, other types of matrices, summary observations on matrices, Network Methodologies:

Text Books:

1. Textbook of Environmental Science & Technology by M.Anji Reddy, BS Publications, 2010
2. Technological guidance manuals of EIA. MoEF.
3. EIA by Canter
4. Man and Environment D.H.Carson 1976 Interactions Part I and III.
5. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications

GT-555 GREEN BUILDINGS

Need of energy in buildings. Role of building design and building services to evaluate the energy performance in buildings. Study of Climate and its influence in building design for energy requirement. Environmental science of buildings. Study of Thermal environment and visual environment. Heat gain and heat loss phenomenon of buildings. Role of building enclosures, openings and materials in thermal environment. Energy efficient light design of buildings.. Design for visual environment. Energy rating of buildings.

GT-556 ENERGY, ENVIRONMENT POLICY AND PLANNING

Energy Action Planning: Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification. Management Principles Organizing location of energy management, top management support, managerial functions, role and responsibilities of energy manager, accountability. Material and Energy Balance Basic Principles-Sankey diagram and its use-Process Flow chart-Method of preparation-Method to carryout M & E Balance Energy & Environmental Acts and

Treaties Global scenario -Indian environmental degradation - Environmental laws - Water (prevention & control of pollution) act 1974 - The environmental protection act 1986 - Effluent standards and ambient air quality standards. Decision support systems for energy planning and energy policy simulation.

1. J. Goldemberg, T.B. Johansson, A.K.N. Reddy and R.H. Williams: *Energy for a Sustainable World*, Wiley Eastern, 1990
2. IEEE Bronze Book: *Energy Auditing*, IEEE Publications, 1996
3. P. Chandra: *Financial Management Theory and Practice*, Tata McGraw Hill, 1992
4. Energy Planning Reports of CMIE, State Governments & Govt. of India
5. J. Rau and D.C. Wooten: *Environmental Impact analysis Handbook*, McGraw Hill, 1980

GT-565 BIO-ENERGY CONVERSION SYSTEMS

Bio energy as by product of waste processing, Biomass classification, Environmental significance, Introduction to anaerobic digestion, Energy plantation, Process fundamentals and design considerations, physical method of bioconversion i.e. Briquetting, pelletization, Energy assessment, Types of reactors, Energy farming. Biogas – A rural energy source, Biogas technology, Types of Biogas plants-components , Selection of model of biogas plant, factors affecting biogas yield, Biogas from landfills , Rural & Urban energy loads, Animal waste, Forest & Agro residue,.

Text Books :

- [1] Maheswari R. C., (1997); Bio Energy for Rural Energisation , Concepts Publication
- [2] Khandelwal KC, Mahdi SS, (1986); Biogas Technology A Practical Handbook, Tat Mcgraw Hill
- [3] Sorensen Bent, Renewable Energy, (2nd Ed 2000), Academic press, New York
- [4] Johansson Thomas B, (1993): Renewable Energy: Sources for fuels and electricity Earthscan Publishers, London
- [5] RosilloCalle Frank, Francisco Rosillo, 2007; The Biomass Assessment Handbook: Bioenergy for a Sustainable Environment Published by Earthscan
- [6] Rai G.D, (2007) ; Nonconventional energy sources by , Khanna Publishers.,
- [7] Mittal K. M , (1996) ; Biogas systems: Principles and applications, New Age International.

GT-566 ENVIRONMENTAL POLLUTION CONTROL TECHNOLOGIES

Classification of Pollution and Pollutants, Causes, Effects and Sources of Pollution. air pollution: primary and secondary pollutants, automobile pollution, industrial pollution, ambient air quality standards, meteorological aspects of air pollution---temperature lapse rates and water pollution: point and non-point source of pollution, major pollutants of water, water quality requirement for different uses, global water crisis issues. marine and nuclear pollution: misuse of international water for dumping of hazardous waste, coastal pollution due to land/soil pollution: Effects of urbanization on land degradation, Impact of Modern Agriculture on Soil, Effect on Environment and Life sustenance, Abatement measures.

Text Books:

1. Text book of Environmental Science and Technology by Dr. M. Anji Reddy, BS Publications, 2010.
2. Environmental Science- Towards a sustainable future by Richard T. Wright, PHI Learning

xxv) NANOTECHNOLOGY(MTech)

First semester

NT-501 SOLID STATE PHYSICS

Crystal bonding and structure, Crystalline, polycrystalline & Non-crystalline solids, X-ray diffraction procedures Defects in solids, Band theory of solids, Free electron theory, Transport properties of materials, dielectric properties of solids, Magnetic materials & its properties, Ferrits & Nano-magnets. Optical and Thermal properties of semiconductors. Structure of Ceramics, Polymers & Composites.

REFERENCES:

1. Introduction to Solid State Physics : Kittel
2. Introduction to Theory of Solids : H.M. Rosenberg

NT-505 INSTRUMENTATION

Resistivity Probing, conductivity, Hall Mobility, Ferroelectric & dielectric measurements. Optical mapping, auto radiography, Electron Micrography. Phase Identification. Chemical assessment, Spectrophotometry, Differential Thermo Analysis. Determination of Physical Structure, use of electrometer. Spectroscopic techniques, NMR, ESR, Photoacoustic spectroscopy. Electron Microprobe Analysis. Measurement of low pressure penning-pirani gauge. Film thickness monitoring & measurement.

REFERENCES :

1. Crystal Growth and Characterisation : R. Ueda and J.B. Mullin
2. Solid State Physics : Ibach and Luth
3. Experimental Techniques of Surface Science: Woodruff and Delchar
4. Handbook of Thin Film Technology : Leon I Maissel & R Glang

NT-503 ATOM & PHOTON PHYSICS

Atomic scale structure of materials. Magnetism: moments, environments and interactions, order and magnetic structure. Scattering theory: Excitations of crystalline materials, magnetic excitations, sources of X-rays and neutrons.

Interaction of light with photon: L.A.S.E.R. Chaotic light and coherence. Laser spectroscopy. Multiphoton processes. Light scattering by atoms. Electron scattering by atoms. Coherence and cavity effects in atoms. Trapping and cooling.

REFERENCES :

1. Light & Matter : Yehuda Band
2. NanoPhotonics : Paras N. Prasad

NT-502 PHYSICS OF NANO MATERIALS

Introduction to Nanotechnology: Characteristic scale for quantum phenomena, Drexler-Smalley debate - realistic projections.

Electronic structure; Quantum well, quantum dots, quantum wires . Nano-clusters , clusters of rare gases, Clusters of Alkali metals. The Jellium Model. Discovery of C₆₀. Fullerene Structure and bonding. Carbon nano tubes. Transport, Optical, Thermal and Mechanical Properties of Nano tubes. Synthesis of nanomaterials using chemical techniques. Application of Nano Materials. Micro & Nano Electromechanical Systems.

REFERENCES :

1. D.Bimberg, M.Grundman, N.N. Ledestov : Quantum Dot Heterostructures
2. Sharma Ashutosh, Jayesh : Adv. In Nano Science & Tech.
3. Dresselhaus M.S. & Avouris : CNT Synthesis, Structure,

NT-504 PROCESSING AND FABRICATION OF NANOSTRUCTURES

Si processing methods: Cleaning /etching, oxidation-oxides, Gettering, doping, epitaxy. Top-down techniques: Photolithography, other optical lithography's (EUV, X-ray, LIL), particle beam lithography's (e-beam, FIB, shadow mask evaporation), probe lithography's. Processing of III-V semiconductors including nitrides. Molecular-beam epitaxy, chemical beam epitaxy, metal-organic CVD (MOCVD). Bottom-up techniques: self-assembly, self-assembled monolayer, directed assembly, layer-by-layer assembly. Combinations of top-down and bottom-up techniques: current state of the art

REFERENCES :

1. Nanostructures : Tsakalakos, Ovidko & Vasudevan
2. Physics of Amorphous Solids : Richard Xylen
3. Nanostructured Films & Coatings : Gang Moog Chow

NT-511 PHYSICS OF NANO FLUIDS AND SURFACES

Nanofluidics and surfaces: liquid structure near solid-liquid interfaces (simple liquids; layering electrolytes: Poisson-Boltzmann equation; Debye Hückel approx.) Hydrodynamic boundary condition: slip vs. non-slip, electro kinetic effects (electrophoresis, electro osmotic effect, electro viscous effect), surface reconstruction, dangling bonds and surface states

REFERENCES :

1. NANO- THE NEXT REVOLUTION : Mohan Sunder Rajan (NBTI)
2. INTRODUCTION TO NANO TECHNOLOGY : Charles P. Pote (Springer)
3. QUANTUM DOT HETEROSTRUCTURES : D.Bimberg, M.Grundman,

NT-512 PHYSICS OF AMORPHOUS MATERIALS

Physics of Amorphous Material: preparation of amorphous materials, metallic glass, thermal evaporation techniques such as sputtering, CVD Techniques, quenching. Glasses, theory for glass transition, glass

transition temperature. Chalcogenide glasses. Structure of disordered materials. Experimental techniques, electronic density of states. Localization phenomenon, transport , optical and dielectric properties.

REFERENCES :

1. Amorphous Materials : S.R. Elliot
 2. Physics of Amorphous Solids : Richard Xylen
 3. Electronic process in Non-Crystalline Materials : Davis & Mott.
- .Disordered Material an Introduction : Paolo M. Ossi

NT-513LASER TECHNOLOGY

Interaction of radiation with matter, absorption and stimulated emission, absorption and gain coefficient, spontaneous emission, homogeneous and inhomogeneous broadening, Doppler width. basic principles of lasers , properties of laser beams, population inversion in three and four level lasers, resonance frequencies, modifications of the laser output, single mode operation, Q- switching. laser materials and types of lasers, solid state lasers, characteristics of dye lasers, semiconductor lasers. Laser applications. Material processing metrology and Remote sensing. Laser induced controlled thermonuclear fusion. Laser applications in spectroscopy.

REFERENCES :

1. Introduction to Laser Physics : K. Shimoda
2. Laser Spectroscopy A Basic Concepts and Instrumentation : W. Demtr der
3. Atomic and Laser Spectroscopy : A. Corney

NT-514 SEMICONDUCTOR DEVICES

Semi conducting materials, p-n junction, space charge and electric field distribution at junctions, forward & reversed biased condition, minority & majority carrier currents, Zener and avalanche break downs, Schottky barrier, Shockley diode & silicon control rectifier, Zener diodes, tunnel diodes, photo diodes. Two port network analysis, H,Y & Z parameters, BJT in CE configuration, Constants of CB & CE amplifier, FET, MOSFET, Equivalent circuit of FET. Source amplifier. Idea of transistor biasing and amplifiers.

