Scheme of Examination and Syllabi of course work for DOCTOR OF PHILOSOPHY

in

Faculty of Engineering & Technology

(2021 – 2022)

PANJAB UNIVERSITY, CHANDIGARH

SCHEME OF EXAMINATION AND SYLLABI OF Ph.D. COURSE WORK FOR ACADEMIC SESSION 2021-22

S. no.	Paper No.	Paper Title	L	T	P	Total	Credits	Marks (Int. Exam)	Marks (Univ. Exam)
1	RM-9001	Research Methodology*	4	-	-	4	4	50	50
2	RS-9002	Research Seminar*	-	-	3	3	2	50	-
3	RS-9003	Research and Publication Ethics*	2	-	-	2	2	50	-
4	**Elective ****		4	-	-	4	4	50	50
	Group I	Computer Science & Engg.							
	Group II	Mechanical Engg.							
	Group III	Electrical and Electronics Engg							
	Group IV	Electronics and Communication Engg.							
	Group V	Biotechnology							
	Group VI	Civil Engg.							
	Group VII	Technical Engg.							
	Group VIII	Information Technology							

* Subjects common to all branches.

** A candidate will be assigned any one subject from any of the groups, in the elective by the Research Advisory Committee.

LIST OF ELECTIVES

Group I: Computer Science and Engineering

S.No.	Paper No./code	Paper Title
1	CSE9101	Network Technologies
2	CSE9102	Cloud Computing
3	CSE9103	Advanced Concepts in Digital Image Processing
4	CSE9104	Advanced Information Security
5	CSE9105	Modeling and Simulation
6	CSE9106	Data Warehousing & Data Mining
7	CSE9107	Concepts in Information Retrieval

Group II: Mechanical Engineering

S.No.	Paper No./code	Paper Title
1	ME9201	Advance Heat Transfer
2	ME9202	Non Conventional Machining
3	ME9203	Continuum Mechanics
4	ME9204	Finite Element Methods
5	ME9205	Composite Materials
6	ME9206	Optimization Techniques
7	ME9207	Design of Experiments
8	ME9208	Material Characterization
9	ME9209	Additive Manufacturing
10	ME9210	Machine Learning

Group III: Electrical & Electronics Engineering

S. No.	Paper No./Code	Paper Title
1	EEE9301	Power System Optimization
2	EEE9302	Power System Reliability
3	EEE9303	Power System Deregulation
4	EEE9304	Power System Stability
5	EEE9305	Electrical Distribution System
6	EEE9306	Neural Networks & Fuzzy Logic
7	EEE9307	Industrial Electronics
8	EEE9308	Digital Control

Group IV: Electronics & Communication Engineering

S. No.	Paper No./Code	Paper Title
1	ECE9401	Advanced Digital Signal Processing
2	ECE9402	Digital System Design
3	ECE9403	Embedded System Design
4	ECE9404	Wireless & Mobile Communication
5	ECE9405	VLSI Design

6	ECE9406	Fiber Optic Communication Systems
7	ECE9407	Digital Image Processing
8	ECE9408	Material Science & Engineering
9	ECE9409	Neural Networks & Fuzzy Logic
10	ECE9410	Antenna Fundamentals and Measurements

Group V: Biotechnology

S.No.	Paper No./code	Paper Title
1	BT9501	Microbial Biotechnology& Molecular Medicine
2	BT9502	Polymer Science & Engineering
3	BT9503	Advances in Biochemical Engineering
4	BT9504	Enzyme Technology
5	BT9505	Nano biotechnology: From theory to applications
6	BT9506	Cancer Biology
7	BT9507	Advances in Biosensor Technology
8	BT9508	Genetic Engineering
9	BT9509	Advances in Biomaterials

Group VI: Civil Engineering

S.No.	Paper No./Code	Paper Title
1	CE9601	Foundation Design and Construction
2	CE9602	Advanced Structural Design and Detailing
3	CE9603	Environmental Engineering & Mgt.
4	CE9604	Pavement Design, Construction and Maintenance
5	CE9605	Design and Construction of Bridges
6	CE9606	Advanced Construction Technology
7	CE9607	Structural Dynamics
8	CE9608	Remote sensing and GIS

Group VII: Technical Engineering

S.No.	Paper No./Code	Paper Title
1	TE9701	Learning and Instruction
2	TE9702	ICT Enabled Education
3	TE9703	Technical and Vocational Education System

Group VIII : Information Technology

S.No.	Paper No./Code	Paper Title
1	IT9801	Natural Language Processing
2	IT9802	Geographical Information Systems
3	IT9803	Advanced Data Mining
4	IT9804	Advances in Cloud Computing
5	IT9805	Wireless Technologies
6	IT9806	Data Acquisition and Interfacing
7	IT9807	Machine Learning
8	IT9808	Advanced Digital Image Processing
9	IT9809	Optical Communication Technologies

*Guidelines for Course Work:

The one semester Course Work of minimum 135 teaching hours would comprise four papers out of which one should be related to Research Methodology (minimum 35 teaching hours) and another one related to Research and Publication Ethics (minimum 30 teaching hours) to be taught by a faculty with a PhD degree and having at least 10 years of teaching experience.
The components of Continuous Evaluation/ Examination would be as under:

(a) Continuous Evaluation (Book reviews, Term Paper and its presentation, Seminar, etc.) : 50 marks

(b) End Examination : 50 marks

(c) Pass percentage in each paper (i) & (ii) together) : 50%

A candidate who passes will be given 'S' grade i.e. Satisfactory completion or else 'X' grade i.e. Unsatisfactory.

Further:

(i) A candidate would be required to attend minimum of 75% of the lecturers delivered/activity undertaken;

(ii) If a candidate has passed at least three papers and is unable to pass the 4th paper due to one reason or the other, he/she be allowed to appear in that paper in the next examination, provided he/she had attended the 75% of the lectures delivered;

(iii) If a candidate is unable to appear in any paper/papers due to the circumstances beyond his/ her control. He/ she be allowed to appear in that paper/ those papers in the next examination, provided he/she had attended the 75% of the lectures delivered;

(iv) If a candidate fails to earn 12 credits he/ she be asked to do the entire course work again;

(v) The End Examination paper will consist of 5 questions and candidate will have to attempt all the questions; and

(vi) A Student Research Advisory Committee (RAC) will be constituted for every Ph.D student by the Joint Administrative and Academic Committee (JAAC) of respective departments/Research centre with minimum of 3 members plus Research Supervisor. The Research Supervisor of the scholar shall be the Convener of this Committee. This Committee shall have the following responsibilities:
   a. To review the research proposal and finalize the topic of research;
   b. To guide the research scholar to develop the study

c. Design and methodology of research and identify the course(s) that he/she may have to do.
d. To periodically review and assist in the progress of the research work of the research scholar.

(vii) A research scholar shall appear before the Research Advisory Committee once in six months to make a presentation of the progress of his/her work for evaluation and further guidance.

Paper Title: Research Methodology

Paper Code: RS-9001

L	T	P
4	0	0

Objectives: This challenging and comprehensive course provides a broad perspective on Research Methodology.

Defining Research and Literature Review: Need and Significance of Research, Research Process, Different Methods of Research, Different approaches to literature survey, difference between survey and review, Locating and selecting a research problem, Defining a problem statement, formulation of objectives, Retrieving literature from libraries (Online and Offline).

Research Design and Methodology: Concept of research design, Concept of population and sample, Selection of sample size, Different types of Sampling, Methods of data collection, Concept of data measurement: Nominal, Ordinal, Interval and Ratio, Ethical issues related to data collection, Various Research Data Repositories

Statistical Methods of Analysis: Descriptive Statistics: Mean, Median, Mode, Range, Standard Deviation, regression and correlation analysis.
Inferential Statistics: Estimation of parameters, Hypothesis, Types of Hypothesis, Testing of Hypothesis, Test of Normality, Introduction to Parametric and Non Parametric tests,
Test of significance: t-test, chi square test, ANOVA(1-way, 2-way), Repeated Measures ANOVA, ANCOVA, α-correction.

Introduction to Statistical software: SPSS/Minitab/MsExcel with hands on practical session on concepts detailed in section A3.

Procedure for writing a research proposal and research report: Purpose , types and Components of research reports, layout of report, Ethical issues related to publishing, plagiarism and self-plagiarism, Introduction to ArXive , BioarXive, Overleaf and Research Gate: Uses and Benefits.

Introduction of Software: Hands on practical session on software useful for technical report writing such as MS-Word/ Open-Office (reference Management, formatting, Tracking changes, Handling Images and tables layout etc.), Google Docs, Writing document in Latex, Introduction to Mendeley.
Graphical presentation of results in different types of graphs and plots.

Books:

1. Kothari C.K. (2004), Research Methodology-Methods and Techniques (New Age International NewDelhi)2nd Ed.
2. Panneerselvam R., Research Methodology, PHI, 2nd Edition
3. N. Gurumani. Scientific Thesis writing and Paper Presentation. MJP Publishers

Paper Title: Research Seminar

Paper Code: RS-9002

L	T	P
4	0	0

Research Scholar will have to present a seminar based upon his/her research area. Performance of the scholar and participation in seminar will be taken into consideration.

Paper Title: Research and Publication Ethics

Paper Code: RS-9003

L	T	P
4	0	0

Objectives: This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands on sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact factor etc) and plagiarism tools will be introduced in this course.

Philosophy and Ethics: **(3 hrs)**

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

Scientific Conduct: **(5 hrs)**

1. Ethics with respect to science and research
2. Intellectual honest and research integrity
3. Scientific misconducts: falsification, fabrication, and plagiarism.
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data.

Publication Ethics: **(7 hrs)**

1. Publication ethics: definition, introduction and importance
2. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice verse, types
5. Violation of publication ethics, authorship and contributor ship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Open Access Publishing: **(4 hrs)**

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright and self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Publication Misconduct: **(4 hrs)**

A. Group Discussions (2 hrs)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs)

Use of plagiarism software like Turnitin, Urkund and other open source software tools

Databases and Research Metrics: **(7 hrs)**

A Databases (4 hrs)

1. Indexing databases

2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs)

1. Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics

References:

1. A Bird, “Philosophy of Science”, Routledge 2006.
2. Alasdair MacIntyre, “A Short History of Ethics”, London 1967.
3. P. Chaddah, “Ethics in Competitive Research: Do not get Scooped; do not get plagiarized”, 2018, ISBN: 978-9387480865.
4. National Academy of Sciences, “On being a scientist: A guide to responsible conduct in research”, third edition, National Academic Press, 2009.
5. D. B. Resnik, “What is ethics in research & why is t important”, National Institute of Environmental Health Science, 1-10, Nature 489 (7415), 179-179.
6. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance, 2019, ISBM: 978-81-939482, 1-7.

ELECTIVES
(Group I: Computer Science and Engineering)

Paper Title: Network Technologies

Paper Code: CSE9101

L	T	P
4	0	0

Overview of wireless networks: Introduction to wireless communication, IEEE 802.11, Wireless ATM, IEEE 802.16 and IEEE 802.20. Review of GSM

IPv6: Basic protocol, extensions and options, support for QoS, security, neighbor discovery, auto-configuration, routing.

WiMAX Networks: Architecture, MAC layer, physical layer, spectrum allocation issues, comparison with WiFi and limitations.

Traffic Management: Economic Framework, Traffic Models, Traffic Classes, Scheduling, Admission Control, Peak Load Pricing

QoS and Security issues: Network security requirements, issues and challenges in security and QoS provisioning, classifications of QoS solutions, IETF integrated services model, Differentiated Services Model. Flow identification, Packet Classifiers and Filters.

Mobility in networks: Mobile IP and related issues like Route Optimization, Handoff, and Security.

Mobile Ad hoc Networks (MANETs): Introduction to Ad hoc wireless networks and sensor networks, Various MANET issues.

Transport layer: Various transport layer solutions and TCP over Ad hoc wireless networks, TCP extensions for high-speed networks, transaction-oriented applications, other new options in TCP, TCP in Wireless Domain

Network Simulation: Elements of queuing model, role of exponential distribution, Event graphs of queuing model, Discrete-event and Continuous Simulation, Introduction to NS2 and Qualnet.

Books:

1. William Stallings," Wireless Communication and Networks", Pearson Education.
2. C. Siva Ram Murthy and B. S Manoj," Adhoc Wireless Networks-Architecture and Protocols", Pearson Education.
3. W. R. Stevens," TCP/IP Illustrated, Vol. 1, Pearson Education.
4. M. Gonsalves and K. Niles," IPv6 Networks", McGraw Hill
5. S. Keshav," An Engineering Approach to Computer Networking", Pearson Education.
6. Hamdy A. Taha," Operations Research and Introduction", Pearson Education.
7. Requests for Comments (RFCs) & Internet Drafts, published by Internet Engineering Task Force (www.rfc-editor.org)
8. Journals: IEEE Journal on Selected Areas in Communications, IEEE Transactions on Communication, ACM/IEEE Transactions on Networking

Paper Title: Cloud Computing

Paper Code: CSE9102

L	T	P
4	0	0

Objectives: This course offers a good understanding of cloud computing concepts and prepares students to be in a position to design cloud based applications for distributed systems.

Cloud Computing Basics: Cloud Computing Overview; Characteristics; Applications; Internet and Cloud; Benefits; Limitations; Challenges.

Cloud Computing Services and Deployment Models: Infrastructure as a Service; Platform as a Service; Software as a Service; Private Cloud; Public Cloud; Community Cloud; Hybrid Cloud.

Cloud Computing vs Other Computing Technologies: Overview of Grid, Peer-to-Peer, Pervasive and Utility Computing technologies; their characteristics and comparison between them.

Accessing the Cloud: Hardware and Infrastructure requirements; Access Mechanisms: Web Applications, Web APIs, Web Browsers.

Cloud Storage and Cloud Standards: Overview; Storage as a Service; Cloud Storage Issues; Challenges; Standards.

Security Issues: Securing the Cloud, Securing Data, Establishing identity and presence.

Developing Applications: Major Players in Cloud Business; Overview of Service Oriented Architecture; Tools for developing cloud services and applications. Introduction to Google App Engine, Azure Services Platform, Amazon EC2, Amazon S3.

Migrating to the Cloud: Overview; Issues; Approaches.

Text Books:

Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter, Cloud Computing: A Practical Approach, McGraw Hill, 2010.

Reference Books:

1. Rajkumar Buyys, James Broberg, Andrzej Goscinski (Editors), Cloud Computing: Principles and Paradigms, Wiley, 2011.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley, 2011.
3. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Cloud Computing for Dummies, Wiley, 2010.
4. Borko Furht, Armando Escalante (Editors), Handbook of Cloud Computing, Springer, 2010.
5. Dimitris N. Chorafas, CRC Press, Taylor and Francis Group, 2011.

Paper Title: Advanced Concepts in Digital Image Processing

Paper Code: CSE9103

L	T	P
4	0	0

Objectives: To introduce the various image processing techniques and their applications in different domains. To get students acquainted with computer vision.

Introduction to Image Processing: Introduction to Digital Image Processing, Examples and Components of Digital Image Processing, Digital Image fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Linear And Nonlinear Operations, Color Models.

Image Enhancements and Restoration: Gray Level Transformations, Histogram Processing, Enhancement Using Spatial Filtering: Smoothing Filters, Sharpening Filters, Image Enhancement in the frequency domain: Introduction to the Fourier Transform , Smoothing filters, Sharpening Filters, Homomorphic Filtering, Image Restoration : Image Degradation/ Restoration Process, Noise Models, Periodic Noise Reduction by Frequency Domain filtering, Linear, Position-Invariant Degradations, Estimating the degradation Function, Inverse Filtering, Minimum Mean Square Error(Wiener)Filtering, Constrained Least Squares Filtering, Morphological Image Processing.

Image Compression and wavelets: fundamentals, image compression models, elements of information theory, error free compression lossy compression, image compression standards, Color Fundamentals, Wavelets and multiresolution processing: multiresolution expansions, wavelets transforms in one dimension, the fast wavelet transform, wavelets transforms in two dimensions, wavelet packets.

Image Segmentation, Recognition and Analysis: Image Segmentation : Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region- Based Segmentation, Representation and Description :Boundary descriptors, Regional Descriptors, Use of Principal Components for Description , Relational Descriptors, Object Recognition : Patterns and Pattern Classes, Recognition Based on Decision- Theoretic Methods, Structural Methods.

Case studies on research areas related to image processing.

Text Books:

1. Gonzalez and Woods, “Digital Image Processing” ISDN 0-201-600-781, Addison Wesley 1992.

Reference Books:

1. Trucco & Verri, “Introductory techniques for 3-D Computer Vision”, Prentice Hall.
2. Jain, A.K. Kasturi and Scunk, “Fundamental of Digital Image Processing”, Tata Mc- Graw-Hill 1995.
3. Sonka, Hlavac, Boyle. “Image Processing, Analysis and Machine Vision” 2nd ed. PWS Publishing, 1999.
4. Madhuri A. Joshi,”Digital Image Processing: An Algorithmic Approach “,PHI learning private limited.
5. S.Jayaraman, S.Esakkirajan, T. Veerakumar,” Digital Image Processing”,Tata McGraw Hill,2010.
6. S.Annadurai, R. Shanmugalakshmi,” Fundamentals of Digital Image Processing”, Pearson Education, 2007

Paper Title: Advanced Information Security

Paper Code: CSE9104

L	T	P
4	0	0

Introduction to Security/Security Models: Introduction to Computer Security, Threats , Security Policy , Formal Model and Mechanism ,Security Trends , Security Attacks, Trust and assurance , Confidentiality and Integrity Model, Lattice Model ,Bell-LaPadulla Model,Access Control Matrix Model ,HRU Model, Integrity Model , Biba Integrity Model,Clark Wilson Model,Originator Controlled Access Control, Role based Access Control,Study of Emerging Access Control Models.

Cryptography and Cryptosystem: Cryptography, Classical Cryptosystems, DES , AES, Computational vs. Unconditional (or Information-Theoretic) Security; One-Way Functions and Hash Functions; Design Principles; Examples: MD5, Secure Hash Algorithm (SHA-1), etc.; Hashing with Block Ciphers; MACs from Hash Functions , Public-Key Cryptography,Trapdoor Functions; Fast Exponentiation; Square-and-Multiply Algorithm; Diffie-Hellman Key Agreement Protocol, Status of Security; Rivest-Shamir-Adleman (RSA) System , Elliptic Curve Cryptosystems , Discrete Logarithm Algorithms , Digital Signatures; Digital Signatures Based on Discrete Logarithms, Public-Key Certificates; Key Management Protocol, X.509,PGP,Study of Emerging Cryptography Techniques .

Intrusion detection and prevention models for network security: Intrusion Detection, Models, Architecture ,NIDS,HIDS, Network Security , Network Security Attacks, Applications of Cryptography in Network Security; Encryption at Different OSI-Layers; Code Based Vulnerabilities, Policy Deployment in Network ,Study of Emerging Intrusion Detection and Prevention Techniques , Protection in general purpose operating systems , Data base protection and security.
Assurance and Trust , Building Secure and Trusted Systems, Software Design Assurance, Formal Methods , Formal Specification and Verification , Formal Specification Languages, Evaluation System Criteria , TCSEC , ITSEC , Common Criteria, Disaster Recovery and Business Continuity, Organisational Policies , Risk Management.

Text Books:

1. Bishop, Matt: Introduction to Computer Security**.** Addison-Wesley, Pearson Education, Inc.

Reference Books:

1. William Stallings," Cryptography and Network Security Principles and Practice", 2/e,Pearson Education.
2. Michael. E. Whitman and Herbert J. Mattord ," Principles of Information Security"
3. William Stallings,"Network Security Essentials, Applications and Standards",Pearson Education.
4. J Pieprzyk,Thomas and Jennifer,"Fundamental of Computer Security",Springer
5. Arthur and White,"Principles of Computer Security",Tata Mcgraw Hill

Paper Title: Modeling And Simulation

Paper Code: CSE9105

L	T	P
4	0	0

Objectives: This course should provide the students with good understanding of various techniques of Simulation. At the end of this course students will be having good knowledge of simulation concepts and simulation languages.

Introduction: What is modeling and simulation? Application areas, definition and types of system, model and simulation, introduction to discrete-event and continuous simulation.

Simulation Methods: Discrete-event Simulation, Time advance Mechanisms, Components and organization of Discrete-event simulation, Flowchart of next-event time advance approach, Continuous Simulation, Random Number generation methods.

Queuing Models: Single server queuing system, introduction to arrival and departure time, flowcharts for arrival and departure routine. Event graphs of queuing model. Determining the events and variables.

Distribution Functions: Stochastic activities, Discrete probability functions, Cumulative distribution function, Continuous probability functions. Generation of random numbers following binomial distribution, poisson distribution, continuous distribution, normal distribution, exponential distribution, uniform distribution.

Programming in MATLAB: Introduction, Branching statements, loops, functions, additional data types, plots, arrays, inputs/outputs etc.

Programming in GPSS and C/C++: Basic Introduction to Special Simulation Languages:-GPSS and Implementation of Queuing Models using C/C++.

Introduction to Simulators: Introduction regarding features and usage of any Network simulator.

Books:

1. Averill M.Law and W. david Kelton," Simulation Modeling and Analysis", Tata McGraw-Hill Publication.
2. Geoffery Gordon," System Simulation", Prentice-Hall of India.
3. D.S.Hira," System Simulation", S.Chand Publications
4. Stephen J. Chapman," MATLAB Programming for Engineers", Thomson learning inc.
5. Jerry Banks, John S. Carson, Barry L. Nelson and David M. Nicol,"Discrete-Event System Simulation", Prentice-Hall of India.
6. Rudra Pratap," Getting Started with MATLAB 7", Oxford University Press.

Paper Title: Data Warehousing & Data Mining

Paper Code: CSE9106

L	T	P
4	0	0

Objectives: This course should provide the students with good understanding of various techniques of Data Warehousing & Data Mining. At the end of this course students will be having good knowledge of Data Mining concepts and warehousing techniques.

Introduction: Introduction to RDBMS, Data Warehouse, Transactional Databases, Data Mining Functionalities, Interestingness of pattern, classification of data mining system, major issues.

Data Warehouse and OLAP: Difference from traditional databases, Multidimensional data model, Schema for Multi dimensional model, measures, concept hierarchies, OLAP operations, starnet query model, Data Warehouse architecture, ROLAP, MOLAP, HOLAP, Data Warehouse Implementation, Data Cube, Metadata Repositories, OLAM

Data Processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept hierarchy generation.

Data Mining Architecture: Data Mining primitives, Task relevant data, interestingness measures, presentation and visualization of patterns, Data Mining Architecture, Concept Description, Data Generalization and Summarization, Attributed oriented induction, Analytical characterization, Mining class comparisons

Association Rules: Association rules mining, Mining Association rules from single level, multilevel transaction databases, multi dimensional relational databases and data warehouses, Correlational analysis, Constraint based association mining.

Classification and Clustering: Classification and prediction, Decision tree induction, Bayesian classification, k-nearest neighbor classification, Cluster analysis, Types of data in clustering, categorization of clustering methods

Introduction of Mining Complex Data: Complex data objects, Mining spatial databases, Multimedia databases, Time Series and sequence databases, Text databases and World Wide Web

Books:

1. Data Mining: Concepts and Techniques By J.Han and M. Kamber By Morgan Kaufman publishers, Harcourt India pvt. Ltd. Latest Edition
2. Data Mining Introductory and Advance Topics By Dunham, Pearson Education, Latest Edition

Paper Title: Concepts in Information Retrieval

Paper Code: CSE9107

L	T	P
4	0	0

Introduction: Introduction to Information Retrieval, Inverted indices and Boolean queries.

Term vocabulary and postings lists: Tokenization, stemming, lemmatization, stop words. Usage of Skip pointers, positional posting and phrase queries.

Dictionaries and tolerant retrieval: Dictionary data structures, Wild-card queries, Spelling and phonetic correction.

Index construction and compression: Blocked sort-based indexing, single pass in-memory indexing, distributed and dynamic indexing.

Scoring: Parametric and zone indexes, term frequency and weighting, vector space model for scoring, various tf-idf functions, Components of an IR system, Computing scores in a complete search system.

Classification: Naive Bayes models. Spam filtering, K Nearest Neighbors, Decision Trees, Support vector machine classifiers.

Web Search and Crawling: Web search basics, crawling architecture, distributed indexes, link analysis.

Evaluation of information retrieval systems: Evaluation of unranked and ranked retrieval sets, assessing relevance, probabilistic information retrieval, language models for information retrieval.

Text Books:

1. Introduction to Information Retrieval, Cambridge University Press,2008 by C. Manning, P. Raghavan, and H. Schütze.
2. Modern Information Retrieval, Addison-Wesley, 1999 by R. Baeza-Yates, B. Ribeiro-Neto.

ELECTIVES
(Group II: Mechanical Engineering)

Paper Title: Advance Heat Transfer

Paper Code: ME9201

L	T	P
4	0	0

Conduction: Steady state heat conduction including heat generation and heat losses in different co-ordinates, numerical analogue and graphical methods. Unsteady state heat conduction as applied to thick wall, cylinder and sphere with sudden and with periodic changes of surface temperature. Semi-infinite state with imposed wall temperature distribution. Heat conduction with moving boundaries numerical analogue and graphical methods.

Conductive Heat Transfer: Fundamentals: Reynold transport theorem. Derivation of N.S equation and energy; Dimensionless Number.

Convection: Laminar duct flows: Convection in fully developed flow and developing flow. Effect of wall boundary condition. Natural Convection: External flows; boundary laying integral similarity solution; Exact & empirical correlation, Heat transfer over plane plate, cylinders,tube banks and spheres. Turbulent Flows: Fundamental of Turbulent Heat convection; turbulent boundary layer; Exact & empirical correlations.

Radiation: Law of Radiation, shape factor Algebra, Radiative heat exchange between different surfaces of simple geometric shape. Use of electrical analysis in solving problem of Radiative heat exchange. Combined effect of heat transfer due to conduction, convection and radiation, use of relaxation methods.