REFERENCES :

1. Electronic Devices & Circuits : Millman & Halkins
2. Solid State Electronic Devices : Ben G Streetman
3. Microwave Principle : W.J. Reich
4. Electronics : S. Bhadran

NT-541 LAB PRACTICE-I

List of Experiments:

1. Study of Hall effect
2. Band gap of semiconductor by Four Probe Method
3. LASER Characteristics :
a) Measurement of spot size, b) Power , c) Beam diversion
4. G.M. Tube Characteristics
5. Absorption Coefficient using GM counter
6. Design & Study of CE amplifier
7. Study of operational amplifier IC – 741
8. Study of Emitter follower
9. I/V characteristics of FET
10. I/V characteristics of MOSFET

NT-542 SEMINAR

1. Seminar on Current Trends in Nanotechnology covering Synthesis Process, Characterization.

Second semester

: NT-551 NANOSTRUCTURE CHARACTERIZATION TECHNIQUES

Compositional surface analysis: Ultraviolet (UV) and X-ray photoelectron spectroscopy (XPS), Secondary ion mass spectrometry (SIMS), Contact angles

Microscopies: Optical microscopy, Fluorescence & Confocal microscopy, Cathodoluminescence (CL) and photoluminescence (PL), TEM, SEM.

Probe techniques: Atomic force microscopy (AFM), scanning tunneling microscopy (STM), scanning nearfield optical microscopy (SNOM), Deep level transient spectroscopy (DLTS), Kelvin-probe measurements. Nanoscale current-voltage (I-V), capacitance-voltage (C-V) relationships

REFERENCES

1. Nanostructures & Nano Materials : Ghuzang Cao
2. Hand Book of Nanophase : Zhong Lin Wang (Springer)
& Nanomaterials (Vol. I&II)

NT-552 PROPERTIES OF LOW DIMENSIONAL SYSTEM

Transport properties: quantization of conductance, density of states, Coulomb blockade, Kondo effect. Hall, quantum Hall, fractional quantum hall effects

Vibrational and thermal properties: phonons, quantization of phonon modes, heat capacity and thermal transport

Optical properties: Collective oscillation (Gustav-Mie explanation), surface plasmon resonance, interactions between Nanoparticles, coupled-dipole approximation, Linear and Nonlinear optical properties.

REFERENCES :

1. Handbook of nanotechnology : Bhushan
2. Nano optoelectronics : M.Grundman
3. Nanophotonics : Paras N.Prasad

NT-553 MOLECULAR PHYSICS

Molecular structure: Born-Oppenheimer approximation; Electronic structure ionic and covalent bonding, H_2 , H_2^+ ; Vibrational and rotational structure.

Molecular spectra: Microwave, infrared and optical spectra of molecules; selection rules, experimental set-ups and examples; Raman spectroscopy. ortho-para states.

Molecular processes: Collisions with electrons and heavy particles; Experimental techniques.

REFERENCES

1. Physics of Molecules : Wolf Gang Demtroder
2. Hand Book of Molecular
Physics & Quantum Chemistry : Stephen Wilson

NT-554 NANO ELECTRONICS

Spintronic: Spin injection, spin valve effect, spin valves and MRAM devices

Solid state devices: quantum dots, quantum wires, microwave induced transport Josephson junctions

Photonic bandgap materials, nanoscale photonic devices, Special phenomena in 2D and 3D structures.

The basic properties of liquid crystals and their display and non-display applications at the nanoscale

REFERENCES

1. Nano Electronics and Information Technology : Rainer Waser

Open elective

NT-555 MOLECULAR ELECTRONICS AND BIOMOLECULES

Organic semiconductors, Organic molecules as switches, motor-molecules and biomimetic components .conducting polymers, light emitting polymers,
The self-assembly of complex organic molecules, Molecular connections and the integration of molecular components into functional devices, Contact issues,
Structure of biomolecules; Biotechnology, recombinant DNA technology, molecular biology
Structural and functional principles of bionanomachines, Interfacing bio with non-bio materials, Porous silicon

References

1. Molecular Electronics : T. Helgakar
2. Semiconductor Quantum Dots : Masumota Takaga

NT-561 OPTO ELECTRONICS

Principle of light guidance in optical wave guides. Fabrication and types of Optical fibres, rays and modes, losses in optical fibres and applications. Optical fibre interconnectors, concept of optical waveguides. Nonlinear optics. Second harmonic generation. Birefringence. Electro-optics (Kerr effect, Pockels effect, Faraday effect), Magneto-optics.

Optical Integrated Circuits, Light Emitting Diode, Solar Cells.

REFERENCES :

1. Optical Electronics : A. Ghatak & K. Thyagarajan
2. Quantum Electronics : A. Yariv
3. An Introduction to Optical Fibers : A.H. Cherin

: NT-562 COMPUTATIONAL PHYSICS

Differential equation, special functions Bessel's, Hermite's. Laguerre polynomials. Eigen value , Eigen functions. Perturbation theory. Numerical analysis. Idea of visual basic, c++ and c-sharp.

REFERENCES

1. Mathematical Physics : S.S. Rajput
2. Visual Basic & C ++ : Shyaum Series

NT-563 ADVANCED TOPICS IN PHYSICS

Electrets physics: various types of electrets, methods of preparation, various studies on electrets, uses of electrets

Luminescence: various kinds of luminescence, theory of luminescence, paramagnetic behavior, activators and co-activators, Clustering, color centers. Preparation techniques and application.

Amorphous semiconductor materials. Preparation techniques in bulk form & in thin form. Rocking and quenching of materials. Characterization of amorphous materials.

REFERENCES :

1. Amorphous Materials : S.R. Elliot
2. Physics of Amorphous Solids : Richard Xylen

NT-564 ADVANCE LOW TEMPERATURE PHYSICS

Thermodynamics & liquefaction of gases, Cryostat design , Transport Phenomenon, Fermi surface, Magnetism. Conductivity of solids, Technique of measurement, Paramagnetic & Nuclear adiabatic demagnetization. Superconductivity. fundamental phenomena of super conductivity, Meissner effect, London equation, Type I and Type II superconductors, qualitative idea of Cooper pairing and BCS theory. Ginsburg-Landau theory, coherence length, Green's functions of electrons and phonons, isotope effect, The BCS Hamiltonian, the gap parameter, Superconductor in a field, flux quantization effect, SQUIDS, High- T_c materials.

REFERENCES

- | | | | |
|----|-------------------|---|--------------------------|
| 1. | Superconductivity | : | Werner Buckel & Reinhold |
| 2. | Thermodynamics | : | M.S.Yadav |
| 3. | Treatise on Heat | : | V.K. Shrivastava |

NT-591 Lab Practice - II

List of Experiments:

1. Study of Nanomaterials using AFM
2. Photoluminescence studies of Nanomaterials
3. To take Debye Scherrer pattern of a given poly-crystalline material and determination of third "d" values from powder lines.
4. To determine the response of silicon solar cells and the effect of prolonged irradiations, and to calculate the efficiency and fill factors of a variety of solar cells.
5. Demonstration of SEM
6. Hysteresis Properties of Ferroelectric materials using P-E Loop Tracer
7. Preparation of materials using CVD & PVD Technique.

NT-592 SEMINAR

Seminar on Current Trends in Nanotechnology covering Synthesis Process, Fabrication and Characterization of nanomaterials and their applications in devices.

NT-648 Major Project Dissertation Phase-I

Dissertation on Current Trends in Nanotechnology covering Synthesis Process, Fabrication and Characterization of nanomaterials and their applications in devices.

Note: Topic is to be selected / finalized in consultation with the concerned guide of the candidate. Accordingly the candidate shall carry out the project work.

NT-698 Major Project Dissertation Phase-II

Dissertation on Current Trends in Nanotechnology covering Synthesis Process, Fabrication and Characterization of nanomaterials and their applications in devices.

Note: Dissertation work is to be carried out and submitted within the stipulated time in consultation with the concerned guide of the candidate. Before submission of Dissertation the student must have one publication in Journal of repute.

MASTER OF COMPUTER APPLICATIONS (MCA)

First SEMESTER

MCA - 101 MATHEMATICS- 1

Logic Propositions and Logical Operations, First Order Predicate Logic, Fuzzy Sets, Fuzzy Relations, Properties and Operations on Fuzzy Relations. Relations, Equivalence Relations, Posets, Lattices, Complemented Lattices, Sub Lattices. Distributive and Modular Lattices. Boolean Algebra, Group

Theory. Graph Theory Directed and Undirected Graphs, Connectedness Algorithms, Shorter Path. Algorithm Euclidian and Hamiltonian Graphs, The Travelling Salesman Problem, Trees: Spanning Trees, Rooted Trees and Binary Trees. Discrete Numeric Functions, Generating Functions, Recursion and Recurrence Relation, Coding Theory, Binary Symmetric Channel, Coding Process, Decoding, Error Detection and Correction Codes. Vector Spaces, Linear Mapping, Linear In-Equality, Inner Products, Norms.

“Applied Discrete Structures For Computer Science”, Alan Doerr & Kenneth Levasseur, Science Research Associates; “Discrete Mathematical Structures For Computer Science”, Bernard Kolman & Robert C. Busby, Prentice-Hall; “Discrete Mathematical Structure with applications to Computer Science”, J.P.Trembley & R.P.Manohar, McGraw Hill;

MCA - 102 COMPUTER ORGANIZATION & ARCHITECTURE

Fundamentals of Computer & Logic Circuits, Register Transfer and Micro Operations, Input-Output Organization, Memory Hierarchy and Memory Management Schemes & Hardware, Pipeline and Vector Processing, Introduction of Microprocessors, Introduction to 8085 Architecture and Its Extension to 8086, First Generation and Modern Second Generation Processors and Its Comparative Study.

“Computer System Architecture”, M. Mano, Prentice-Hall; “Advanced Computer Architecture”, Kai Hwang, Tata McGraw-Hill; “Digital Electronics”, Malvino & Leach, McGraw Hill;

MCA - 103 DATA STRUCTURE

Introduction to Data Structure, Primitive and Abstract Data Types, Complexity Analysis, Abstract Data Types, Linear Data Structures: Stacks, Queue, Linked List; Non-Linear Data Structures Trees, Graph, Searching & Sorting Techniques.

“An introduction to data structures and algorithms”, Tremblay & Sorenson, Addison Wesley; “Data Structures Using C”, Aaron M. Tenenbaum, Prentice Hall; “Introduction to Data Structures”, Bhagat Singh & Thomas Naps, West Publishing Company; “Fundamentals of Data Structures”, Ellis Horowitz & Sartaj Sahni, Computer Science Press;

MCA - 104 OPERATING SYSTEM

(3-0-0) 3

Fundamental Concepts of Operating System, Process & Processor Management, Deadlock Handling, Concurrent Processes, Memory Management, File Systems, Device Management, Distributed Systems. Case Studies: Unix, Windows, Linux, Mac.