Text Books:

1. Incropera & Dewtt," Heat & Mass Transfer", John Willey Ltd.
2. J.P. Holman," Heat Transfer",TMH
3. R.C. Sachdeva," Heat & Mass Transfer",New Age

Paper Title: Non Conventional Machining

Paper Code: ME9202

L	T	P
4	0	0

Introduction: Classification, Advantages & limitations of non conventional machining, Hybrid Machining, Ultrasonic machining (USM)-Principle of operation, process details, applications and advantages, limitations of USM.

Abrasive and Water Jet Machining: Basic principle, mechanism of material removal, working principle of Abrasive jet machining (AJM), water jet machining (WJM), merits & demerits, application.

Chemical Machining (CM): Working principle, process characteristics, procedures, advantages & disadvantages of chemical machining.

Electrochemical Processes: Fundamentals, details of machining setup, materials and selection of tools, applications, Concept of others processes like ECG, Electrochemical deburring etc.

Thermal Metal Removal Processes: Working principles, Mechanism of material removal, process parameters, advantages & limitations, applications of processes like electric discharge machining(EDM), Electron Beam Machining (EBM), Ion beam machining (IBM), Plasma arc machining (PAM), Laser beam machining(LBM).

Books:

1. V K Jain,"Advanced Machining Processes," Allied
2. Benedict," Unconventional Machining Methods", McH
3. HMT ,"Production Technology," TMH
4. M. Adithan,"Non Convectional Machining," John Wiley
5. P.K. Mishra," Non Conventional Machining", Narosa
6. Shan & Pandey," Modern machining process",TMH

Paper Title: Continuum Mechanics

Paper Code: ME9203

L	T	P
4	0	0

1. Introduction
2. Tensors: Indicial Notation, Tensors, Tensor Calculus, Curvilinear Coordinates
3. Kinematics of a Continuum
4. Stress
5. Integral Formulation of General Principles
6. The Elastic Solid: Linear Isotropic Solid, Linear Anisotropic Elastic Solid, Constitutive Equation for Isotropic Solid under Large Deformation Newtonian Viscous Fluid.
7. Non-Newtonian Fluids:Linear Viscoelastic Fluid, Non-Linear Viscoelastic Fluid, Viscometric Flow of Simple Fluid

Paper Title: Finite Element Methods

Paper Code: ME9204

L	T	P
4	0	0

Introduction& Fundamental Concepts: Historical Background, Stresses and equilibrium, Boundary Conditions, Strain-Displacement Relations, Stress-Strain Relations, Temperature Effects, Vectors and Matrices. Classification of Differential Equations, Rayleigh-Ritz Method, Galerkin's Method, Point Collocation Method, Least Square Method, Weighted Residual Method, Variational Formulation.

1-D FE Modeling: Finite Element Modeling, Coordinates and Shape Functions, Generalized Coordinates, Natural Coordinates in 1D, 2D and 3D, Coordinate Transformation, Assembly of Global Stiffness matrix and Load vector, Properties of Stiffness Matrix, Treatment of Boundary Conditions and Temperature Effects. Truss and Beam Elements.

2-D FE Modeling: Finite Element Modeling, Constant Strain Triangle (CST)

3-D FE Modeling: The Four Node Quadrilateral, Numerical Integration, Higher Order Elements; Nine Node Quadrilateral, Eight Node Quadrilaterals, Six Node Triangle

Truss: Introduction, Plane Trusses, Assembly of Global Stiffness Matrix and load vector

Higher-Order Elements: Plate Bending, C0 and C1 Elements, Non-conforming Elements and Patch Test

Scalar Field Problems: Introduction, Steady-state heat transfer, Potential Flow, Fluid Flow in Ducts

Dynamic Considerations: Element Mass Matrices, Evaluation of Eigen Values and Eigen Vectors. (Introduction only)

Computer Implementation: Introduction; Computer Program Organization for Calculation of System Matrices

Books:

1. Chandrupatla and Belegundu,"Introduction to Finite Elementsin Engineering", PHI
2. Bathe," Finite Element Procedures," PHI
3. Reddy,"An Introduction to FiniteElement Method," TMH
4. Huebner," The Finite Element Methods for Engineers," John Wiley
5. Zienkiewicz ,"The Finite Element Method", TMH
6. Buchanan," Finite Element Analysis", McGraw Hill

Paper Title: Composite Materials

Paper Code: ME9205

L	T	P
4	0	0

Introduction: General introduction to composites; historical background; concept of matrix and reinforcement and particulates.

Matrix and reinforcement: Types of matrix and reinforcement, volume fraction and weight fraction Fiber architecture fiber packing arrangements, whiskers.

Fabrication methods of polymer composites: Liquid resin impregnated routes, pressurized consolidation of resin pre-pegs, consolidation of resin molding compounds, injection molding of thermoplastics, hot press molding of thermoplastics

Fabrication of ceramic composites: Powder based routes, reactive processing, layered ceramic composites, carbon/carbon composites

Fabrication routes of metal matrix composites: Squeeze infiltration, stir casting, spray deposition, powder blending and consolidation, diffusion bonding of foils, PVD.

Testing and characterization: Different tests like internal stress measurement by diffraction, metallographic preparation etc with special emphasis to metal matrix composites

Secondary processing and application of composites: Secondary processing like machining, joining, extrusion of composites; Application and case studies

Books:

1. S.C.Sharma," Composite materials", Narosa Publishers
2. R.K.Everret & R.J.Arsenault," Metal matrix composite", Academic press
3. Introduction to metal Matrix Composite

Paper Title: Optimization Techniques

Paper Code: ME9206

L	T	P
4	0	0

Objectives: This course will provide the students with good understanding of various optimization techniques used in engineering applications. At the end of this course, students will be having good knowledge of optimization techniques, their concept and applications.

Numerical Techniques: Introduction to numerical techniques, Numerical differentiation and numerical integration, Eigen value problems, Newton-Raphson's method, Computer based numerical analysis.

Introduction to Optimization: Introduction and Engineering applications of optimization, Optimal Problem Formulation; Design –variables, Constraints, Objective function, Variable bounds.

Single-variable Optimization: Optimality Criteria, Bracketing Methods – Exhaustive search and Bounding phase methods, Region-Elimination Methods-Interval halving method; Fibonacci search method, golden section search method,Point-Estimation Method: Successive quadratic estimation method, Gradient-based Methods: Newton-Raphson method, Bisection method, Secant method, Cubic search method

Multivariable Optimization: Optimality Criteria, Unidirectional Search, Direct Search Methods: Simplex, Hooke-Jeeves pattern search and Powell's conjugate direction method, Gradient-based Methods: Cauchy's (steepest descent) method, Newton's method, conjugate gradient method, variable – metric method.

Constrained Optimization: Kuhn-Tucker Conditions, Transformation Methods: Penalty function method, Sensitivity Analysis, Direct Search for Constrained Minimization: Variable elimination, Complex search and Random search methods, Linearized Search Techniques: Frank-Wolfe method, Cutting plane method, Feasible Direction Method, Generalized Reduced Gradient Method, Gradient Projection Method.

Testing and characterization: Different tests like internal stress measurement by diffraction, metallographic preparation etc with special emphasis to metal matrix composites

Programming: Integer Programming,Geometric Programming

Books:

1. Sastry S.S., "Introductory methods of Numerical Analysis", Prentice Hall India, 2009.
2. Rao S.S., "Engineering Optimization : Theory and Practices", John Wiley and Sons, 4th Edition, 2009.
3. Kambo N.S., "Mathematical Programming Techniques" East West Press, 2009.
4. Deb Kalyanmoy, "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall of India New Delhi, 2005.

Paper Title: Design of Experiments

Paper Code: ME9207

L	T	P
4	0	0

Introduction: Strategy of experimentation, Some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation.

Simple Comparative Experiments: Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Paired comparison Designs, Inferences about the Variances of Normal Distributions.

Introduction To Factorial Design: Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and Surfaces, Blocking in a factorial design.

Fitting Regression Models: Introduction, Linear regression models, Estimate of parameters in linear regression models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression, Prediction of new response observations, Regression model diagnostics, Testing for lack of fit.

Taguchi Method Of Design Of Experiments: Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Mean (ANOM), Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study

Analysis of Variance (Anova): Introduction, Example of ANOVA process, Degrees of freedom, Error variance and pooling, Error variance and application, Error variance and utilizing empty columns, the F-test.

Books:

1. Douglas C Montgomery , “Design and Analysis of Experiments” ,John Wiley Publishers.
2. John P.W.M., “Statistical Design and Analysis of Experiments”, John Wiley Publishers.
3. Montgomery D.C., Runger G.C., “Introduction to Linear Regression Analysis”, John Wiley Publishers.
4. Myres R.H. and Montgomery D.C., “Response Surface Methodology Process and Product Optimization Using Designed experiments”,Wiley Publishers.
5. Taguchi , G, “Introduction to Quality Engineering”, UNIPUB,White Plains,New York.

Paper Title: Material Characterization

Paper Code: ME9208

L	T	P
4	0	0

Fundamentals of optics: Properties of light, Image formation, Magnification and resolution, Depth of field, focus and field of view, Optical microscope and its instrumental details, Variants in the optical microscopes and image formation

Microscopy: Opaque stop microscopy, Phase contrast microscopy, Dark field microscopy, Polarization microscopy, Differential interference contrast,Fluorescence microscopy, Sample preparation techniques for optical microscopy, Applications

Scanning Electron Microscopy (SEM): Introduction, Lens aberrations, Object resolution, Image quality, Imaging capabilities, Structural and elemental analysis, Instrumental details and image formation, Various imaging techniques and spectroscopy, Sample preparation and Applications

X-ray Diffraction(XRD): Introduction, Bragg's Law, X-ray scattering, Factors affecting X-ray peaks, Instrumental details and analysis of XRD pattern, Residual stress measurements, Applications

Transmission electron microscopy (TEM): Introduction, Science of Imaging and diffraction, TEM instrumental details and variants in imaging techniques, Sample preparation procedures and instruments for various materials

Books:

1. Spencer, Michael, Fundamentals of Light Microscopy, Cambridge UniversityPress,1982.
2. David B. Williams, C. Barry Carter, " Transmission Electron Microscopy: A Textbookfor Materials Science" ,Springer, 2009.
3. Joseph I Goldstein, Dale E Newbury, Patrick Echlin and David C Joy, "ScanningElectron Microscopy and X-Ray Microanalysis", 3rd Edition , 2005.
4. B.D.Cullity and S.R.Stock, "Elements of X-Ray Diffraction" Third edition, Prentice Hall,NJ , 2001.
5. Physical metallurgy and advanced materials' R.E. Smallman and A.H.W. Ngan,Seventh edition, 2007, Elsevier Ltd., USA.

PaperTitle: Additive Manufacturing

PaperCode: ME9209

L	T	P
4	0	0

Introduction to Additive Manufacturing: Process, Classification, Advantages, Additive v/s Conventional Manufacturing processes, Applications.

CAD for Additive Manufacturing: CAD software for 3D Modeling, CAD Data formats, Data translation, Data loss, STL format.

Additive Manufacturing Techniques: Stereo- Lithography, Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Binder Jet technology; Process parameters, Process Selection for various applications.

Application Domains: Aerospace, Electronics, Healthcare, Defence, Automotive, Construction, Food Processing, Machine Tools.

Materials: Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties; Polymers and their properties; Support Materials.

Additive Manufacturing Equipment: Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting, Process Design.

Post Processing: Requirement and Techniques.

Product Quality: Inspection and testing, Defects and their causes.

Books:

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, RapidTooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
4. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles andApplications”, World Scientific, 2017.
5. Zhiqiang Fan And Frank Liou, “Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy”, InTech, 2012.

PaperTitle: Machine Learning

PaperCode: ME9210

L	T	P
4	0	0

Introduction: Overview of Machine learning**,** Relationship between AI and Machine Learning, Role of statistics in machine learning, Role of algorithms in machine learning, Introduction to Big Data

Coding in Python: Introduction to Python; Data types – numeric, Boolean, strings, lists etc.;Creating and using functions; Using conditional and loop statements; Storing data using sets, lists and tuples; Indexing data using dictionaries; Using Python libraries; File handling

Maths fundamentals: Linear Algebra, Probability Theory, Optimization, Statistical Decision Theory, Regression, Classification, Bias, Variance

Linear and Logistic Classification: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal ComponentRegression, Partial Least squares, Logistic Regression, LDA, Perceptron

Classical Techniques: Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, k-Means, kNN, GMM, Expectation Maximization, Applications

Neural Networks: Neural Networks - Introduction, Early Models, Perceptron Learning, Neural Networks - Backpropagation,Initialization, Training & Validation, Parameter Estimation

Convolutional Neural Networks: CNN Operations, CNN architectures, Training, Transfer Learning, Applications

Books:

1. John Paul Mueller & Luca Massaron, “Machine Learning”, Wiley India Pvt. Ltd., 2018 (dummies edition).
2. Machine Learning by Tom Mitchell.
3. Introduction to Machine Learning by EthemAlpaydin
4. Gareth James, Daniela Witten, Trevor Hastie,Robert Tibshirani, “Introduction to Statistical Learning”, Springer, 2013

ELECTIVES
(Group III: Electrical and Electronics Engineering)

PaperTitle: Power System Optimization

PaperCode: EEE9301

L	T	P
4	0	0

Introduction to Optimization and Classical Optimization Techniques: single variable optimization, multivariable optimization without constraints, multivariable optimization with equality constraints, multivariable optimization with inequality constraints.