“Operating System Principles”, A. Silberschatz, PB Galvin & G. Gagne, wiley india; “Internal structure of window 95”, N.Zipps, PHI; “Operating System” , James L. Patterson, Addison Wesley; “Opearting Systems”, Nutt G, Addison Wesley Addison Wesley;

MCA- 105 PROGRAMMING Through C & C++

(3-0-0) 3

Programming concepts, Data Types, Decision Making and Loop constructs, Arrays, Structures, Pointers, Functions, File Handling, Pointers, Structures, Principles of Object oriented programming, Classes and objects, Polymorphism, Inheritance, Templates, Exception and File Handling,

“Complete reference in C”, Herbert Schield, TMH; “Let us C”, Yashwant Kanetkar, BPB; “An introduction to object-oriented programming”, Timothy Budd, Addison-Wesley; “Mastering C++”, KR Venugopal & Rajkumar, TMH;

MCA-131 Programming Lab – I

(0-0-5) 5

The students have to carry out the assignment work of the papers MCA101, MCA 103 & MCA 105.

Second Semester

MCA–201 MATHEMATICS 2

Finite Difference, Interpolation and Extrapolation, Inverse Interpolation, Numerical Differentiation Numerical Integration, Gauss-Legendre, Monte Carlo Methods of Integration, Numerical Solution of Ordinary Differential Equations of First And Second Order, Solution of Simultaneous Differential Equation, Solution of Algebraic and Transcendental Equation Solution of Non-Linear Equations. Solution of Linear Simultaneous Equations, Fourier Transform, Sine and Cosine Transform, Laplace Transformation of Elementary Functions, Inverse Transform, Solution of Ordinary Differential Equations Using Laplace Transform Techniques

“Numerical Algorithms”, B.S. Grewal, Khanna Publications; “Numerical Algorithms EWP”, Krishnamutry & Sen; “Numerical Methods for Scientists & Engineers” M.K. Jain & Iyengar; “Simulation and Modeling” Gordan, PHI; “Advanced Engineering Mathematics” Erwin Kreyszig, Wiley;

MCA-202 ADVANCED COMPUTER ARCHITECTURE.

Review of General Concepts of Computer System Architecture, Overview of Modern Processor Architectures PRAM and VLSI Models, Multiprocessors and Multicomputer. Multivector and SIMD Computers, PRAM and VLSI Models, Basic Parallel Processing Architecture, Taxonomy-SSID.MISD, SIMD, MIMD Structures, CISC Vs. RISC. Vector Pipeline Architectures and Pipelined CPU Architecture, Connectivity Interconnection Networks: Topology, Routing, Flow Control, Deadlock Avoidance, Static and Dynamic Interconnection Networks, Concurrency and Synchronization, Parallel and Scalable Architectures. Case Study: Basic Features Current Architectural Trends .DSP Processor, Dual Core, Intel Core i3, i5, i7.

“Advanced Computer Architecture”, Kai Hwang, Tata McGraw Hill; “Computer Architecture & Organization”, John P. Hayes, Tata McGraw Hill; “Computer organization and Design; The hardware/Software interface”, John Hennessy & David Patterson, 2nd Edition, Morgan Kaufman Publishers; “Modern Operating Systems”, Andrew S Tanenbaum, 2nd Edition, Prentice Hall;

MCA - 203 SOFTWARE ENGINEERING.

Software Characteristics, Components, Models and Myths, Software Process and Metrics, Software Project Planning, Risk Management, Project Scheduling and Cost Estimation, Quality Assurance, System Engineering Concepts, Analysis, Modelling.

“Software Engineering”, Pressman, TMH; “Software Engineering”. Pankaj Jalote, Narosa Publication; “Software Engineering Concept”, Richard Fairley, TMH; “Analysis and design methods”, J. Senn, McGraw-Hill;

MCA-204 PRINCIPLES OF PROGRAMMING LANGUAGES.

Concepts & Elements of Programming Languages, Procedures and Processes; Iterative Vs. Recursive, Local Procedures and Local Variables, Programming Language Implementation – Compilation and Virtual Machines, Syntax and Semantics, Data Types, Concept Of Binding, Type Checking, Expressions and Statements, Control Subprograms and Blocks, Scope and Lifetime Of Variable, Overloaded Sub-Programs, Generic Sub-Programs, Co-Routines. Abstract Data Types, Concurrency Semaphores, Monitors, Message Passing, Threads. Exception Handling, Object Oriented Programming Logic Programming, Functional Programming Languages, Imperative Programming. Case Study: C, C++, C#, JAVA & Other Programming Languages.

“Concepts of Programming Languages” Robert .W. Sebesta, Pearson Education; “Programming Languages”, Louden, Thomson; “Programming Languages Design and Implementation”, Pratt & Zelkowitz, PHI/Pearson Education; “Concepts of Programming Languages” Robert Sebesta, Addison Wesley;

MCA-205 THEORY OF COMPUTATION.

Strings Alphabets and Language, Finite State Systems, Deterministic and Nondeterministic Finite Automata, Two Way Finite Automata, Finite Automata with Output, Finite State System, Regular Expression and Language, Regular Grammar. Properties of Regular Languages, Context Free Grammar & Language, Normal Forms, Pumping Lemma for CFL, Application for CFL Of Pumping Lemma. Closure Properties, Context Sensitive Language, Chomsky Hierarchy, Unrestricted Grammar, Pushdown Automata, Equivalence of PDA’s and CFL’s Turing Machine. Undecidability & Intractable Problems. Computational Complexity Theory. Case Study: LEX, YACC, JAVA CC.

“Introduction to Automata Theory Language and Computation”, By John E. Hopcraft & Jeffery D. Ullman; “Introduction to Automata Theory Language and Computation”, By John E. Hopcraft Jeffery D. Ullman & Rajeev Motwani; “Theory of Computer Science” K.L.P. Mishra & N. ChandraShekaran;

MCA-231 Programming Lab – II

The students have to carry out the assignment work of the papers MCA 201, MCA 204 & MCA 205.

Third Semester

MCA – 301 MATHEMATICS–III

Probability Theory Conditional Probability, Baye’s Theorem. Non-Linear Regression, Multiple Correlations and Regression, Random Numbers: Algorithms for Generation of Random Numbers, Discrete Random Variables, Acceptance and Rejection Techniques. Random Variables and Distributions- Random Variables, Continuous Random Variables, Probability Density Functions. The Discrete Uniform, Distributions, Binomial, Poisson, Hyper Geometric Distributions. Continuous Probability Distributions, Uniform, Exponential and Normal Distributions. Hypothesis Testing-Testing of Statistical Hypothesis, Null Hypothesis, Tests of Hypothesis and Significance, One Tailed Proportions, Chi-Square, T, Z and F Tests, Losses and Risks. Analysis of Variance- One Way and Two-Way. Matrix Decomposition, Singular Value Decomposition, PCA

“Mathematical Statistics”, J.E. Freund & R.E. Walpole; “Probability and Statistics with reliability queuing and Computer Science Applications” by K.S. Trivedi; “Introduction to Mathematical Statistics”, F. Kreyzic; “Statistical Analysis: Computer Oriented Approach” A.A. Affi; “Statistics” Schaum’s Series, M.R. Spiegel.” “Basic Principal Component Analysis”, I.T. Jouiffe Springer;

MCA-302 UNIX AND ITS INTERNALS.

General Overview of The System, Internal Representation of Files, Structures of Processes and Process Control, Process Scheduling, System Calls, Memory Management Policies, I/O Subsystem, The Inter-Process Communication.

“UNIX Utilities”, Tare, McGraw-Hill; “UNIX Operating System”, Subhajit Das; “Unix Operating System”, Maurice J Bach, Prentice-Hall; “Unix Shell Programming”, Yashavant P. Kanetkar, BPB Publications; “Unix” Stephen Prata;

MCA - 303 WINDOWS PROG AND SCRIPTING LANGUAGE.

Introduction to Windows Program. Message Processing, Menu and Accelerators. Handling Icons, Cursor and Bitmaps, Dialog Box & Child Window Controls, Working With Text and Font and Graphics, Consoles, Multitasking Process and Threads, Advance Window, Advance Features of Windows

Programming Like GDI Metafiles, Clipboard Drag and Drops Sound API, Scripting Languages, Programming Through Vbscript, Java Scripts, Web Application Development Using Databases.

“Windows Programming”, Charles Petzold, Microsoft press; “Windows Programming”, Herbert Schildt, Osborne;

MCA – 304 ANALYSES AND DESIGN OF ALGORITHM

Algorithm and its characteristics, Asymptotic Notations, Divide and Conquer Approach- Searching and Sorting, Matrix Operations, Recurrence Relations, Augmenting Data Structure, Dynamic Programming, Greedy Algorithm, Amortized Analysis, Branch & Bound Techniques, Linear Programming Problems, Tree and Graph- Minimum Spanning Tree, Shortest Path, NP hard and NP Complete Problems.

“Fundamentals of Computer Algorithms” Ellis Horowitz & Sartaj sehani galgotia; “Introduction to Algorithms”, Cormen, Leiserson, Rivest, PHI; “Algorithm Design”, Michael T. Goodrich & Roberto Tamassia; “Introduction to the Design & Analysis of Algorithms”, Anany Levitin, Addison Wesley; “Analysis and Design of Algorithm”, Ullman, TMH;

MCA - 305 DATA BASE MANAGEMENT SYSTEM

Introduction to Database Design and Data Models, The Relational Model, Relational Algebra and Calculus, SQL, Embedded and Dynamic SQL, Query Processing and Optimization, Database Design Issues and Normalization, Transaction Processing and Concurrency Control, Failure and Recovery Systems, Security and Authorization, Design of Object Oriented Databases.

“Data Base Management System”, Raghu Ramakrishnan & Johannes Gehrke, McGraw-Hill; “Database System Concept”, Henry F. Korth Abraham Silber Schatz, McGraw-Hill; “Database System Concept”, C.J. Date, Addison Wesley; “SQL PL/SQL - The Programming Language of Oracle”, Ivan bayross, BPB Publications; “Fundamental of Database Systems”, Elmasi, R. & Navathe, Addison-Wesley.

MCA-331 Minor Project – 1

The students are required to develop small projects in Database, Window Programming

Fourth Semester

MCA - 401 COMPUTER ORIENTED OPTIMIZATION

Linear Programming, Mathematical Model, Hungarian Method & Its Algorithm. Transportation Problem, Integer Programming Integer Programming Algorithm, Dynamic Programming Optimal Subdivision Problem, Decomposition, Queuing Theory, Queuing Problem and System, Transient and Steady State Distributions In, Queuing System, Poisson Process, Exponential Process, Classification of Queuing Models, Inventory Theory Economic Deterministic Inventory Models Probabilistic Inventory Models With Instantaneous Demand, Games Theory Minimax-Maxmin Principle for Mixed Strategy Games, Graphical Method, Solution of (Mxn) Job Sequencing PERT – CPM.

“Operations Research”, S.D. Sharma, Kedarnath Ramnath & Co.; “Operations Research”, P.K.Gupta & D.S.Hira, S.Chand & Co; “Operations Research”, Kantiswaroop, S.Chand & Sons; “Introduction to Operations Research A Computer-Oriented Algorithmic Approach”, Billy E. Gillett, TMH; “Introduction to operations Research”, Hillier, TMH;

MCA - 402 COMPUTER NETWORKS

Introduction: Type of Networks & Protocol Hierarchies. Reference Models: The OSI & TCP/IP Reference Models, Physical Layer: Transmission Media & Related Issues; Analog, Digital & Wireless Transmission, Transmission and Switching, The Data Link Layer: Design Issues: Services Provided, Framing, Error Control, Flow Control; Error Detection and Correction; Elementary and Sliding Window Protocols, Medium Access Sub Layer, Channel Allocation Problem, Multiple Access Protocols, Ethernet, IEEE 802 Standards for LANs And MANs, Network Layer, Design Issues, Routing Algorithms,

Congestion Control, QOS, Internetworking, IP & IP Addressing, Transport Layer : Transport Service, Elements Of Transport Protocols, TCP & UDP, Application Layer Overview : Email, DNS, WWW. Case Study: Network Monitoring & Simulation: Study Of Wireshark, NS-2,NS-3, Exata Etc.

“Computer networks”, Andrew S. Tanenbaum, Prentice Hall; “Communication networks: fundamental concepts and key architectures”, Leon Garcia, TMH; “Local Area Networks”, Gred Keiser, TMH; “Beginning Programming with C++ For Dummies”, Stephen R. Davis, John Wiley & Sons; “Unix Network Programming”, S. Davis, PHI; Kurose, “Computer Networking : A Top-Down Approach Featuring the Internet”, J.F. Kurose & K.W. Ross, Addison Wesley;

MCA-403 COMPILER DESIGN

Introduction to Compiling, Lexical Analysis, Parsing Techniques, Syntax Directed Translation, Symantec Analysis, Symbol Table, Code Generation & Code Optimization Techniques,

“Art of Compiler Design : The Theory & Practice”, Thomas Pittman & James F. Peters, Prentice Hall; “Compiler Design” Renhard Wilhelum & Dieter Mauerl; “Compiler design in C”, Allen I. Holub, Prentice Hall; “Building an optimizing compiler”, Robert Morga & Butterworth-Heinemann; Modern Compiler Design;

MCA-404 DISTRIBUTED SYSTEMS

Distributed System & Its Architecture. Hardware & Software Issues. Communication: Layered Protocols, Client Server Protocols, RPC, Group Communication. Coordination, Synchronization & Consistency: Logical Clocks, Physical Clocks, Mutual Exclusion, Election Algorithms, Atomic Broadcast, Sequential Consistency Transaction Distributed Consensus, Threads: Thread Synchronization, Implementation Issues, Threads Vs. RPC, Models of Distributed Computing: Client Server and RPC, RPC Architecture & Underlying Protocols, IDL, Marshalling. Group Models and Peer To Peer: Groups For Service Replication/Reliability, Groups for Parallelism / Performance, Client/ Server Vs. Peer-To-Peer, Multicast, Atomic Broadcast, Distributed File System, Distributed Shared Memory & Its Architecture, Fault Tolerant Distributed Systems, Distributed Multimedia System, Security Techniques and Cryptography.

“Distributed Systems”, Concepts and Design”, George Colouris, Dick Grune Henri E. bal Ceriel .h.jacobs Koen G.la, Pearson Education India; Distributed System, Sape Mull Ender, Addison Wesley;

MCA-405 WEB BASED APPLICATIONS DEVELOPMENT

Programming with JAVA, Packages, JDBC & ODBC Connectivity, Types of Drivers, Remote Method Invocation RMI, JAVA BEANS, JAVA Security, Concepts of COM, DCOM, Active X, ORB, WAP, Bluetooth, Net Technology, Case Study: Perl, Python, PHP.

“Complete Reference JAVA2”, H.Schildt, TMH; “Java Servlets”, Phil Hanna, TMH; “Java Thread Programming”, Paul Hyde, Sams; “Java Virtual Machine”, Tim Lindholm & Frank Yellin, Addison Wesley;

MCA-431 Minor Project – 2

The students are required to develop Web Based Applications.

Fifth Semester

MCA - 501 COMPUTER GRAPHICS

Graphics System and Primitives, Input and Output Devices, Shapes & Drawing Algorithms, Scan Conversion, Geometric Transformation, Viewing & Clipping, Curves, Lines and Surfaces, Colour & Shading Models, Projection, Hidden Surfaces, Introduction to Multimedia and Animation. Case Study: Graphics Tool Kit.

“Computer Graphics”, D.Hearn & M.P. Baker, Pearson Education; “Procedural Elements of Computer Graphics”, David F. Rogers, WCB/McGraw-Hill; “Principles of interactive computer graphics”, New Mann & Sprovl, McGraw- Hill;“Digital Multimedia” Nigel Chapman & J. Chapman, Wiley India;

MCA-502 INTELLIGENT SYSTEMS

Introduction to Intelligent System, Heuristic Search Techniques, Knowledge Representation using Predicate Logic, Semantic Nets, Frames, Conceptual Dependency.

Natural language Processing and Study of its Different Phases, Game Playing, Planning: Nonlinear and Hierarchical planning. Statistical Reasoning: Probability and Bayes Theorem Certainty Factor and Rule Based System Parallel and Distributed AI Psychological Modeling, Learning, Expert System, Common Sense, Ontology.

“Artificial Intelligence”: Kevin Knight, Elaine Rich & B. Nair, McGraw Hill Education; “Artificial Intelligence: A Modern Approach”, Stuart Russell & Peter Norvig, Prentice-Hall;

MCA-503 MOBILE APPLICATION DEVELOPMENT

Introduction to Mobile Computing, Factors in Developing Mobile Applications, Mobile Software Engineering Frameworks and Tools, Mobile Application Design :Application Model and Infrastructure, Hardware and Software Architecture Mobile development Environment and Software, Interface Development for Mobile Apps, Intents and Services, Storing and Retrieving Data, Mobility and Location Based Services ,Communications, Web Telephony, Notifications and Alarms, Graphics, Multimedia, Packaging and Deploying, Security and Hacking.

Case Study: Android, Symbian /S60, Mac, BREW, JavaME/JavaFX etc.

“Mobile Design and Development”, Brian Fling, O'Reilly Media; “Mobile Applications Development”, Scott B. Guthery, Mary J. Cronin, McGraw-Hill; “ Professional Android Application Development” ,_Reto Meier, Wrox;

Department Elective-I

MCA-511 DATA WAREHOUSING & MINING.

Data Warehousing & Mining, Data Pre-processing, Mining Association Rules, Classification and Prediction, Classifier Accuracy, Cluster Analysis, Applications and trends in Data Mining, Graph Mining, Text Mining, Case Study: Data Mining Tools.

“Building Data Ware House”,W.H.Inmon, John Wiley & Sons;“Data Mining Concepts & Techniques”,Jiawei Han & Micheline Kamber; Harcourt India PVT Ltd;“Oracle 8i Building Data Ware Housing” Michall Corey, M.Abbey, I Azramson & Ben Taub, TMH;“Data Mining, Practical Machine Learning tools & techniques with Java” Ian H. Witten & Eibe Frank, Morgan Kanffmen;

MCA-512 ADVANCED SOFTWARE ENGINEERING

Design Concepts and Principles of Software Design and Engineering, Software Testing Methods and Strategies, Object-Oriented Software Engineering, Object-Oriented Testing, Software Quality Assurance, Web Engineering Client-Server Software Engineering, Reengineering, Computer-AIDED Software Engineering.Case Study: Rational Rose & Other Case Tools.

“Software Engineering- A Practitioner’s Approach”, R. S. Pressman, McGraw Hill; ”Software Engineering”, Ian Sommerville, PHI; “An integrated approach to software engineering”, Pankaj Jalote, Narosa; “Fundamentals of Software Engineering”, A. Leon & M. Leon, Vikas;

MCA-513 ADVANCED RDBMS

The Extended Entity Relationship Model and Object Model, Object-Oriented Databases, Complex Objects, and Database Schema Design for OODBMS, OODBMS Architecture and Storage issues. Object

Relational and Extended Relational Databases Query Processing and Optimization, Advance Querying. Parallel and Distributed Databases and Client-Server Architecture and various issues i.e. Data Fragmentation, Replication, and Allocation Techniques for Distributed and Parallel Database. Databases on the Web and Semi Structured Data: Web Data and XML, Temporal Database Concepts, Spatial Databases, Mobile Databases, Geographic Information Systems, Multimedia Databases. Advance Transaction Processing Systems and Multimedia Database. Case Studies: Advance Features in Oracle, Microsoft SQL Server for Multimedia Database, Web Database.

“Fundamentals of Database Systems”, Elmasri and Navathe, Pearson Education; “Database System Concepts”, Korth, Silberchatz & Sudarshan, McGraw-Hill;” Introduction to Database Systems”, C.J.Date & Longman, Pearson Education;

MCA-514 INFORMATION RETRIEVAL

Goals and History of IR, Basic IR Models, Experimental Evaluation of IR, IR Forums, Query Languages and Operations, Text and Text Operations, Indexing and Searching, Web Search Engines: Spiderling Met Crawlers.

Multimedia Languages and Properties & IR: Models & Languages, Parallel and Distributed IR, User Interface and Visualization, Digital Libraries, Recommender Systems, Information Extraction and Integration

“Modern Information Retrieval”, Ricardo Baeze & Yates Berthier Ribeiro-Neto, Pearson Publication; “Introduction to Information by Manning”, Raghavan & Schuetze, Retrieval Cambridge University Press;

MCA-515 NATURAL LANGUAGE PROCESSING

Introduction to Natural Language Processing: Linguistic Background, Grammar and Parsing: Grammars & Parsing, Ambiguity Resolution. Semantic & Logic Forms, Linking Syntax and Semantics, Ambiguity Resolution, Symantec Interpretation, Knowledge Interpretation Reasoning. Local Discourse Context and References Discourse Structure, Conversational Structure.

“Natural Language Understanding”, James Allen, Pearson Education; “Foundations of Statistical Natural Language Processing” Christopher D. Manning & Hinrich Schuetze, MIT Press; “Statistical Machine Translation” Philipp Koehn, University of Edinburgh Cambridge Press;

ELECTIVE – II (MAC 521- 525)

MCA-521 MULTIMEDIA COMPUTING

Introduction to Multimedia, Multimedia Objects, Multimedia Hardware, Software, Presentation Tools, Audio & Video File Formats, Sampling, Digital Audio Concepts, Compression, Multiple Monitors, Bitmaps, Video Representation, MHEG Standard, Recent Development in Multimedia.