Linear Programming Problem: standard form, simplex method, two phase simplex method, duality, dual simplex method, sensitivity analysis, decomposition principle, transportation problem.

Non-linear Programming Problem: unimodal function, elimination methods – unrestricted search, Fibonacci method, golden section method, direct search method – random and grid search methods, indirect search methods – steepest descent and conjugate gradient method.

Dynamic Programming: multistage decision process, concept of suboptimization and principle of optimality, conversion of final value problem into an initial value problem, LP as a case of dynamic programming.

Genetic Algorithm: introduction to genetic algorithm, working principle, coding of variables, fitness function, GA operators, similarities and differences between GA and traditional methods, unconstrained and constrained optimization using GA.

Applications to Power System: economic load dispatch in thermal and hydro thermal system using GA, unit commitment problem, reactive power optimization, LPP and NLP techniques to optimal flow problems.

Books:

1. S. S. Rao, " Optimization – Theory and Applications", Wiley Eastern Ltd.
2. Hiller and Liberman, "Operations Research", McGraw Hill Publishing.
3. Kothari and Dhillon, "Power System Optimization", PHI.
4. S.Rajasekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications" , Prentice-Hall of India Private Limited.
5. Hira and Gupta, "Operations Research"
6. Kalyanmoy Deb, " Optimization for Engineering Design – Algorithms and Examples", Prentice-Hall of India Private Limited.
7. D.E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison-Wesley Reading, Mass.

PaperTitle: Power System Reliability

PaperCode: EEE9302

L	T	P
4	0	0

Probability and Reliability: Review of probability concepts, probability distributions, applications of binomial distribution to engineering problems, probability distribution in reliability evaluation, reliability indices, network modeling and evaluation of simple and complex networks, system reliability evaluation using probability distributions, frequency and load duration techniques, key indices of power system reliability and their calculations.

Generation System Reliability Evaluation: Concept of loss of load probability (LOLP), Energy demand, E (DNS), Evaluation of these indices for isolated systems, generation system, reliability analysis using the frequency and duration techniques.

Transmission System Reliability Evaluation: Evaluation of LOLP and E (DNS), indices for an isolated transmission system, interconnected system reliability, bulk power system reliability.

Distribution System Reliability Evaluation: Reliability analysis of radial systems with perfect and imperfect switching.

Books:

1. Billinton R., “Power System Reliability Calculation”
2. Endreyni, “Power System Reliability Evaluation”

Paper Title: Power System Deregulation

Paper Code: EEE9303

L	T	P
4	0	0

Power Sector Economics: Introduction to various concepts such as depreciation, fixed & variable cost, profitability indices, net present value, financing of power sector. Different techniques for project evaluation (capital cost, life cycle cost), various aspects of capital costs, comparison annualize cost.Typical Cost Components of utilities &their determinants (power purchase cost, C&M cost, manpower, depreciation, finance charges, full cost). Tariff setting principles Rate structure, Average cost of supply, cost to serve various consumer categories, marginal cost.

Performance of Indices of Power Utility: Performance indices for different aspects power utility such as generation, transmission, distribution, metering, billing, costs, power quality & consumer service.

Demand Side Management (DSM) & Integrated Resource Planning (IRP): Different techniques &objectives of DSM, utility DSM program design implementation &evaluation. Integrated Resource Planning: - Conceptual Issues & methodology.

Power Sector in India: Evaluation of integrated, monopoly, state owned electricity boards. Introduction to various institutions in Indian power sector & their role. Challenges before the Indian power sector, planning commission CEA, NT, PFC, ministry of power SEBS.

Power Sector Restructuring: Structural models (single buyer model wholesale competition Retail competition) Ownership model (Public sector state owned and municipal utilities, joint sector, cooperatives and private sector).

Review of International experience of Restructuring: Rational for restructuring structural and ownership changes, outcomes technological aspects of restructuring, Impact of Power Sector restructuring on DSM, IRP, and Regulation.

Overview of legal framework governing Indian Power Sector.

Books:

1. Kahn Edward, “Electric Utility Planning and Regulation” –, University of California.
2. Various Indian Electricity Acts 1). Indian Electricity Act , 1910 2)The Electricity Supply Act , 1998 proposed Electricity Bill 2001.
3. Tripathi S.C, “Electrical Energy Utilization And Conservation” (TMH Pub.)

PaperTitle: Power System Stability

PaperCode: EEE9304

L	T	P
4	0	0

Power System Stability Considerations: definitions-classification of stability-rotor angle and voltage stability-synchronous machine representation –classical model-load modeling concepts-modeling of excitation systems-modeling of prime movers.

Transient Stability: Swing quation-equal area criterion-solution of swing equation-Numerical methods -Euler method-Runge-Kutte method-critical clearing time and angle-effect of excitation system and governors-Multimachine stability –extended equal area criterion-transient energy function approach.

Small Signal Stability: state space representation – eigen values- modal matrices-small signal stability of single machine infinite bus system – synchronous machine classical model representation-effect of field circuit dynamics-effect of excitation system-small signal stability of multimachine system.

Voltage Stability: generation aspects - transmission system aspects – load aspects – PV curve – QV curve – PQ curve – analysis with static loads – loadability limit - sensitivity analysis-continuation power flow analysis - instability mechanisms-examples.

Methods of Improving Stability: transient stability enhancement – high speed fault clearing – steam turbine fast valving-high speed excitation systems- small signal stability enhancement-power system stabilizers – voltage stability enhancement – reactive power control.

Books:

1. Kundur P. “Power System Stability and Control McGraw-Hill International Editions.
2. Anderson, P.M. and Fouad, A.A., “Power System Control and Stability,” Galgotia Publications, New Delhi, 2003

PaperTitle: Electrical Distribution System

PaperCode: EEE9305

L	T	P
4	0	0

Industrial and Commercial Distribution Systems: Energy losses in distribution system – system ground for safety and protection – comparison of O/H lines and under ground cable system .Network model – power flow, short circuit and loss calculations.

Distribution System, Reliability Analysis: reliability concepts – Markov model – distribution network reliability – reliability performance.

Distribution System Expansion Planning: load characteristics, load forecasting, design concepts, optimal location of sub station, design of radial lines, solution technique.

Voltage Control: Application of shunt capacitance for loss reduction, harmonics in the system, static VAR systems, loss reduction and voltage improvement.

System Protection Requirement: fuses and section analyzers, over current, under voltage and under frequency protection, coordination of protective device.

Books:

1. Pabla, A.S., "Electrical Power Distribution System," 5th Edition, Tata McGraw Hill, 2004.
2. Gonen T, "Electrical Power Distribution System Engineering," McGraw Hill, 1986.
3. Sterling, M.I.H., "Power System Control," Peter Peergisus, 1979.

PaperTitle: Neural Networks & Fuzzy Logic

PaperCode: EEE9306

L	T	P
4	0	0

Fundamentals of Neural Networks: Introduction, Biological Neurons and Memory, Structure & Function of a single Neuron, Artificial Neural Networks (ANN). Typical Application of ANN - Classification, Clustering, Pattern Recognition, Function Approximation. Basic approach of the working of ANN –Training, Learning and Generalization.

Supervised Learning: Single-layer Networks, Linear Separability, handling linearly non-separable sets. Training algorithm. Error correction & gradient decent rules. Multi-layer network- Architecture, BackPropagation Algorithm (BPA) – Various parameters and their selection, Applications, Feedforward Network, Radial- Basis Function (RBF) network & its learning strategies.

Unsupervised Learning: Winner-takes all Networks, Hamming Networks. Adaptive Resonance Theory, Kohonen's, Self-organizing Maps.

Neurodynamical models: Stability of Equilibrium states, Hopfield Network, Brain-state-in-a-Box network, Bidirectional associative memories.

Fuzzy Logic: Basic concepts of Fuzzy Logic, Fuzzy vs. Crisp set Linguistic variables, membership functions, operations of fuzzy sets, Crisp relations, Fuzzy relations, Approximate reasoning, fuzzy IF-THEN rules, variable inference, techniques, defuzzification techniques, Fuzzy rule based systems. Applications of fuzzy logic.

Books:

1. Satish Kumar,"Neural Network : A classroom approach".
2. Jacek M.Zurada," Artificial Neural Networks".
3. Simon Haykin," Artifical Neural Network".
4. Rajasekaran & Pai,"Neural networks, Fuzzy logic and genetic algorithms".
5. Hagan, Demuth & Beale,"Neural Network Design.".
6. T. J. Ross," Fuzzy logic with engineering applications".

PaperTitle: Industrial Electronics

PaperCode: EEE9307

L	T	P
4	0	0

Power Semiconductor diodes and transistors: Characteristics of power diodes, power transistor, power MOSFETS, insulated Gate Bipolar Transistor (IGBT), Mos-controlled thyristor and their comparison.

Thyristors and their characteristics: Review of thyristors such as SCR, TRIAC, GTO, PUT, SUS, SCS, ASCR, RCT. Thyristor Controlled Circuits.

Three phase controlled rectifiers: Single phase half wave and full wave converters, Analysis of three phase rectifier, Effect of source impedance on the performance of converters, Dual Converters.

Choppers: Control strategies, step up choppers, A, B, C, D and E type of choppers, Voltage, Current and Load commutated choppers.

Inverters: Single phase series and parallel inverter, single-phase & three-phase bridge inverters, Pulse width modulated inverters, Reduction of harmonics in the inverter output voltages, Current source inverter.

Cycloconverters : Single phase, Mid-point and bridge type cycloconverters. Three phase half-wave cycloconverters, Output voltage equation, Load commutated cycloconverters.

Electric drives: Single-phase and three-phase dc drives, chopper drives, ac drives, Induction motor drives, Speed control of three-phase induction motors, Synchronous motor drives, Microprocessor controlled ac and dc drives.

FACTS Controllers: SVC, TCSC, STATCOM, SSSC, UPFC

Books:

1. David Finney,"The Power thyristor and its applications," McGraw-Hill Book Co. UK.
2. Richard A. Peerman,"Power Electronics: Solid state motor control", Prentice Hall.
3. P.C. Sen," Power Electronics'', Tata Mc Graw Hill Publishing company, New Delhi
4. M.H. Rashid," Power Electronics", Prentice Hall of India.
5. Dubey, Doradla, Joshi, Sinha," Thyristorised Power Controller", Wiley Eastern, New Delhi.

PaperTitle: Digital Control

PaperCode: EEE9308

L	T	P
4	0	0

Introduction: Control system terminology, control theory history and trends, computer-based control. An overview of classical approach to analog controller design. Basic digital control scheme.

Signal processing in digital control: Principles of signal conversion, Basic discrete time signals, Time domain models for discrete-time systems. Transfer function models, Stability on the Z-plane and jury stability criterion. Sampling as impulse modulation, Sampled spectra and aliasing. Filtering, choice of sampling rate, Principles of discretisation. Routh stability criterion on the r-plane.

Models of Digital Control Devices and Systems: Z-domain description of sampled continuous-time plants and systems with dead-time, Digital Controller design using direct synthesis procedures.

Control System Analysis using State Variable Methods for Digital Control Systems: State variable representation, Conversion of state variable models to transfer function and of transfer function to canonical state variable models, Eigen values and Eigen vectors, Solution of state difference equations, controllability and Observability, Multivariable system.

Pole-Placement Design and State Observers: Stability improvement by state feedback, Necessary and sufficient conditions for arbitrary pole-placement. State regulator design, Design of state observer. Compensator design by separation principle. Servo design. State feedback with integral control, Deadbeat control by state feedback and deadbeat observers.

Lyapunov stability analysis: Basic concepts, Stability definitions and theorems, Lyapunov functions for linear and non linear systems, A model reference adaptive system.

Linear Quadratic Optimal Control: Parameter optimization and optimal control, Quadratic performance index, control configurations, State regulator design through the Lyapunov equation, Optimal state regulator through the Matrix Riccati-equation for digital control systems.

Books:

1. B.C. Kuo," Digital Control Systems", Prentice Hall of India.
2. Sushil Das Gupta," Automatic Control Systems", Khanna Publishers.
3. M Gopal," Digital Control & State Variable Methods", TMH.
4. M. Gopal," Control System Principles & Design", TMH, 1997 edition.
5. K.Ogata," Discrete-time control systems", Prentice Hall India.

ELECTIVES
(Group IV: Electronics and Communication Engineering)

Paper Title: Advanced Digital Signal Processing

Paper Code: ECE9401

L	T	P
4	0	0

Transformations : Review of Z-Transform, Solution of Linear Difference Equations, Fourier series and Fourier Transform, Discrete Fourier Transform, Radix-2 FFT. Introduction to Radix-4 and Split Radix FFT, Discrete Cosine Transform, DCT as Orthogonal Transform, Walsh Transform, Hadamard Transform, Wavelet Transform.

Digital Filters: FIR Filter Design: Filter Specifications, Coefficient Calculation Methods- Window method, Optimal method, Frequency Sampling method. Realization Structures, Finite Word Length Effects.IIR Filter Design: Specifications, Coefficient Calculation methods- Pole-Zero Placement method, Impulse Invariant method, Matched Z-Transform method, Bilinear Z-Transformation method, Use of BZT and Classical Analog Filters to design IIR Filters. Realization Structures, Finite Word Length Effects.