“Multimedia, Making IT Work”, Tay Vaughan, Osborne McGraw Hill; “Multimedia Systems”, Buford, Addison Wesley; “Multimedia technology and Applications”, David Hillman, Galgotia Publications; “Data Compression Book”, Mark Nelson, BPB;

MCA-522 PARALLEL COMPUTING

Computational Demands, Advantages of Parallel Systems, Topologies, PARAM Model of Parallel Computation, PARAM Algorithms, Mapping and Scheduling, Applications of Parallel Computing.

“Parallel Computing: Theory and Practice”, Michael Jay Quinn, McGraw-Hill; “Advanced Computer Architecture”, Kai Hwang & Naresh Jotwani, McGraw-Hill;

MCA-523 CLOUD COMPUTING

Introduction to Cloud Computing, Cloud Architecture and Service Models, The Economics and Benefits of Cloud Computing, Horizontal/Vertical Scaling, Thin Client, Multimedia Content Distribution, Multiprocessor and Virtualization, Distributed Storage, Security and Federation/ Presence/ Identity/ Privacy in Cloud Computing, Disaster Recovery, Free Cloud Services and Open Source Software and Example Commercial Cloud Services.

“Cloud Computing Implementation Management and Security”, J W Rittinghouse & J F Ransome, CRC Press; “Cloud Application Architecture”, George Reese, O’Reilly;

MCA-524 IMAGE PROCESSING

Introduction to Image Processing Systems, Digital Image Fundamentals, Manipulation on Images, Images Transformation, Image Smoothing, Restoration, Image Encoding and Segmentation, Edge linking and boundary detection, Thresh-holding, Filtering, Information Theory. Image Representation Models.

“Digital Image Processing”, Rafael C. Gonzalez, Richard E. Woods, PHI; “Digital Image Processing, A.K.Jain, PHI; “Computer Image Processing and Recognition”, Hall, E. L., Research sponsored by the U.S. Air Force; “Digital Image Processing”, Pratt, W. K, Wiley-Interscience, New York.; “Digital Image Processing”, Bernd Jahne, Springer;

MCA-525 NEURAL N/W & FUZZY LOGIC

Introduction to Neural Network Architecture and Basic Models of Neural Network: McCulloch Pitt Model, Hopfield Network, Adaline and Madaline, Supervised and Unsupervised learning Learning. Supervised Neural Network, Perceptron, Convergence theorem, Multi-layer Perceptrons, Attractor Neural Network: Bidirectional Associative Memory. Radial Basis Function Networks, Kernel methods for pattern analysis: Support Vector Machines, Support Vector Regression. Self-Organizing Maps, Feedback Neural Network, Adaptive Resonance Theory. Basic Concepts of Fuzzy Logic. Case Study: MATLAB Tool Boxes.

“Neural Network”, Simon Haykin, Pearson Education Association; Satish Kumar, “Neural Networks – A Classroom Approach”, Satish Kumar, Tata McGraw-Hill;

MCA-531 MINOR PROJECT III

The students are required to develop a small project in any concern area of the study as decided by supervisors.

Sixth Semester

The student is required to carry out a major project work during this semester.

MCA-601 FINAL DISSERTATION (MAJOR PROJECT)

MCA-602 SEMINAR/PRESENTATION (MAJOR PROJECT)

MASTER OF BUSINESS ADMINISTRATION (MBA)

First Semester

MBA101-Principle and Practices of Management

Concept, Art vs Science, Management vs Administration, levels and evolution of management, Hawthorne experiments, planning and its types, process, barriers to effective planning, decision making, and process. Organisation Theories, organisational structure, Span of Control, Authority & responsibility, staffing concept, system approach, Manpower Planning, Direction and Supervision, control and its type, Methods.

Reference books:-

- ❖ Stoner, Freeman & Gilbert Jr – Management- Prentice Hall of India Pvt Ltd New Delhi.
- ❖ Heinz Weinrich & Harold Koontz- Management- A global perspective- Tata McGraw Hill

MBA 102 Organizational Behaviour

Introduction, goals, elements, scope and historical development of Organizational Behaviour, fundamental concepts, contributing disciplines to OB, Models of OB, social systems and organizational culture, international dimensions of organizational behaviour, limitations of Organizational behaviour, the future of O, Individual behaviours, Personality, Perception, Emotions, Attitudes, Values, Learning, Theories of Motivation, Behaviour in the organization, Interpersonal behaviour, Group dynamics, Employee stress.

Reference

- ❖ Organizational Behaviour, K. Awathappa, Himalaya Publication.
- ❖ Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
- ❖ Understanding Organizational Behaviour, Parek, Oxford

MBA103 Managerial Economics

Micro and macro economics, relevance, fundamentals principles, Demand analysis-theory, types , utility analysis, elasticity of demand and its measurement, techniques of demand forecasting, law of variables proportions, cost-output relationship , production functions, Isoquants, Market Structure and products pricing- perfect and imperfect Market Structure, duopoly, oligopoly, National income and methods of measurements.

- ❖ Managerial Economics- Analysis and cases , PL Mehta, S.Chand sons New delhi
- ❖ Managerial Economics- Pearson and lewis- Prentice hall India.
- ❖ Managerial Economics- GS gupta-TMH, New delhi.

MBA 104 Business Statistics

Introduction to Statistics: Measurement of Central Tendency (Mean, Median, Mode). Measurement of Dispersion, Standard Deviation, Variance. Probability Theory and Probability Distributions: additive and multiplicative rules, conditional probability, Baye's Theorem, Binomial, Poisson and Normal distributions. Time Series: Methods of studying Components of Time Series: Measurement of trend, Measurement of seasonal variations, Measurement of cyclic variations. Correlation & Regression: Karl Pearson's and Spearman's Coefficient, Methods of computing simple correlation and regression. Sampling and Sampling Distribution. Theories of Estimation and Hypothesis Testing: Introduction to methodology and Types of errors, sample tests for univariate and bivariate analysis using normal distribution, F-test, t-test, Z-test and chi-square test. Statistical Decision Theory: Decisions under Uncertainty and Decisions under Risk.

Reference books:-

- ❖ Richard I. Levin and D.S. Rubin, “**Statistics for Management**”, New Delhi: Prentice Hall of India, 2000
- ❖ S. P. Gupta, “**Statistical Methods**”, New Delhi, Sultan Chand and Sons, 2001
- ❖ Naval Bajpai – Business Statistics (Pearson).
- ❖ P C Tulsian Bharat Jhunjunwala **Business Statistics** S.Chand Publishing (2008)

MBA 105 Information Technology & Applications

Evolution of computer and its components, Types of softwares, OS, Languages. Introduction to DBMS, and RDBMS. Data modeling, ER diagrams, Distributed database System, Basics of Data ware housing and Data mining in business.

Computer Networking, types, topologies, Transmission modes, LAN, MAN, WAN, Intranet and Extranet, and wireless networks, introduction to different protocols, OSI/TCP/IP. Internet Banking and Online Shopping.. The IS Security, Security Threats and remedies. (Piracy, Hacking, Cracking, Spamming Etc.), Overview of Antivirus, Firewalls and Overview of IT-ACT 2000.

Reference readings:

- ❖ Peter Norton, Introduction to Computers, Tata McGraw-HILL
- ❖ Turbon, Potter, Introduction to Computers, John Wiley & Sons (Asia) Pvt Ltd
- ❖ Rajaraman, V., an Introduction to Computers, Prentice Hall of India.

MBA 106 Business & Corporate Laws

Basic Principles of Indian Constitution – fundamental rights and Indian Constitution, Contract Act, 1872 ; Partnership Act, 1932; Sale of Good Act, 1930; Negotiable Instrument Act, 1881; Companies Act, 1956; Consumer Protection Act, 1986

Recommended Books

- ❖ D D Basu Introduction to Constitution of India – Lexis Nexis Law Books
- ❖ N D Kapoor – Mercantile Law (Sultan Chand)
- ❖ Akhileshwar Pathak – Legal Aspects of Business (Tata McGraw Hill)

MBA 107 Financial Accounting and Analysis

Accounting concepts, conventions and principles; Accounting Equation, International Accounting principles and standards. . Double entry system of accounting, journalizing of transactions; preparation of final accounts, Profit & Loss Account, Ratio Analysis- solvency ratios, activity ratios, liquidity ratios, market capitalization ratios and profitability ratios. Cash Flow Statement- Various cash and non-cash transactions, flow of cash, preparation of Cash Flow Statement and its analysis.

Recommended Books

1. Maheshwari S.N & Maheshwari S K – A text book of Accounting for Management (Vikas).
2. Mukherjee - Financial Accounting for Management (Tata McGraw Hill).
3. Khan and Jain - Management Accounting (Tata McGraw Hill)
4. Shukla and Grewal Advanced Accounts Vol 2 s chand & company ltd

MBA-108, Business Communication

Communication- definition and types, principles of communication, Barriers to communication; Presentation skills-kinesics, proxemics, chronemics, haptics, paralanguage- knowledge of sounds of a language, features of language , participation in meetings, negotiation skills; Office management- proficiency in business correspondence-letter drafting, business and technical report writing; Time management, Interpersonal skills; Communication styles of legendary leaders from different domains of society.

Second Semestres

MBA 201 Financial Management

Introduction: Concept, scope and objectives of Finance, Functions of Finance Manager in Modern Age, Financial decision areas, Time Value of Money, Risk and Return Analysis. Investment Decision: Appraisal of project; Concept, Process & Techniques of Capital Budgeting and its applications; Risk and Uncertainty in Capital Budgeting; Leverage Analysis – financial, operating and combined leverage along with implications; ; Cost of Capital : Cost of equity, preference shares, debentures and retained earnings, weighted average cost of capital and implications. Dividend Decision

Recommended Books

- ❖ Prasanna Chandra - Fundamentals of Financial Management (TMH)
- ❖ Khan and Jain - Financial Management (TMH)
- ❖ I M Pandey – Financial Management (Vikas)

MBA 202 Marketing Management

Marketing: Definition, types, basic concepts, approaches to marketing, Functions and importance, Marketing environment, buying behaviours, marketing mix, market segmentation, market targeting and positioning strategies, product and product line: PLC, New product decision process, pricing, packaging, Physical distribution, promotion, market evolution and controls, marketing ethics, International marketing, Relationship marketing.

Recommended

- ❖ Principles of marketing 9th edition, -philip kotler and garry Armstrong, prentice hall, new delhi.
- ❖ Marketing- Bovee and john thill, Tata Mc Graw Hill, New delhi.

MBA 203 Human Resource Management

Human Resources Management (HRM): Basic concepts, Evolution, HRM environment. Human Resources Development in India: evolution and principles of HRD. HR Managers. Strategic Human Resource Management. Human Resources planning; Human Resources Information system: HR accounting and audit, Job Analysis, Job Design and Job Evaluation; Recruitment; Selection. Training and Development; Performance Appraisal. Compensation Administration: Wage Policy in India; Incentive Payments; Incentive Schemes in Indian Industries, Fringe Benefits. Discipline and Grievance Procedures; Industrial Relations; Promotion, Transfer and Separation .

Recommended Books

1. Aswathappa K - Human Resource and Personnel Management (Tata McGraw Hill).
2. Pareekh and Rao: Designing and Managing Human Resource Management, John Wiley & Sons.
3. Ronald J Burke and Cary L Cooper – Reinventing of Human Resource Management: Challenges and New Directions (Routledge)

MBA 204 Cost and Management Accounting

Accounting for Management, Role of Cost in decision making, Comparison of Management Accounting and Cost Accounting, types of cost, cost concepts, Marginal Costing: Marginal Costing versus Absorption Costing, CVP analysis and P/V Ratio Analysis and their implications, Concept and uses of Contribution & Breakeven Point. . Budgeting: Concept of Budget, Budgeting and Budgetary Control, Types of Budget, Advantages and Limitations of Budgetary Control

Recommended Books

- ❖ I M Pandey – Management Accounting (Vikas Publishing).

- ❖ Bhattacharyya and Dearden - Accounting for Management (Vikas Publishing).
- ❖ Khan and Jain - Management Accounting (Tata McGraw Hill)

MBA 205 Management Information Systems (MIS)

Concept and of importance of MIS Various types; TPS,OAS,KWS MMIS,ESS Decision, Programmed and Non- Programmed decisions, DSS, GDSS, factors of success and failure, value and risk of IS. Introduction to different enterprises information systems, financial Information system, marketing information system, HR information system etc. Various Strategic issues in implementation of information systems, and IT infrastructure

Recommended Books

- ❖ MIS: Managing the digital firm, Kenneth C. Landon, Jane P. Landon, Pearson Education.
- ❖ Management Information System, W.S Jawadekar, Tata Mc Graw Hill Publication.
- ❖ Management Information System, David Kroenke, Tata Mc Graw Hill Publication.

MBA 206 Business Environments

Concept of Business Environment, Environment scanning, Types of economy, PPF Curve, Overview of Political, Socio-cultural, Legal, Technological and Global environment, FEMA, SEBI, the monetary policy and fiscal policy, RBI- Role and functions, Consumerism, Social Responsibility of business enterprises, Globalization, Foreign trade policy, FDI policy, Multinational Corporation (MNCs) and transnational corporations (TNCs), Global Competitiveness.

Recommended Books

- ❖ Samuelson, Nordhaus, Sen and Chaudhari – Economics (TMH)
- ❖ Suresh Bedi – Business environment (Excel Books)
- ❖ Vivek Mittal – Business Environment (Excel Books)

MBA 207 Research Methodology

Research : Meaning, Purpose, Types of research, significance of research in social and business sciences, Identification, selection and formulation of research problem, Review of literature, hypothesis testing, Factorial experimental design, basic principles – replication, randomization, blocking, Sampling and Non-sampling error, Advantages and limitations, primary and secondary data, Processing of data, Analysis, structuring the report. **Recommended Books**

- ❖ Cooper and Schindler – Business Research Methods (TMH)
- ❖ Saunders, Lewis and Thornhill – Research Studies for Business Students (Pearson Education)
- ❖ C.R. Kothari – Research Methodology & Techniques (New Age International Publishers)

MBA 208 Operations Research

Operations research: Uses, Scope and Application. Decision Tree: Approach and its applications. Markov Analysis, Linear programming problems: features, formulation and solution. Transportation, Assignment, and Transshipment problem and models: Definition, algorithm and solutions. Game theory: Concept, types, methods and models of solution, Sequencing problem, Queuing Systems. Network models: CPM, PERT.

Recommended Books

- ❖ Introduction to Operations Research - Hillier and Lieberman, McGraw Hill.
- ❖ Quantitative Techniques in Management – N.D. Vohra, Tata McGraw Hill
- ❖ Operations Research - Sharma J.K., Pearson Publications

Third Semester

MBA 301 Strategic Management

Basic concepts and Stakeholders' Issues, Environmental Scanning, Organizational Analysis and Industry Analysis; Strategy formulation – Situational Analysis, Business Strategy, Corporate Strategy and Functional Strategy; Strategy Implementation, Evaluation and control; other strategic issues – Technology Management & Innovation, Small Industries & Entrepreneurship, Globalization and Strategic Management for nonprofit organizations.

Recommended Books

- ❖ Strategic Management & Business Policy – Thomas Wheelen and J D Hunger (Pearson)
- ❖ Strategic Management & Business Policy- Azhar Kazmi (TMH)
- ❖ Strategic Management : An integrated Approach – Charles W.L Hill & Garrett John, Houghton Mifflin Company, New York.

MBA 302 Supply Chain Management

Basic concept & philosophy of SCM, Key issues and drivers of ScM, Supply chain cycle, Responsiveness and efficiency of supply chain, forecasting, Procurement: Strategic sourcing, Supplier Selection, Supplier relationship, Supplier Quality Management , E-procurement. Various Manufacturing systems. Inventory management system. Distribution and Warehousing Management. Logistics, Transportation Network Management. Role of customer relationship in SCM, role of IT in SCM, Green supply Chain Management.

Recommended Books

- ❖ Supply Chain Management – Sunil Chopra and Peter Meindl, Prentice Hall
- ❖ Logistics and supply chain Management – Martin Christopherm, Prentice Hall
- ❖ A Textbook of Logistics and supply chain management – D.K. Agarwal Macmillan Publishers India Ltd. Delhi, 2003

MBA 303 Operation management and Material Management

Operations Management:, Importance and Functions, Evolution, factory system, manufacturing systems, Classification of operations, Responsibilities of Operations Manager, Facilities Location & Layout, Principles and Types of Facilities Layout Forecasting types and methods, Concepts of Quality, TQM, Six Sigma. Production Planning & Control, Inventory Management, Concept & definitions, Factors contributing to productivity improvement, Lean Production System, JIT. Definition and Uses, Methods of work sampling, Time study. Introduction, scope of materials management, MRP, MRP II. Principles of Materials Handling system. Safety issues.

Recommended Books

- ❖ Adam Jr Everetl E. R J – Production and Operations Management (Prentice-Hall).
- ❖ Chary - Production and Operations Management (Tata McGraw-Hill).
- ❖ McGregor D – Operations Management (McGraw-Hill).
- ❖ Bedi Kanishka - Production & Operations Management (Oxford University Press).

MBA 303 Summer training project report and defence (4 credit points)

Fourth Semester

MBA FM 401 International Business and Trade

Growth of International Business: Globalization its effects, benefits and costs; Emergence of MNCs & TNCs and their impact; Dunning's eclectic paradigm. Environment of International Business; Scenario analysis and country wide risk investment decisions. International business competitive strategies: Porter's model, critiquing of Porter's model, Prahalad and Doz strategy model. Foreign investments: FDI, FII and Joint ventures. International organization and control: Bartlett & Ghoshal's model of TNC.

Theories & Models : Balance of trade and balance of payment: Problems and perils for developing and under developed countries. Theories of foreign exchange determination, World Bank, IMF, ADB, OECD, and WTO. Important and critical issues in global trade.

Recommended Books

- ❖ V K Bhalla – International Business: Environment and Management (Anmol publication).
- ❖ Michael Czinkota – International Marketing (Cengage).

MBA 402 Project Management

Concepts, roles and responsibilities of project team members, division of responsibility and authority, Project Planning and Selection, methods, lifecycle, Time and cost estimates, work breakdown structure network diagrams, gantt chart, critical path Method, programme evaluation review technique, COCOMO model, critical chain scheduling, project crashing, project evaluation and termination, project monitoring, project control, periodic project performance evaluation audits, trade-off analyses, causes associated with project success and failure, Earned value management, risk management, project audit and project terminate

MBA 403 Business Ethics, Human Values and Corporate Governance

Introduction to Business Ethics, Ethics, Morals & Values, Law and Ethics. Nature of Ethics in Management Business Standards and Values, Value Orientation of the Firm. Ethical issues at the top management, Ethics in financial markets and investor protection – Ethical responsibility towards competitors and business partners, ethics in human resource management and marketing management. Conflicts in decision making from ethical and economic point of view. Solving ethical dilemma; Managerial integrity and decision making. Personal Integrity and self development. Wisdom based leadership. Ethical Issues in managing public limited firms. Ensuing sustainable development. Global and National Perspectives – Global Corporate Governance models. Claims of Various Stakeholders, Cadbury Report, Changes over the last few decades, OECD Committee Recommendations – SOX Act (of USA). Internal Corporate Governance Mechanism: Board of Directors, Functional Committees of Board; Code of conduct, whistle blowers. External Corporate Governance Mechanism: Regulators, Institutional Investors, Corporate raiders. Corporate Governance in India: corporate form in India 50s to 90s – developments in Corporate Governance in India in nineties and 2000s – CII, Kumaramangalam, Narayanamoorthy, Naresh Chandra, J J Irani Committee reports – Legal and Regulatory Changes – introduction and modification of Clause 49, Corporate governance in practice in India and cases.

Recommended Books

- ❖ Manuel Velasquez – Business Ethics: Cases & Concepts (Orient International)
- ❖ Stephaine Bainbridge – The New Corporate Governance in Theory and Practice (Oxford University Press).
- ❖ Subash Chandra- Corporate Governance in India: An Evaluation (Prentice Hall of India)

MBA 404 Project Work and Report (6 credit points)

Department Electives

Finance:-

MBA FM 301 Security Analysis and Portfolio Management

Overview of Capital Market: Market of securities, Stock Exchange and New Issue Markets, . Regulatory Mechanism: SEBI guidelines; Investor Protection. Risk and Return: Concept of Risk, Measures of risk and return, calculation, trade off, systematic and unsystematic risk components. Valuation of Equity, Debentures and Bonds. Portfolio Analysis and Selection: Portfolio concept, Portfolio risk and return, Beta as a measure of risk, calculation of beta, Portfolio Management and Mutual Fund Industry.

Recommended Books

- ❖ Chandra P - Investment Analysis and Portfolio Management (TMH).
- ❖ Fischer and Jordan - Security Analysis and Portfolio Management (PHI).
- ❖ Francis and Taylor – Theory and Problem of Investments (TMH).