Multirate Digital Signal Processing: Sampling Rate Alteration Devices, Multirate Structures for sampling rate conversion, Multistage design of Decimator and Interpolator, The Polyphase Decomposition, Arbitrary Rate Sampling Rate Converter, Filter Banks, QMF banks, Multilevel Filter Banks, Sub-band Coding, Discrete Wavelet Transform.

Linear Prediction and Optimum Linear Filters: Forward and Backward Linear Prediction, Properties of Linear Prediction-Error Filters, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Adaptive Digital Filters: Concepts of Adaptive Filtering, LMS Adaptive Algorithm, Recursive Least Squares Algorithm, Applications.

DSP Chips: Introduction to fixed point and floating point processors, ADSP21xx and TMS320Cxx-Architecture, Memory, Addressing Modes, Interrupts, Applications. Comparison of ADSP21xx and TMS320Cxx series.

Books:

1. “Digital Signal Processing: A Practical Approach”, by Ifeacher& Jervis, -Pearson Education.
2. “Digital Signal Processing: Principles, Algorithms and Applications”, by Proakis&Manolakis, 4e, -Pearson Education
3. “Digital Signal Processing”, by S.K.Mitra, -Tata-Mcgraw Hill.
4. “Discrete Time Signal Processing”, Oppenheim & Schafer. PHI.
5. “Modern Digital Signal Processing”, Roberto Cristi.
6. Digital SignalProcessing”, bySalivahanan, Vallavaraj&Gnanapriya, - Tata-Mcgraw Hill.

Paper Title: Digital System Design

Paper Code: ECE9402

L	T	P
4	0	0

Introduction to Digital Design Concepts: Design Constraints and Logic Representation of System.

Analog interfacing: A/D conversion concepts, Analog & Digital Conversion related errors.

Combinational Logic Design and Implementation: Multiplexer/Decoder, PLA/ Pal/ GAL, ROM, CPLD and FPGA level customized design, ALU, VHDL models and simulations of combinational circuits.

Sequential Logic Design and Implementation: Practical Synchronous and asynchronous circuit design. Design and Implementation of sequential digital system, state representation, analysis of digital systems, synchronization, design criteria, design procedure. High level modeling of digital systems, controller realization, Timing & Frequency consideration, system examples. VHDL models and simulation of sequential circuits.

Design for Testability: Fault and Fault coverage in digital circuits, internal scan test methodology, BIST and Boundary scan (JTAG) techniques.

Books:

1. Combinational design & testing using PLA/PAL/ROM chips.
2. Combinational design, simulation, synthesis & implementation.
3. W.J.Fletcher," An Engineering Approach to Digital Design",
4. M. Morris Mano,"Digital Design",
5. J.F.Wakerly," Digital Design principles and practices",
6. Ronald Tocci,"Digital Systems-Principles and applications",
7. Daniel D.Gajaski," Principles of Digital Design," Prentice Hall.

Paper Title: Embedded System Design

Paper Code: ECE9403

L	T	P
4	0	0

Introduction to Embedded System: Their classification & characteristics, Concepts and Processes of system level design of embedded system.

Microcontrollers: Introduction to microcontrollers, Memory , Buses, Direct Memory Access , Interrupts, Microprocessor Architecture, Interrupt Basic, Shared Data Problems, Interrupt Latency, PIC 16F8XX Flash Microcontrollers, CPU architecture, Register file structure, Instruction Set, Programs, Timers and Interrupts, Interrupt Service Routine , Features of Interrupts, Interrupt vector & Priority, Timing Generation & Measurements, Interfacing Methods, I/O Interface, LCD interfacing, Seven segment interfacing, I^2C Bus, DAC, ADC, UART.

Program Modeling Concepts in Single and multiprocessor system Software- Development Process: Modeling Processes for software Analysis before software implementation, Program model for event controlled, Modeling of Multiprocessor Systems.

Embedded Core Based Design: System -on -Chip, Application specific Integrated circuit, Overview of Embedded Processors like ARM, MIPS and Intel MMX series, Architecture, Organization and instruction set, Memory management, High level logic synthesis. Data parallel issues e.g SIMD, MIMD, MISD, SISD. Introduction to FPGA, Basics of FPGA

Real Time programming and Operating System (RTOS): RTOS Overview, Basics of RT- Linux as a RTOS, Assembly language, C++

Books:

1. Ajay V. Deshmukh," Microcontrollers (Theory and Applications)"
2. David E. Simon," An Embedded System Primer"
3. Steve Heath," Embedded system Design"
4. John B. Peatman," PIC Microcontroller "
5. Steve Furber,"ARM system architecture ",Addison Wesley
6. M.Barr," Programming Embedded System in C/C++ "
7. H. Kopetz," Real Time Systems"
8. Raj Kamal," Embedded Systems"

Paper Title: Wireless & Mobile Communication

Paper Code: ECE9404

L	T	P
4	0	0

Mobile Communication: Types of Mobile Communication Systems, Mobile radio systems around the world, Trends in cellular radio and personal communications.

Cellular Design Fundamentals: Frequency reuse, Channel alignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems, mechanism for capacity improvement-cell splitting, cell sectoring, and micro cell zone concept.

Multiple access schemes : TDMA, FDMA, CDMA, WCDMA, OFDMA, Random Multiple access Scheme, Packet Radio Protocols, CSMA, Reservation Protocols, Capacity of Cellular systems.

GSM Architecture& Protocols, GSM Burst structure, Carrier and Burst Synchronization, Design Consideration. Security Aspects, Power Control strategies.

CDMA Digital Cellular Standards, Services and Security Aspects, Network Reference Model and Key Features, Advantages over TDMA, CDMA WLL System. Recent developments.

Multipath Propagation: Fading, Large scale path loss, reflection, Diffraction, Scattering, Outdoor Propagation model-Okumura Model, HataModel,Indoor Propagation Models. Small-scale multipath propagation, Types of small scale fading, Rayleigh and Ricean distributions. Diversity Schemes.

Introduction to 3G Wireless Networks: WiFi, WiMax, Bluetooth

Books:

1. Raj Pandya,"Mobile and personal Communication Systems and services", PHI
2. Rappart," Wireless Communication," PHI
3. Lee," Mobile Communication",TMH
4. Dharam Prakash Aggarwal, Qing-Anzeng,"Wireless & Mobile System",Thomson

Paper Title: VLSI Design

Paper Code: ECE9405

L	T	P
4	0	0

Introduction to VLSI: Introduction to solid state electronics, CMOS Logic, VLSI Design Flow MOS FET theory: Ideal V-I Characteristics, C-V Characteristics, Non-ideal I-V Characteristics, CMOS processing technology: P-well, N-well, Twin Tub and silicon on Insulator processing, layout Design rules, CMOS Process enhancement. (10)

CMOS Circuit and Logic design: Combinational Circuit Design: Introduction, circuit Families like static CMOS, Ratioed circuits, CVSL, Dynamic Circuits, Pass Transistor circuit,.
Sequential Circuit design: Sequencing methods, Max-Delay constraints, Min-delay constraints, time borrowing, and clock skew. Data Path Subsystems: Adders, Sub tractors, Comparators, flip-flops, Shifter,counters,Multiplier (12)

Design Methodology & Tools: Design Methodology: Introduction, structured Design, Programmable logic, fully Custom design, CAD tools in VLSI Design Process. Floor Planning: Introduction, Block Placement and Channel Definitions, Global Routing, Switchbox routing, Power Distribution, clock Distribution. Architecture Design: Introduction, HDLs, High level synthesis, Logic Synthesis. (11)

VLSI Simulation and Algorithm: Hierarchy of simulation tools, Switch level simulations, Layout synthesis, Placements and routing algorithms, spice simulation. (12)

Books:

1. CMOS VLSI design by Neil H.E. Weste, David Harris, Ayan Banerjee, Pearson Education.
2. Modern VLSI Design by Wayne Wolf, Pearson education.
3. FPGA-Based system design by Pearson Education.
4. Introduction to VLSI Systems by Mead and Conway, Addison wisely.
5. VLSI Design by Puckneel

Paper Title: Fiber Optic Communication Systems

Paper Code: ECE9406

L	T	P
4	0	0

Review of Optical Fiber Communication: Need of optical transmission, Fiber optic communication system, Advantage of OFC, Basic optical laws and transmission parameters, Geometrical optics description: Step Index Fiber & Graded Index Fiber, Mode Theory for optical propagation, Modes in planar wave, Phase & Group Velocity. (6)

Signal Degradation in OFS: Attenuation, Material Absorption, Scattering Loss, Bending Loss, Information Capacity Determination, Group Delay, Material Dispersion, Waveguide Dispersion, Higher order Dispersion, Polarization Mode Dispersion, Dispersion compensating fibers, Non-linear effects on network performance (SPM, SRS, SBS, XPM & FWM). (9)

Optical Transmitter: Basic Concept: Emission and absorption Rates, p-n junctions, Non-radiative recombination, semiconductor materials, LED: Power current relationship, LED spectrum, LASER Diodes, ILD & its characteristics, Optical Gain, Feedback and Laser threshold, working principle of Distributed feedback lasers & VCSEL. (7)

Optical Receivers: Optical detection principles & devices, Detection response time, p-i-n photo-diode, Avalanche photodiode, Receiver operation: Digital Transmission, Error sources, Receiver configuration, Digital receiver performance, Probability of error. (6)

Transmission System Design: Link power budget, Rise time budget, Modulation Formats: Direct and External Modulation, need for modulation/encoding, NRZ, RZ, CSRZ, DPSK, QAM modulation formats. Fiber Loss-Induced Limitations, Balanced Coherent Receiver, Dispersion-Induced Limitations, ASE-Induced Limitations, Equivalent Noise Figure, Impact of Amplifier Spacing, Direct Detection Receiver. (8)

Optical Amplifier: Basic application and types of optical amplifiers, Semiconductor optical amplifiers, Erbium doped fiber amplifiers: architecture and types, Raman Amplifier, Amplifier-noise. (4)

Optical Components & Networks: Coupler/splitter, optical switches, optical add/drop multiplexers, fiber grating, WDM & DWDM systems, optical CDMA & TDMA. (5)

Text Books:

1. Optical Fiber Communications by Gerd Keiser, third edition, McGraw Hill.
2. Fiber optic communication technology by D.F Mynbaev and L. Scheiner, Pearson Education.

Recommended Books:

1. Fiber optic communication systems by Govind P. Agrawal, third edition, Wiley India.
2. Fiber Optic Communications: Fundamentals and Applications, Shiva Kumar, M. Jamal Deen, Wiley Publication.
3. Free Space optical networks for ultra broad band services by Stamatios V. Kartalopoulos, Wiley Publication.
4. Optical wireless communications: system and channel modeling with MATLAB by Z. Ghassemlooy, W. Popoola, S. Rajbhandari, CRC Press

Paper Title: Digital Image Processing

Paper Code: ECE9407

L	T	P
4	0	0

Introduction: Fundamental concept of digital image processing, Fields of Digital Image Processing, Component of image processing system, Image sensing and acquisition. (2)

Image Transformation, Filtering and Restoration: Relationship between pixels, Mathematical Tools used in image processing, Intensity Transformation Functions, Histogram Processing, Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters. Filtering in frequency domain, Image smoothing using low-pass frequency domain filters, Image sharpening using high-pass frequency domain filters. Noise Models, Restoration in the presence of noise and degradations, Inverse Filtering.