MBA FM 302 Corporate Tax Planning and Management

Nature and Scope of Tax Planning: Nature, Objectives of Tax Management, Tax Planning, Tax Avoidance & Tax Evasion, Assessment Year, Previous Year, Assessee – types, Residential status, Non-resident Indians. Tax on Individual Income: Computation of tax under the various heads. Corporate Income Tax

Central Excise Act and Excise planning; Customs Act and Customs Duties Planning, VAT, Service Tax. Tax treaties at bilateral and multilateral levels, GST and DTC.

Recommended Books

- ❖ Singhania V K - Direct Taxes, Law & Practice (Taxmann).
- ❖ Prasad Bhagwati - Income Tax Law & Practice (Vishwa Prakashan)
- ❖ Kanga J B and Palkhivala N A – Income Tax.

MBA 303 Management of Financial Institutions and market

Financial System and Markets: RBI- Role and functions. Monetary and fiscal policies, Techniques of regulation and rates; Overview of Foreign Exchange Market, Financial Sector Reforms in India, Overview of Financial Services,. Banking Industry in India, banking sector reforms, commercial interest rates, capital adequacy norms, Liquidity Management, Asset Liability Management, Management of Non-performing assets.

Securitization: Securitization in India. DFIs in India, Exim Bank. State Level Institutions; Insurance & Mutual Fund organizations.

Leasing and Hire Purchase, Hire purchase and lease. Factoring, Forfaiting, Discounting and Re Discounting of Bills, Consumer Credit and Plastic Money.

Recommended Books

- ❖ Fabozzi – Foundations of Financial Markets and Institutions (Pearson Education).
- ❖ Khan M Y – Financial Services (TMH).

- ❖ Kothari V – Lease Financing, Hire Purchase including Consumer Credit (Wadhwa & Co.)

MBA FM 401 International Finance Management

Institutions/Development Banks – World Bank – IBRD – IDA – IFC – MIGA – International Monetary Fund, The Foreign Exchange Market – SWIFT – Arbitrage – Spot market – Forward market – Cross rates of exchange – Bid – Ask spreads – Balance of payments – Foreign exchange rates – Theories of Foreign Exchange Rate. Foreign exchange exposure and management, Financial Management of the Multinational Firm Financing Foreign Operations – Eurocurrency markets – Instruments – Interest rate swaps – Currency swaps and its pricing – Depository receipts – GDR and ADR – Euro and its implications for India.

Recommended Books

- ❖ Buckley, A., Multinational Finance, Prentice Hall
- ❖ Levich. R.M., International Financial Markets: Prices and Policies, Tata McGraw Hill.
- ❖ 4. Apte, P.G., International Financial Management, Tata McGraw Hill.

MBA 402 Working capital management

Factors Determining Working Capital Requirements, Importance of Optimum Working Capital, Working Capital Policy and Management, Permanent-Temporary, Financing Working Capital, Working Capital Monitoring and Control. Different Components of Working Capital, Estimation of Working Capital Requirements. Cash Management, Factors Affecting Cash Needs, Cash Budget, Control Aspects, Managing Types Of Bank Credit, Other Sources of Short Term Financing, Regulation of Bank Credit In India.

Recommended Books

- ❖ [Working capital management](#) by V. E. Ramamoorthy
- ❖ [Working Capital Management](#) by Leo R. Cheatham

MBA 402 Working capital management

Factors Determining Working Capital Requirements, Importance of Optimum Working Capital, Working Capital Policy and Management, Permanent-Temporary, Financing Working Capital, Working Capital Monitoring and Control. Different Components of Working Capital, Estimation of Working Capital Requirements. Cash Management, Factors Affecting Cash Needs, Cash Budget, Control Aspects, Managing Types Of Bank Credit, Other Sources of Short Term Financing, Regulation of Bank Credit In India.

Recommended Books

- ❖ [Working capital management](#) by V. E. Ramamoorthy
- ❖ [Working Capital Management](#) by Leo R. Cheatham

MBA 403 Financial Auditing

Principles of Auditing, The Accounting System, Its importance to Independent Audit, Internal Control, Internal Audit. Rights and Duties of Auditors. Professional Liabilities of an Auditor. Application of Auditing Principles and Techniques to all Types of Trading, Commercial. Industrial, Banking, Insurance and Investment under-takings, Audit programme. Limitations of Audit, Audit Report

Books

- ❖ [Modern Auditing: Assurance Services and the Integrity of Financial Reporting](#) by [William C. Boynton](#) and Raymond N. Johnson
- ❖ [Auditing and Assurance Services, 14th Edition](#) by Pearson

Marketing:-

MBA MM 301 - Product and Brand Management

Product: Basic concept, product planning and development: Product lifecycle Management, Product Portfolio Analysis and Management. Brand: concept, role of brand, brand awareness, brand management. Brand Equity:, Brand Positioning, Brand Marketing Programs, Choosing Brand Elements to Build Brand Equity, Designing Marketing Programs to Build Brand Equity. Branding Strategies: Designing and

Implementing Branding Strategies, Managing Brands, Brand leveraging strategies, Brand identity system, Brand valuation and Failure of brands.

Recommended Books

- ❖ Strategic Brand Management: International Edition publisher: Prentice Hall Author: Kevin Keller India Pearson education
- ❖ Managing Brand Equity, David Aakers, New York; Free press.
- ❖ Brand Positioning, sengupta Subroto, TMH

MBA MM 302 — Marketing Research

Marketing Research – Conceptual framework, process, and Data Collection, Marketing Mix Research, qualitative, quantitative research, Exploratory Research, Causal Research, Research Design, Scaling techniques, Questionnaire, Sampling types. Data Analysis Techniques – Univariate, Bivariate, Multivariate, Regression Analysis, Factor Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Web based marketing research, report generation.

Recommended Books

- ❖ Beri, G. C., “Marketing Research” , Third Edition, Tata McGraw-Hill, New Delhi,
- ❖ Hair, Joseph, Robert Bush, and David Ortinau, “Marketing Research: Within a Changing Information Environment”, Second Edition, McGraw-Hill, New York,
- ❖ Proctor, Tony, “Essentials of Marketing Research” , Second Edition, Pitman, London, Malhotra, K.N., Dash S “Marketing Research ”, Fifth Edition, Pearson Education, Delhi

MBA MM 303 - Sales & Distribution Management

Sales Management; Objectives and Functions, Setting up a sales organization, Personal Selling, Management of Sales force, Recruitment & Selection, Training, Motivation and Evaluation, Compensating Sales Force, Sale forecasting, Territory Management, Sales Budget, Sales Quota. Distribution Management, Design of Distribution Channel, Channel Conflict, Co-operation & Competition, Vertical marketing system, Horizontal Marketing system, Designing Customer Oriented Marketing Channels: Wholesaling, Retailing. Order Processing, Transportation, Warehousing, Inventory, Market Logistics Decision, SCM, Emerging Trends.

Recommended Books:

- ❖ Sales Management – Still, Cundiffs, Govani – Pearson
- ❖ Sales & Distribution Management , Chunnwala –HPH
- ❖ Sales & Distribution Management,Panda and Sahadev,Oxford

MBA MBA MM 401: - Consumer Behavior

Theories of Consumer Behaviour: Learning theory, Psychoanalytic theory, Gestalt, Cognitive theory, Psychological field, Models of Consumer Behaviour; Howard-Seth Model, Angle-Blackwell-Kollat, Nicosia Model. Seth’s Family Decision-making Model, Factors influencing consumer decision making, Segmentation, Psychographics Individual Determinants of Behaviour- Personality, perception, attitude, Motivation, Group influence on consumer behaviour-Social class, Social groups, Opinion leaders. Culture, Sub-culture, Cultural relevance to marketing decisions, Cultural Values, Cultural Changes, Cross cultural understandings. Family: Role & Structure, Family Life Cycle, Purchasing decisions, changing role of families.

Recommended Books:

- ❖ Consumer Behaviour – Schiffmen, Kanuk – Pearson
- ❖ Consumer Behaviour – Suja R. Nair – HPH
- ❖ Consumer Behaviour – Blackwell / Minlard / Engel - Cengage
- ❖ Consumer Behaviour – Batra & Karmi – Excel Books

MBA MM 402 : Rural Marketing & Agri-Business

Rural market structure, rural consumer behaviour, rural marketing information system, research & forecasting rural demand, problems of rural marketing, rural marketing agencies, rural marketing mix. agri- marketing: - scope, role in economic development, demand supply of farm products, marketing of agriculture inputs and farm products, strategy for agriculture marketing.

Recommended Books:

1. Rural Marketing – K. Ramkrishnan – Pearson
2. Rural Marketing – kshyap, Raut Biztantra

MBA MM 403 - Marketing of services

Services Marketing, Difference between Product and Services, Characteristics, challenges, environment of services marketing, Classification, service triangle, service quantum, new product development, life cycle, CRM, service quality, service marketing models, Marketing mix, Additional Dimensions in Services Marketing mix, Understanding service market, services and consumer behavior, growth and development in Indian business.

Books-

1. Thomas J DeLong & Asish Nanda: Managing Professional Services- Text and case, Tata Mcgraw Hill International
2. Christopher Lovelock: Services marketing people, technology, strategy, Pearson education, New Delhi
3. Shanker Ravi, Service marketing, Excel Books, New Delhi
4. Payne, A. The essence of Services Marketing, Prentice Hall of India Pvt Ltd. Verma, H.V., Marketing of Services, Gobal Business Press, New Delhi

Human Resource:-

MBA HR 301 Human Resource Development

HRD concepts, Evolution of HRD from Personnel management, Importance of HRD, Subsystems of HRD: Human Resource Planning, Potential Appraisal, Assessment Center, Performance appraisal including 360 degree appraisal. Organizational Culture and Climate: Role of HRD in promoting a development oriented Culture and climate in the Organizations. Developing Human Capability: Aptitude, Knowledge, Values, Skills of Human Relations, Responsiveness, Loyalty and Commitment, Transparency, Leadership development. Training and Development; Training need analysis, Types of training Internal and external, Evaluating HRD: Human Resource Accounting, HR Audit and Bench marking, Impact-assessment of HRD initiatives on the bottom-line of an organization. Quality of Work life and, Grid training, Benefits of OD. Organizational Development Process. Recent Trends in HRD and OD.

Recommended Books

1. Dressler and Gary – Human Resource Management, Prentice Hall of India.
2. Fisher, Schoenfedlt and Shaw – Human Resource Management, Houghton Mifflin.
3. Leap, Terry L and Michael D Crino- Human Resource Management, MacMillan India.
4. T V Rao and Udai Pareek – Designing and Managing Human Resource Systems, India Book House.