(8)

Color Image Processing: Color Fundamentals, Color Models, Color Transformations, Color Image Smoothing and Sharpening, Color in image segmentation, Noise in color images. (3)

Wavelets and Other Image Transforms: Matrix based transforms, Correlation, Basis functions in time-frequency plane, basis images, Fourier related transforms, DHT, DCT, DST, Walsh Hadamard transforms, Slant transform, Haar transform, Wavelet transform: scaling functions, wavelet functions, wavelet series expansion, DWT in one dimension, Wavelet Transform in two dimensions, Wavelet Packets. (8)

Image Compression: Redundancies in Images, Huffman Coding, Arithmetic coding, Symbol based coding, Bit-plane coding, Block Transform coding, Predictive coding, Wavelet Coding, Digital Image watermarking. (5)

Morphological Image Processing: Erosion and Dilation, Opening & Closing, Basic Morphological Algorithms: Boundary & Region Extraction, Convex Hull, Thinning, Thickening, Skeletons, Pruning (5)

Image Segmentation & Representation: Point, Line and Edge Detection, Thresholding, Region growing, Region splitting and merging, Clustering and Superpixels, Boundary preprocessing and feature descriptors, Region feature descriptors, SIFT. (6)

Digital video Processing: Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X. (6)

Case studies on research areas related to image processing (2)

Books:

1. Digital Image processing by R.C. Gonzalez and R.F.Woods, Pearson Education.
2. Fundamentals of Digital Image Processing by A.K Jain.
3. Digital Image Processing, by W. K. Pratt.
4. Digital Image Processing using MATLAB by Woods & Gonzalez , Pearson Education.
5. The Image Processing Handbook, John C. Ruses, Fourth Edition.
6. Digital Video Processing, Murat Tekalp, Prentice Hall, 2nd edition, 2015.
7. Algorithms for image Processing and Computer Vision, James R.Parker

Paper Title: Material Science & Engineering

Paper Code: ECE9408

L	T	P
4	0	0

Material Science: Introduction, processing & selecting materials, looking at Materials by Powers of Ten. Atomic Bonding**:** Atomic Structure, The Ionic Bond, The Covalent Bond, The Metallic Bond, The Secondary or van der Waals, Bond Materials-The Bonding Classification. (7)

Crystalline Structure & Defects: Metal Structures, Ceramic Structures, Polymeric Structures, Semiconductor Structures, Lattice Positions, Directions, and Planes. Point Defects, Linear Defects, Planar Defects-Two Dimensional Imperfections Non-crystalline Solids- Three Dimensional Imperfections. Thermal Production of Point Defects, Solid State Diffusion, Steady- State Diffusion, Alternate Diffusion Paths. (8)

Mechanical and Thermal Behavior: Mechanical:Stress versus Strain, Elastic Deformation, Plastic Deformation, Hardness, Creep and Stress Relaxation, Viscoelastic Deformation. Thermal:Heat Capacity, Thermal Expansion, Thermal Conductivity, Thermal Shock, Failure Analysis and Prevention (7)

Phase Diagrams: The Phase Rule, the Phase Diagram, the Lever Rule, Heat Treatment, Time the Third Dimension the TTT Diagram, Hardenability, Precipitation Hardening Annealing, The Kinetics of Phase transformations for Nonmetals. (6)

Structural Materials & Processing: Metals, Ceramics, and Glasses, Polymers and Composites, Processing all four Structural Materials, Electronic Materials**:** Charge Carriers and Conduction, Energy Levels and Energy Bands, Conductors, Insulators, Semiconductors, Composites, Electrical Classification of Materials (6)

Optical and Magnetic Materials: Optical Materials, Magnetic Materials, Materials in Engineering Design, Selection of Electronic, Optical, and Magnetic Materials (5)

Advanced Semiconductor Materials: Band structure, carrier concentration, Electrical Mechanical and optical properties of Gallium Nitride, Aluminium Nitride, Indium Nitride, Boron Nitride, Silicon Carbide, Silicon-germanium (Sil-xGex), Materials of special applications viz. cryogenic, high temperature, high frequency Applications. (6)

Text Books:

1. Properties of Advanced Semiconductor Materials: Gan, Aln, Inn, by Michael E .Levinshtein, Springer. 2001.

Recommended Books:

1. Introduction to Materials Science for Engineers, 6th Edition by James F. Shackelford, Prentice Hall.2001
2. Fundamentals of Semiconductors: Physics and Materials properties by Yu and M Cardona, Springer, 1996.

Paper Title: Neural Networks & Fuzzy Logic

Paper Code: ECE9409

L	T	P
4	0	0

Fundamentals of Neural Networks: Introduction, Biological Neurons and Memory, Structure & Function of a single Neuron, Artificial Neural Networks (ANN). Typical Application of ANN - Classification, Clustering, Pattern Recognition, Function Approximation. Basic approach of the working of ANN – Training, Learning and Generalization. (10)

Supervised Learning: Single-layer Networks, Linear Separability, handling linearly non-separable sets. Training algorithm. Error correction & gradient decent rules. Multi-layer network- Architecture, Back Propagation Algorithm (BPA) – Various parameters and their selection, Applications, Feed-forward Network, Radial- Basis Function (RBF) network & its learning strategies. (15)

Unsupervised Learning: Winner-takes all Networks, Hamming Networks. Adaptive Resonance Theory, Kohonen's Self-organizing Maps. (09)

Neurodynamical models: Stability of Equilibrium states, Hopfield Network, Brain-state-in-a-Box network, Bidirectional associative memories. (06)

Fuzzy Logic: Basic concepts of Fuzzy Logic, Fuzzy Vs. Crisp set Linguistic variables, membership functions, operations of fuzzy sets, Crisp relations, Fuzzy relations, Approximate reasoning, fuzzy IF-THEN rules, variable inference, techniques, defuzzification techniques, Fuzzy rule based systems. Applications of fuzzy logic. (10)

Books:

1. Neural Network : A classroom approach by Satish Kumar.
2. Artificial Neural Networks by JacekM.Zurada.
3. Artifical Neural Network by Simon Haykin.
4. Neural networks, Fuzzy logic and genetic algorithms, by Rajasekaran&Pai.
5. Neural Network Design by gan, Demuth & Beale.
6. Fuzzy logic with engineering applications by T. J. Ross.

Paper Title: Antenna Fundamentals and Measurements

Paper Code: ECE9410

L	T	P
4	0	0

Antenna: Introduction – Types of Antennas, Antenna Parameters: Radiation Patterns, Radiation Power Density, Radiation Intensity, Gain, Antenna Efficiency, Bandwidth, Polarization, Input Impedance, Antenna Radiation Efficiency, Antenna as an Aperture, Directivity and maximum Aperture, Friis Transmission Equation, Antenna Temperature.

Arrays: Linear, Planar, and Circular: Introduction, Array theory, Array calculations and analysis,Two-Element Array-N-Element Linear Array, Uniform Amplitude and Spacing- N-Element Linear Array: Directivity , Design Procedure- N-Element Linear Array: Three-Dimensional Characteristics. Rectangular-to-Polar Graphical Solution- N-Element Linear Array: Uniform Spacing, Non Uniform Amplitude- Super Directivity planner Array-Design Consideration-Circular Array.

Microstrip Radiators: Definition of microstrip antenna, advantages and disadvantages of microstrip antennas, applications, Radiation mechanism and Radiation fields of microstrip antennas, excitation techniques, Analysis of Rectangular patch radiators, The Model, the transmission line model, Bandwidth Enhancement Techniques. Micro-Strip Antenna Arrays.

Antenna Synthesis and Continuous Sources: Introduction, Continuous Sources, Schelkunoff Polynomial Method, Fourier Transform Method, Woodward-Lawson Method, Taylor Line-Source (Tschebyscheff-Error), Taylor Line-Source (One-Parameter), Triangular, Cosine, and Cosine-Squared Amplitude Distributions, Line-Source Phase Distributions, Continuous Aperture Sources, Multimedia.

Antenna Measurements: Introduction–Antenna Ranges, Radiation Patterns, gain measurements, directivity measurements, radiation efficiency, impedance measurements, current measurements, polarization measurements, scale model measurements.

Books:

1. Antennas by J.D. Kraus, MC Graw-Hill, 1988.
2. Antenna theory analysis and Design by Constantine A. Balanis, John Wiley.
3. Microstrip antennas by J.J. Bahl and Bhartia, Artech House, 1982.
4. Microwave Antenna Theory and Design by Samuel Silver, IEE Press, London 1984.
5. Microstrip Antenna Theory and Design by James J. Hall, P.S. Wood, 1981.

ELECTIVES
(Group V: Biotechnology)

Paper Title: Microbial Biotechnology & Molecular Medicine

Paper Code: BT 9501

L	T	P
4	0	0

Microbial Metabolism & Strain Improvement: Microbial metabolic pathways-amphibolic and biosynthetic, production of primary and secondary metabolites, microbial products of industrial importance, ideal growth medium for production of biomass and a microbial product, culture preservation, strain improvement by mutagenesis and by genetic means.

Techniques in Biotechnology:(For Purification and characterization of industrial products)

i) Centrifugation: Principle, Types, Applications.

ii) Chromatography: Principle, Types of Chromatography such as gel permeation, ion exchange, affinity etc, modes of Chromatography, Applications.

iii) Electrophoresis: Principle, protein and DNA electrophoresis, SDS-PAGE, preparative and analytical, applications of each type.

iv) Spectrophotometry.

Microbial Pathogenesis and Drug Development: Understanding pathogenesis, multidrug resistance and mechanisms, screening of microbes and microbial compounds for development of new chemotherapeutic agents, Disease diagnosis, identification and characterization of novel proteins by proteomics study, 2D PAGE and Mass spectrometry.

Books:

1. Brock, T.D., Biotechnology : A Text of Industrial Microbiology. Smaeur Associate (1990) IInd ed.
2. Crueger, W. and Crueger, A., Bio-Technology, A Handbook of Industrial Microbiology. Ponima Pub (2000) IInd ed.
3. Stanbury P.F. and Whitakar A., Principles of Fermentation Technology, Orgamon Press, (1995) 2nd edition.
4. Maheshwari, D. K., Dubey, R.C and Kang, S.C., Biotechnological applications of microorganisms: A techno- commercial approach. I K International Publishing House (2006).
5. Waites, M. J.,Morgan N.L., Rockey J.S and Higton G. Industrial Biotechnology: An Introduction. BlackwellScientific Press, UK (2007).
6. Patel, A.H., Industrial Microbiology. Mac Millan India Ltd, New Delhi (2005).

Paper Title: Polymer Science and Engineering

Paper Code: BT 9502

L	T	P
4	0	0

Introduction to polymers: Basic concept, classification of polymers, molecular weight and its distribution, preparation of polymeric materials and their characterization. Step growth and chain polymerization, copolymerization, kinetics and molecular weight distribution in polycondensation and free radical addition polymerization, control of molecular weight. Dilute Solution viscometery, conformation and molecular dimensions of polymer chains, Thermodynamics of polymer solutions. Rubber elasticity, flow curve and its determination. Polymerization processes. Polymeric materials with discussion on electrical, optical, transport and mechanical properties. Viscoelasticity, linear viscoelastic models. Bio-polymer materials, applications in bio-technology and controlled drug delivery system.

Books:

1. Fried., Joel R., Polymer Science and Technology, 2014, Pearson.
2. Williams., David J., Polymer Science and Engineering, Prentice hall of India (1971)
3. Billmeyer, F.W., Text Book of Polymer Science, Wiley and Sons (2005).

Paper Title: Advances in Biochemical Engineering

Paper Code: BT 9503

L	T	P
4	0	0

Various applications of microbes: modeling of biochemical reactions and applications to scale up.

Case studies based on bioreactor models for industrial productions, latest topics in fermentation engineering. Separation techniques for the extraction of fermentation products, modeling and analysis. Overview of bench-Scale preparative bio separations.

Selectivity in synthesis: biocatalysis and bioconversion; stereochemical considerations, Stereo specific and Stereo selective reactions. Analytical methods and techniques for determination of enantioselectivity: Specific rotation, Chiral 1H NMR, Chiral shift reagents and Chiral HPLC, Chiral GC.

Books:

1. Shuler, M.L. and Kargi, F. Bioprocess Engineering: Basic concepts, 2nd ed., Prentice-Hall, 2002.
2. Doran Pauline M, Bioprocess Engineering Principles, Academic Press, 1995.
3. Nielsen, J. and Villadsen, J. “Bioreaction Engineering Principles”. Springer, 2007.
4. Blanch, H.W and Clark D.S., “Biochemical Engineering”, Marcel Dekker,1997

Paper Title: Enzyme Technology

Paper Code: BT 9504

L	T	P
4	0	0

Introduction: Mechanism of enzyme action. Strategies of purification of enzymes, criteria of purity, molecular weight determination and characterization of enzymes Stereo selective biocatalysts for the synthesis of chiral pharmaceutical intermediate such as synthesis of ACE inhibitors, definition, mode of action of inhibitors.

Kinetics of enzyme action*:* Methods for investigating the kinetics of Enzyme catalysed reactions – Initial velocity Studies, Estimation of Michaelis Menten parameters, Effect of pH and temperature on enzyme activity, kinetics of inhibition. Modeling of rate equations for single and multiple substrate reactions.

Immobilized Enzymes: Kinetics of immobilized enzymes, effect of solute, partition & diffusion on the kinetics of immobilized enzymes, design and configuration of immobilized enzyme reactors; applications of immobilized enzyme technology, Economic argument for immobilization.

Modelling of Diffusion Systems: External, Internal mass transfer diffusion and reaction within biocatalysts, derivation of finite model for diffusion-reaction systems, dimensionless parameters from diffusion-reaction models, the effectiveness factor concept.

Design and Analysis of Biological Reactor: Ideal bioreactors-batch, fed batch, continuous, cell recycle, plug flow reactor, two stage reactors, enzyme catalyzed reactions, reactor dynamics and stability.

Books:

1. Trevor Palmer and Philip L Bonner. “Enzymes: Biochemistry, Biotechnology, Clinical Chemistry”, East- West Press, 2004.
2. Shuler, M.L. and F. Kargi, “Bioprocess Engineering: Basic Concepts” 2nd Edition, Pearson, 2002.
3. Bailey.J.E and Ollis.D.F, “Biochemical Engineering Fundamentals”, 2nd Edition, McGraw-Hill, 1986.
4. Faber, Kurt “Biotransformations in Organic Chemistry: A Textbook.” 5th Edition. Springer,2008

Paper Title: Nano-biotechnology: From theory to applications

Paper Code: BT 9505

L	T	P
4	0	0

Introduction: Overview of nanoparticles in biomedical applications, limitations and challenges in using nanoparticles in biomedical fields, biocompatibility/toxicity of nanomaterials (5)

Bioconjugation: Introduction to bioconjugation, interaction of biomolecules with nanoparticles, surface functionalization/modification of nanoparticles by ligand exchange or ligand modification; reactions of bioconjugation, types of cross linkers-homofunctional, heterofunctional, zero length; bioconjugation using covalent, non-covalent, biological approaches; examples of bioconjugation with metallic, semiconducting, magnetic nanoparticles and liposomes, modification and conjugation of antibody, enzyme, nucleic acid and oligonucleotide coupling reactions.