MBA HR 302 Industrial Relations and Labour Legislations

Industrial Relation:- Origin & overview, factors affecting IR in changing Environment, Approaches to the study of IR. Trade Union: – Functions, Types & structure, Impact of globalization on Trade union

movement. Industrial Dispute- Overview, Industrial Relation Machinery to solve Industrial Dispute. Collective Bargaining- Process of Collective Bargaining causes for failure, Grievance management. Workers Participation in Management- Concept, Pre-Requisites, Levels Of Participation, Benefits of Participation. Impact of Globalization & Information Technology on IR, Role of Human Resource Development in Developing Industrial Relation-Industrial Relation Democracy, Industrial peace. Salient features of Industrial Employment (Standing order) Act 1946 and Indian Trade Union Act 1926.

Recommended Books

1. Industrial Relations Shifting Paradigms – Ratna Sen,
2. Dynamic Personnel Administration – Prof. M.N.Rudrabasavraj.
3. Personnel Management and Industrial Relations–P.C.Shejwalkar and S.B.Malegaonkar
4. Labour Management Relations in India – K.M.Subramanian
5. Trade Unionism. Myth and Reality, New Delhi, Oxford University Press, 1982.

MBA HR 303 Compensation and Performance Management

INTRODUCTION TO PERFORMANCE APPRAISAL: Importance and Process of appraising performance, Traditional and modern methods. Performance management process, Competency mapping, 360 degree feedback and its variants, Current trends in performance management. INTRODUCTION TO WAGES AND SALARY: Minimum wages, Need based minimum wages, fair wages and living wages. Monetary wages and real wages. Factors affecting wages and salary levels. Wage policy: Objectives & need, formulation of wage policy in India. Recommendation in wage policy. Labour market and compensation management . WAGE DETERMINATION : Principles of wage and salary, administration, Job Evaluation: Methods and techniques, Performance based pay systems, Knowledge based pay system & market based pay system. Wage Policy in India, Methods of wage determination in India, Wage Boards. The minimum wages Act, The Pay Commission, Payment of Wages Act & Payment of Bonus Act. EMPLOYEE BENEFITS: Incentive Payment and types of incentive plans. Compensation practices of multinational and global organizations, Incentive based pay systems, Executive compensation Practices of MNCs.

Text Books:

- ❖ Milkvich & Newman : Compensation - TMH
- ❖ Henderson – Compensation Management in knowledge based world, Pearson.
- ❖ Human resource management-Gary Deseler, Prentice Hall
- ❖ Performance Appraisal-T.V.Rao, SAGE Publications Pvt. Ltd

MBA HR 401 Strategic Human Resource Planning

Introduction to business and corporate strategies, Traditional Vs strategic HR, Strategic Human Management, Linkages between HRM and Strategic management process, Role of HRM in Strategy formulation. Human resource management Model, Toyoto model, Ten C model, Michigan Model , Harward Model, Core competencies model for HRM, Professional David Guest model. Efficient utilization of human resource– Cross training and flexible work assignment-world teams-non unionization, strategies for employee shortages, surpluses, performance and development. Typology of performance types-marginal performers, under achievers, stars, solid citizens, managing employee ability-recruitment and selection strategy typology, incentive alignment, psychological contracting. Introduction to global HR strategies, Developing HR as a value added function.

Recommended Books

- ❖ Strategic HRM-Jeffery Mello,Thompson publication,New Delhi
- ❖ Strategic HRM –Charles Greer,Pearson education Asia,New Delhi.

- ❖ Strategic HRM-Ararwal,Oxford University press,

MBA HR 402 : ORGANIZATION DEVELOPMENT & CHANGE MANAGEMENT.

Organizational Development Conceptual frame work of OD, History of OD, First order and second order Change, Values, assumptions and beliefs in OD, Participation and Empowerment, Teams and teamwork, Parallel learning structures, Managing the OD Process , OD interventions, models of organizational change Force Field, Kurt Lewis, Systems, Managerial approaches for implementing change, perspectives on change, understanding the change process, facilitating change, dealing with individual and group resistances, intervention strategies, Organizational Culture & Change, Corporate Culture, emerging trends in Organizational culture, Organizational Constraints for Creativity & Innovation

Recommended Books

- ❖ Organization Development, behavioral science interventions for Organization Improvement, Wendell L.French, Cecil H.Bell, Veena, Jr, Pearson, PHI.
- ❖ Organization Development, & Transformation, Managing Effective Change, Wendell L.French, Cecil H.Bell, Jr, TMH
- ❖ Organization Change and Development, Kavith Singh, Excel Books
- ❖ Managing organizational change, Palmer, Dunford, Akin, Tata Mc- Graw Hill edition

MBA HR 403 International Human Resource Management

Introduction to IHRM: Emergence, Approaches, Models, Organizational dynamics and IHRM, Organizational processes in IHRM, Linking HR to International expansion strategies, Challenges. Strategies for International Growth: mastering expatriation, Becoming locally responsive: understanding diversity, the challenges of localization. Managing alliances and joint ventures. Recruitment, selection and staffing in International context: International Managers, different approaches to multinational staffing decisions. Performance Management: performance management cycle, models, performance appraisal in IHRM, appraisal of expatriate. Current scenario in international training and development, types of expatriate training, developing international staff and multinational teams. Key components of international compensation, compensation practices across the countries, social security systems across the countries, global compensation. HRM practices in different countries.

Recommended Books:

- ❖ International Human Resource Management – Peter J Dowling & Denise E Welsch
- ❖ International Human Resource Management - Dennis R. Briscoe, Randall S. Schuler, Lisbeth M. Claus
- ❖ International Human Resource Management - Third Edition - Anne-Wil Harzing
Ashly Pinnington , (SAGE Publications).

Information Technology:-

MBA IT 301; Data Warehousing & Data Mining

Introduction,, characteristics, and Evolution of DW and architecture & components. Process of ETL, Aggregation, Meta data and its architecture, Granularity, Dimensional data modeling, OLAP Star Schema and Snowflake Schema. Data warehouse lifecycle, various issues and challenges faced during DW lifecycle, Vertical and Horizontal Partitioning, Capacity planning, back-up strategies. Concept of data mining. Knowledge (KDD process, Virtuous, query tools, database processing vs data mining processing, Application of data mining in management decision making. Business Intelligence, Classification

technique & Association rule technique for data mining. K-nearest neighbor, neural networks, decision trees, CRM and fraud detection, Web mining and text mining.

Recommended Readings:-

- ❖ “Data warehousing Fundamentals” by Paulraj Ponniah, Wiley Publications.
- ❖ “Modern Data Warehousing, Mining and Visualization” by George M. Marakas, Pearson Publications.
- ❖ “Data Mining for Business Intelligence” by Shmueli, G. Patel, N and Bruce, P; Wiley India.

MBA IT 302 Technology & Innovation Management

Concept & Classification of Technology and its management, Critical Parameters in managing Technology, Life cycle of Innovation & Technology, Process of Technological & Non Technological Innovation, competitiveness of Firm/ industry, a Nation. Technology Strategy in reference to business and IT strategy. Technology Audit model. Creativity, idea, and innovation process. Research & development (R&D) Management Innovation and firm capability, Value creation through Innovation, Technology Transfer & Legal frame/IPR/ Patents/copy rights/cyber law etc. Case studies focused with Indian cases in Global Paradigm.

Recommended Readings:-

- ❖ Technology Management authored by – *Megantz, Robert C*
- ❖ Hand Book of global technology Policy Authored by –*Nagel, Stuart S.*
- ❖ Management of Technology authored by *Tarek khalil*
- ❖ Innovation Strategies for knowledge economy authored by *Emidon, Debra M*

MBA 303 E – Business

Fundamentals in E-Commerce, commerce – meaning, nature, limitation. e-commerce- – Origin, nature, meaning, definitions, features, need, advantages & disadvantages, essential requirements, e-Commerce Vs traditional Commerce. Business Models for e Commerce, e-business: meaning, definition, importance, e-business models based on the relationships of transaction parties, B2C, B2B, C2C, and C2B. E-Payment System, Modes of e-payment, Risks & e payment system: Data protection, risk from mistakes & disputes- Consumer protection, Management Information Privacy, Managing Credit Risk.

Recommended Readings:-

- ❖ “Introduction to e-commerce” by Jeffrey F. Rayport & Bernard J. Jaworski; TATA Mcgraw Hill Publications.
- ❖ “Creating a Winning E – Business” by Napier Rivers, Wagner & Napier, Cengage Learning Publications.
- ❖ “Internet Business Models & Strategies” by Alan Afuah & Christopher L. Tucci

MBA IT 401 Software Project Management

Concept Software project Management, SDLC, and process models, requirement analysis. Quality and testing issues, Process and project metrics. Triple constraints, framework for project management. Strategic Planning and Project Selection methods. Project Integration Management, Project Scope Management, creep, scope planning, WBS. Activity sequencing, CPM, PERT, Schedule Development, critical Chain Scheduling and other Project Time Management processes. cost estimation, budgeting, Control, Earned Value Management Project Quality Management: Concept of Quality, waste, six sigma, and other project quality management processes. Risk and Change Management. Project Communication, HR issues of Software project management.

Recommended Readings:-

- ❖ Kathy Schwalbe, “IT Project Management”, Cengage Learning
- ❖ Jack Meredith & Samuel J Mantel Jr, “Project Management: A Managerial Approach,” John Wiley & Sons.
- ❖ John M Nicholas, “Project Management for Business and Technology”, Pearson Education.

MBA IT 402 Enterprise Resource Planning

Integration of business activities, dependent Vs independent items, Different planning horizons viz strategic, tactical and operational, MRP inputs, bill of Materials, Master production schedule and inventory master file, MRP process, Evolution of ERP, Benefits of ERP. ERP, Reengineering- need and challenges, Management concerns about BPR. BPR to build business Model for ERP, ERP & competitive advantage Basic constituent of ERP, Selection criteria for ERP Packages. Procurement process for ERP Package, ERP packages SAP R/3, PEOPLE SOFT, BAAN IV, MFG/PRO, ORACLE-FINANCIAL. ERP Implementation- issues, Role of Consultants, Vendors, Users, Need for training, customization. ERP implementation methodology and post, implementation issues ERP and cases.

Reference readings:

- ❖ Alexis, Leon (1st Edition, 2000). ERP Demystified. Tata McGraw Hill.
- ❖ Garg, V.K. and Venket, Krishna, N.K., (1st edition, 1997). ERP Concepts and Practices. PHIPublications.
- ❖ Sadagopan, S. (1st Edition, 1999). ERP: A Managerial perspective. Tata McGraw Hill.

Abbreviations

GOI	-	Government of India
MHRD	-	Ministry of Human Resource Development
SPRC	-	Senate Postgraduate Research Committee
DPRC	-	Departmental Postgraduate Research Committee
ARC	-	Academic Reforms Committee
SGPA	-	Semester Grade Performance Average
CGPA	-	Cumulative Grade Performance Average
NIMCET	-	National Institute of Technology Master of Computer Application Entrance Test
NIT	-	National Institute of Technology
DRPC	-	Department Research Programme Committee
RDC	-	Research Degree Committee