Bioanalytical techniques: Fluorescent probes and their use in nanotechnology, ligand immobilization on chromatography supports, PEGylation and synthetic polymer modification, characterization of nanobioconjugates using electrophoresis, chromatography and various spectroscopic techniques.

Bioinspired nanomaterials: Superhydrophobic materials such as lotus leaf structure, bio-inspired superglues (adhesive nanostructures), ultrahard materials, organic and inorganic natural nanomaterials, natural fibers (spider silk, sponge fibers), nanomaterials derived from cell walls.

Bionegineering: Biomaterials- biomineralization, applications and importance of compatibility, biological/circadian rhythms and its phase markers, neurotransport: nerve impulse conduction and conduction across synapse, EEG, ECG and its association with the working of the heart.

Tissue engineering: Concept of tissue engineering-cell types, scaffolds and bioreactors, nanopump, molecular motors-types and examples, nanoscale biostructures, self-healing structures.

Applications: Lab-on-a-chip, organic molecular based computing -amorphous computing, DNA fingerprinting, bio-imaging, bioassays, nanovectors&drug delivery, nano-diagnostics &therapeutics, DNA molecular therapy, photodynamic therapy, smart materials, biosensors, nanorobotics.

Books:

1. Nanostructures and Nanomaterials by G. Cao, Imperial College Press, 2004 2.Biophysics, PV Gautham, Narosa Publishing House, New Delhi, 2002.
2. Biometals by SV Bhat, Narosa Publishing House, New Delhi, 2002.
3. Modern Bioelectricity by A. A. Marino, Marcel Dekker Inc New York, 1998.

Paper Title: Cancer Biology

Paper Code: BT 9506

L	T	P
4	0	0

Incidence and etiology of cancer, Molecular biology of cancer, Immune system and cancer cells, risk and prevention genetics of cancer, various factors controlling cancer progression, Cellular hallmarks of cancer, Cancer metastasis, journey of benign tumor to metastatic cancer, Stages of cancer metastasis, tools of cancer diagnosis, cell imaging

Relation between nutrition and cancer, Diet- and lifestyle-related risk factors for cancer development and survival, mechanisms by which nutrition impacts cancer, prevention, Different types of cancer, Cancer treatment; surgery, radiation therapy, chemo therapy, recent developments.

Books:

1. Molecular Biology of the Cell. 4th edition. Alberts B, Johnson A, Lewis J, et al. New York: Garland Science; 2002.
2. Molecular Cell Biology. 4th edition. Lodish H, Berk A, Zipursky SL, et al. New York: W.H. Freeman; 2000
3. All Cancers Fact Sheet, GLOBOCAN 2018. The Global Cancer Observatory. Available online: https://gco.iarc.fr/today/data/factsheets/cancers/39-All-cancers-fact-sheet.pdf.
4. Bray, F.; Ferlay, J.; Soerjomataram, I.; Siegel, R.L.; Torre, L.A.; Jemal, A. Global Cancer Statistics 2018:GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J.Clin. 2018, 68, 394–424.
5. Arruebo, M.; Vilaboa, N.; Sáez-Gutierrez, B.; Lambea, J.; Tres, A.; Valladares, M.; González-Fernández, Á. Assessment of the evolution of cancer treatment therapies. Cancers 2011, 3, 3279–3330.

Paper Title: Advances in Biosensor Technology

Paper Code: BT 9507

L	T	P
4	0	0

Sensors-signals and systems, Biosensors and its components, types of recognition elements (aptamers, antibodies, DNAzymes, enzymes, nucleic acids, bacteriophages) and transducers (optical and electrochemical).

Colorimetric biosensors, fluorescent biosensors, SPR based sensors Electrochemical biosensors (potentiometric, amperometric, and impedimetric) Dipstick, strip-based, and microfluidic assays

Applications of biosensors in healthcare, food, and environment sectors

Biology at the nano-interface, conjugation and crosslinking approaches for development of biosensor, types of crosslinkers.

Nanomaterials: synthesis and characterization, Properties, Applications in Biosensors

Characterization techniques involved in biosensor development: Thermal methods, X□ray methods, Spectroscopic methods (UV, FTIR, Raman, PL), Chromatographic methods, Mass spectroscopy, Electron Microscopy (SEM, TEM), Electron Probe Micro Analysis (EDX), Quantitative Analysis (AAS, ICP).

Books:

1. Jeong-Yeol Yoon, 2016. Introduction to Biosensors, Springer International Publishing.
2. Chandran Karunakaran, Kalpana Bhargava, Robson Benjamin, 2015. Biosensors and Bioelectronics. Elsevier Publishers.
3. Helmut Günzlerand Alex Williams, 2001. Handbook of Analytical Techniques. Wiley Publishers.

Paper Title: Genetic Engineering

Paper Code: BT 9508

L	T	P
4	0	0

Scope of Genetic Engineering: Milestones in Genetic Engineering, genetic code, genetic elements that control gene expression.

Molecular Tools in Genetic Engineering: Restriction and DNA Modifying enzymes (Polymerases, Reverse Transcriptase, Ligases, Alkaline phosphatase, Terminal deoxynucleotide transferases, Nucleases - S1 nucleases etc.), Vectors for *E. coli* (Plasmids, Phages, Cosmids, Fosmids, Phagemids, BAC), Vectors for Eukaryotes (YEPs, YIPs, YRPs, YAC), Vectors for plants (Ti and Ri plasmids, caulimoviruses, geminiviruses), Vectors for animals (P-elements, baculovirus, adenovirus, papillomavirus and retrovirus).

Nucleic Acid Amplification and Gene Cloning Strategies- PCR analysis, their types and applications, prokaryotic and eukaryotic transformations, Creating and screening DNA libraries (Genomic library and cDNA library preparations)**.**

Directed Mutagenesis and Protein Engineering- *in-vitro* mutagenesis, *in-vivo* mutagenesis, error-prone PCR, adding disulphide bond, increasing enzymatic activity, modifying metal cofactor requirement *etc*.

Molecular Markers and Diagnostic Systems- Molecular Markers (RFPL, AFLP, RAPD, SSR, SNP, CAPs, SSR and their applications), Human molecular genetics **(**genetic linkage and genetic mapping), Detection of microbes (radioactive, non-radioactive hybridization procedure, molecular beacons, DNA fingerprinting, bacterial biosensor), Diagnosis of genetic diseases (cystic fibrosis, sickle cell anemia, PCR/OLA).

Application of Genetic Engineering in Plants, Animals and Microbes- Transgenic plants (Disease resistant, insect resistance, herbicide tolerance and biopharming), in Animals (hormones and pharmaceutical protein production, generation of transgenic animal, Gene therapy, to fight AIDS), Transgenic Microbes (Production of restriction endonucleases, small biological molecules such as ascorbic acid, indigo, antibiotics and enzymes, insulin, growth hormones, monoclonal antibodies/magic bullets, humanized monoclonal antibodies, biopolymers such as xanthum gum, animal adhesive biopolymer, bioremediation i.e. degradation of xenobiotics, clearing oil spills, starch and cellulose utilization and case studies.

Regulation and Patenting in Molecular Biology- importance of regulation, regulating food and food ingredients, GMOs release and controversy, Human gene therapy.

Books:

1. Gene Cloning and DNA Analysis, An Introduction. T.A.Brown, Wiley –Blackwell publication, 2010.
2. Recombinant DNA by Watson., Scientific American books, New York, 1992.
3. Bernard R. Glick and J. J. Pasternak,2003, Molecular biotecnlogy, ASM Press, Washigton, 3rd edition

Paper Title: Advances in Biomaterials

Paper Code: BT 9509

L	T	P
4	0	0

Classification Of Biomaterials And Their Properties: Metals- crystal structure, properties, processing, oxide formation and corrosion, Examples-Stainless steel, Ti and Ti-based alloys.Ceramics- classification- inert, bioactive and resorbable ceramics, structure and processing, Examples- Alumina, Carbon, hydroxyapatite. Composite material- -basic concept, matrix phase, particle reinforcement-organic and inorganic, fibre reinforcement. Synthesis techniques. Example- Ceramic- Polymer composites. Polymers- natural and synthetic polymers- structure- property relationship.

Characterization Of Biomaterials: atomic bonding, crystal lattice. Methods of material characterization: Thermal analysis, TGA, DTA, DSC, basic principle. Mechanical properties(stress strain curve, tensile strength) optical properties, surface properties, tribology.

Testing Of Biomaterial: In vitro assessment of cell and tissue compatibility. In vivo assessment of tissue compatibility

Host Response To Biomaterials: Biomaterial-Blood interaction, blood coagulation, foreign body reaction, inflammation, wound healing process

Applications Of Biomaterials: Soft tissue application cardiovascular, skin and facial implants. **Hard tissue application** – orthopedic and dental implants. **Tissue engineering scaffolds**- scaffolds for bone and skin tissue engineering. **Drug delivery**-. Targeted drug delivery. Coating on implant surface.

Implant Failure: Wear, cracks, fatigue, degradation of material in the biological environment.

Books:

1. Biomaterials. Bhat, S.V. Alpha Science International, 2005, 2nd edition.
2. Biomaterials Science: An Introduction to Materials in Medicine, Edited by: Ratner, B.D., Hoffman, A.S., Schoen, F.J. and Lemons, J.E. Academic Press ,2013, 3rd edition.
3. Biomaterials: An Introduction. Park, J. and Lakes, R.S. Springer Science+ Business Media, 2007, 3rd edition.
4. Essential Biomaterials Science. Williams, D. Cambridge University Press, 2014, 1st edition.

ELECTIVES
(Group VI: Civil Engineering)

Paper Title: Foundation Design and Construction

Paper Code: CE9601

L	T	P
4	0	0

General Principles of Foundation Design: Functions of foundations, essential requirements of a good foundation, types of foundations, principal modes of failure, estimation of allowable bearing pressures, calculation of ultimate bearing, capacity by theoretical and empirical methods: Terzaghi's Method, Skempton's analysis for clays, Mayerhof's analysis BIS Method (IS:6403), Settlement of foundations. Factors to be considered foundation design, numerical problem based in BIS method. (09)

Shallow Foundations: Introduction, essential requirements, types and depth of footing like Strip footing, Isolated footing, Combined footing, Strap footing, Raft footing , electrically loaded footings; design features and construction details related to size and depth of footing problem of frost heave, its causes and prevention, effect of ground water and environmental considerations; Numerical problems related to size and depth of footings. (08)

Pile Foundations: Purpose/uses of pile foundations, Classification of piles based on different criteria, Brief details of timber, concrete, steel piles their advantages and disadvantages, selection of pile type, pile action, behavior of pile and pile groups under load, definition of failure load. Estimation of carrying capacity : Single driven pile in cohesionless soils - methods based of on SPT and CPT, ultimate load on driven and cast-in-place piles and bored and cast-in-place piles in cohesionless soils. Factors affecting pile capacity.- Numerical problems problems Ultimate capacity of single pile driven in cohesive soils;modification for driven and cast-in-place piles and boredand cast-in-place piles. Capacity of very long piles – Numerical problems Carrying capacity of piles on rocks.
Piles in fills - negative skin friction, Carrying capacity of pile groups in cohesive soil and cohesionless soils, Efficiency of pile group. Piles subjected to horizontal or inclined loads. Mode of failure of piles. Equipment for Installation of Piles by Driving and Boring and cast in place method (16)

Soil Stability: Retaining walls – Introduction, types, Principles of design, Modes of failure, drainage of the back fill, problems related to design of gravity retaining wall and stability of retaining walls..
Unbraced excavations, braced excavations. Sheet piles - types anchors and tie backs.
Shoring and Underpinning - necessity and methods. (08)

Improvement of Foundation Soils

Purpose :

a) Improvement of granular soils : term used to describe degree of compactness – relative density, density ratio and degree of compaction; Methods- Vibration at ground surface, factors influencing roller compaction; deep dynamic compaction, vibro-compaction impact at depth.

b) Improvement of cohesive soils :preloading, or dewatering, methods of installing sand drains ,drain wicks, electrical and thermal methods. Grouting : purpose, functions, types of grouts ; soil bentonite - cement mix, cement mix, emulsions, solutions: grout injection methods. Geo-synthetics : types, functions, manufacturing of geo-textiles , Classification of geo-textiles. Specific Applications :Bearing capacity improvement, reinforcement, retaining walls, embankment etc. testing of geo-synthetics, usage in India and a case study. (09)

Elementary principles of design and construction of foundations subjected to earthquake or dynamic loads, special measures for foundations constructed under water.

(04)

Practical Exercises:

1. Conduct of Standard Penetration Test and estimation of bearing capacity for shallow foundation case.
2. Determination of shear strength characteristics by field tests like in situ vane shear test, pocket penetrometer etc.
3. Determination of shear strength characteristics by laboratory tests.
4. Computation of bearing capacity and settlement for given conditions of soil, depth and type of foundation and loading.
5. Recommend a field investigation programme to obtain design data.
6. Design of a shallow foundation. (Determination of depth and size of footing)
7. Recommend suitable dimensions, depth and spacing of pile/pile group for given loading conditions.

Reference Books :

1. Tomlinson MJ, Foundation Design and Construction , ELBS-Longman, 6e,.
2. Bowles Joseph E, Foundation Analysis and Design, McGraw Hill.
3. Som, NN & Das S.C. , Theory and Practice of Foundation Design, Prentice Hall of India, 2003
4. Braja M. Das, Principles of Foundation Engineering, 6e, Thomson, 2007
5. Koerner, Robert M, Construction and Geotechnical Methods in Foundation Engineering , McGraw Hill,
6. Dinesh Mohan, Pile foundations, Oxford & IBH, 1998
7. Kurian, N.P. Modern Foundations, Tata McGraw Hill, 1982.
8. Fang H.Y. Foundation Engineering Handbook, Van Nostrand Reinhold, 23, 1991.
9. Kaniraj Shenbaga R, Design Aids in Soil Mechanics and Foundtion Engineering, Tata McGraw Hill,
10. Fleming etal, Piling Engineering, Surrrey Univ. Press/John Wiley and Sons,.
11. Chellis, Robert D, Pile Foundations, MCGraw Hill, 1961
12. Tomlinson MJ, Pile Design and Construction Practice, a view point publication, 3e, 1981.

13. Peck, Hanson, Thornburn, Foundation Engineering, Wiley Eastern Ltd. 2e, 1980
14. CBRI Roorkee, Application Potential of Geosynthetics in Civil Engineering , Proceedings of Workshop Jan, 4-6, 1989 Tata McGraw Hill.
15. Alam Singh & G.R. Chowdhry, Soil Engineering in Theory and Practice, CBS Publishers, 2e, 1990.
16. Duggal et-al , Soil Sampling and Testing, NITTTR, Chandigar, 2006
17. Duggal A K , Bearing Capacity of Shallow Foundations, NITTTR, Chandigarh, 2007
18. Duggal A K , Pile Foundations, NITTTR, Chandigarh, 2005
19. IS : 6403 Determination of bearing capacity of Shallow foundations
20. IS 8007- Part –I Calculation of Settlement of Foundation

Paper Title: Advanced Structural Design and Detailing

Paper Code: CE9602

L	T	P
4	0	0

Introduction: Introduction to limit state method of design; provisions in the Indian Standard codes for loading, wind loads and seismic loads, design and detailing of concrete structures. (4)

BIS handbook for design : Examples of design using handbook (4)

Structural Analysis and Design for:

1. Columns with biaxial moments. (4)
2. Curved beams (4)
3. Intze tank and underground water tanks (10)
4. Silos and bunkers (8)
5. Concrete Chimneys (6)
6. Multi-storey building frame design (8)
7. Use of computer software for analysis and Design (6)

Practice tasks :

i) Analysis and design of beams using the BIS handbook for design
ii) Complete analysis and design of an underground water tank
iii) Analysis and design of a silo
iv) Analysis and design of a concrete chimney using design tables.
v) Analysis and design of a 10-storey building using a computer programme.

Books:

1. Dayaratnam, P: Reinforced Concrete Structures.
2. Jain, A.K. : Reinforced Concrete,Limit State Method of Design. Nem Chand & Bros.
3. Punmia, B.C.Reinforced Concrete Structures, Vol II., Laxmi Publications
4. Jain and Jaikrishna : Plain and Reinforced Concrete Vol II.
5. STAAD Pro- (Software)

Paper Title: Environmental Engineering & Management

Paper Code: CE9603

L	T	P
4	0	0

Environment & Ecology: Definition and understanding of concepts, ecosystem, energy flow in ecosystem, water, carbon and nitrogen cycle, community's inter-relationships in an ecosystem. Importance of clean environment. (2)

Type of Pollutants and Protection of Environment:

2.1 Water Pollution :

Sources, causes and measurement of water pollutants in surface and ground water, water quality criteria for various uses of fresh water, river basin studies for surface water pollution control, biochemical oxygen demand, effect of oxygen demanding wastes on rivers.

2.2 Domestic and industrial Pollution :

Sources, Standards for disposal of waste water and industrial effluents, basic unit operations in control of waste water pollution, C.P.C.B./M.O.E.F. for abatement of Industrial Pollution and Pollution Control/Treatment methods and technologies .

2.3 Air Pollution :

Definition, principle materials causing pollution, types of air contaminants, their sources and illeffects on living and nonliving materials, permissible limits. air pollution control - basic principles, natural self cleansing, pollution control methods and various engineering devices to Control particulate and gaseous pollutants, controlling air pollution from automobiles.

2.4 Noise Pollution :

Definition, sources of noise and its units, adverse effects of noise pollution, sound pressure level and its measurement, octave band and its importance; noise pollution control measures.

2.5 Solid Waste Pollution:

Sources, effects and treatment of solid wastes. (15)

Degradation of Land Resources :

3.1 Deforestation and Wetlands : Forest land, deforestration and its effects on land use and environmental quality, wetland and their importance in environment, causes and extent of wasteland, Soil degradation problems , erosion, salinization, water logging , land use management & planning (8)

Current Issues in Environmental Engineering : Global warming, ozone depletion, acid rain, oil pollution, radiation hazard and control, role of non- conventional sources of energy in environment. (5)

Environment Impact Assessment : Definition and its importance for environment management, constituents of environment impact assessment , project data for EIA study, prediction of impacts, EIA methodologies, constraints in implementation of EIA, impact prediction on water resources projects and other relevant case studies. Environment pollution. (6)

Environmental Management System: Main clauses and basic steps for certification. Water pollution, air pollution and EPA and their salient features. (6)

Cleaner Production Technologies : Need and benefits, cleaner production techniques and options, zero impact manufacturing initiatives CDM and carbon credits/case studies.

Practice Tasks:

1. Analysis of water for various parameters using spectrophotometer and flame photometry.
2. Determination of BOD for domestic waste/ industrial waste.
3. Determination of MPN of given sample.
4. Air sampling and determination of standard particulate matter and other gaseous contaminants
5. Measurement of CO_2, CO, NO_X levels in ambient air by gas analyzer
6. Monitoring of vehicular pollution emission.
7. Determination of noise levels for indoor and outdoor noise. .
8. Use of Atomic Absorption spectroscopy (Demonstration only)
9. Visit and submission of report for treatment of waste water in measuring trace element plant of any industry/city.

Reference Books:

1. Peavy,Rowe,,Techobanoglous, Environmental Engg. Tata McGrawHill.
2. Mackenzie L Davis, Environmental Engg. Tata McGrawHill.
3. Baljeet S. Kapoor; Environmental Engg. An overview, Khanna Publishers.
4. Glbert H.Masters , Environmental Engineering and Science, Prentice Hall of India Pvt.Ltd.
5. GN Panday, GC Carney Environmental Engineering,TataMcGrawHill.
6. P.D. Sharma, Ecology and Environment Rastogi Publications.
7. Ray P.A Lcances Environmental Impact Assessment Hand Book, National Environmental Protection Council Manila.
8. P Venugopala Rao ; Text Book of Environmental engineering, PHI
9. Duggal AK, Sharma S, Water & Waste Water Analysis , Galgotia Publications

Paper Title: Pavement Design, Construction and Maintenance

Paper Code: CE9604

L	T	P
4	0	0

Introduction: Types of pavement structure, functions of pavement components, factors affecting pavement design.

(07)

Design of Pavements: Methods for design of flexible pavements: CBR , Group Index Method , California bearing value method , Triaxial test method , Burmister method , McLeod's method.

(12)

Design considerations, methods for design of rigid pavements: Westergaard's method, F.A.A. method, types of joints and their design in cement concrete pavments.

(10)

Thickness design for Airport pavement ,FAA method for Flexible and Rigid pavements, ESWL Concept , CBR method (USACE) , LCN system of pavement design (08)

Construction of Highways: Types of Highway Construction and their selection, materials for construction, construction procedure of different highways: Gravel roads, WBM , W.M.M., Bituminous pavements, cement concrete pavements, Joints in cement concrete pavements, introduction to various Equipment used for highway construction. Constructional features for Pre-Mix Carpet, Mix Seal Surfacing , B.M. , SDBC. Other higher quality pavement layers – DBM , BC (introduction only) (10)

Maintenance of Highways: Pavement failures, their causes and remedial measures typical flexible and rigid pavement failures, types of highway maintenance: routine, periodic and special type,materials used for maintenance of different pavement such as bituminous pavements, cement concrete roads. Slurry Seal, Liquid Seal, Fog Seal, Patching Defects/ Failures in Flexible Pavement- their types and causes Remedial Measures Surface defects, Cracks, Deformation, disintegration, Cracks, Spalling , Slab Rocking , Joint Sealant Failure and Rectification

(07)

Practical Exercises:

1. Determination of CBR value of sub-grade soils.
2. Determination of stripping value of road aggregate.
3. Study of Sensor- paver and other construction machinery
4. Study of batching and mixing plant for construction of roads.
5. Determination of Marshall Stability value.
6. Evaluation of pavement strength by using Benkelman's Beam.
7. Determination of strength of existing pavement by Dynamic Cone Penetration Test.
8. Roughness measurement of road surface

Reference Books:

1. Khanna and Justo ; Highway Engineering, Nemchand & Bros. Roorkee
2. Clarkson H.Oglesby and Gary Hicks; Highway Engineering. John Wiley & Sons, London,
3. Rao ; Airport Engineering , Tata McGraw Hill Publishing Co. New Delhi
4. Khanna and Arora.; Airport Planning and Design
5. Wright and Paquette; . Highway Engg , John Wiley and Sons, New York

6. Vaswani, Highway Engg Roorkee Publishing House, Roorkee
7. Sharma and Sharma.; Principles and Practices of Highway Engg., Asia Publishing House, New Delhi
8. Ken Atkinson, Highway Maintenance, Thomas Telford Ltd. London
9. Baker, Handbook of Highway Engineering, Van Nostrand Reinhold Co. London
10. Duggal AK & Puri VP , Laboratory Manual in Highway Engineering, New Age Publishers

Paper Title: Design and Construction of Bridges

Paper Code: CE9605

L	T	P
4	0	0

Introduction: Definition; components of a bridge; classification; importance of bridges. (03)

Standard Specifications for Road Bridges: Indian Roads Congress Bridge Code; width of carriageway; clearances; loads to be considered; dead load; I.R.C.standard live load; impact effect; application of live load on decks; wind load; longitudinal forces;centrifugal forces; horizontal forces due to water current; Buoyancy effect ; earth pressure ; temperature effects ; seismic force. (12)

Reinforced concrete Bridges : General arrangement and suitability : T-beam bridges; Balanced cantilever bridges ; Continuous girder bridges; Rigid frame bridges; Arch bridges; Steel bridges (Familiarization with MOST specifications and drawings), design of solid slab bridge. (15)

Sub-Structure: Design of piers and abutments (Masonry & R.C.C). (04)

Foundation: Types of foundations; Open; Piled and Well foundations; including construction details. Pile Foundations: Suitable Pile types for bridges, Pile Installation, Carrying capacity of bored and cast- in-situ pile (No numericals) Well Foundations in Components and brief description, Well Cap, Stability of a single well. (07)

Bearings, Joints,and Handrails : Different types of bearings, joints and handrails. (04)

Construction and Maintenance of Bridges. (09)

Construction Methods of bridges, Long span concrete bridge, Traditional method, Incremental Push launching method, Cantilever method, Maintenance of Bridges.

Books:

1. Victor Johnson; Essentials of Bridge Engineering , Oxford & IBH Publishing Co, New Delhi.,2007
2. Khadilkar; C.H. , A text book of Bridge Construction, Allied Publisher, New Delhi.
3. Rangwala; Bridge Engg
4. Rowe, R.E., Concrete Bridge Design , John Wiley & Sons, Inc. New York
5. Raina , V.K. , C oncrete Bridges Practice Book , Tata McGraw Hill , New Delhi
6. Jagadeesh, Jayaram : Design of Bridge Structures , Prentice Hall.
7. Raina, V.K. Concrete Bridges Handbook, Galgotia Publications (P) Ltd, New Delhi
8. IRC.78.200
9. IS 5050
10. IS 3955

Paper Title: Advanced Construction Technology

Paper Code: CE9606

L	T	P
4	0	0

Earthen Dams: Introduction, types ,design considerations/aspects to suit available materials, causes of failures , criteria for safe design ,section, d/s drainage system, seepage analysis, stability analysis, stability of d/s slope during steady seepage, stability of u/s slope during sudden draw down, stability of u/s and d/s slopes during construction, stability of foundation against shear, seepage control measures,design considerations in earthquake regions, design of earthen dam. Quality control in construction of embankments – monitoring of post-construction behaviour and instrumentation.(12)

Special Foundations : Foundations for chimney, cooling towers, telecommunication/ transmission towers, foundations for underground structures, coastal and off shore structures in different soil conditions, foundations in expansive soils. dewatering and its various methods. (14)

High Rise Construction : High rise buildings; architectural & structural aspects; special features of construction; tall chimneys, components, design aspects; slip form method , lift slab method; special problems of high rise construction.

(12)

Prefabricated Construction:

Advantages of pre fabricated construction; selection of structural design aspects; elements;co-assembly of precast elements; jointing , modular and tolerances; structural systems ordination for buildings; single and building systems; methods and equipments. For handling multi- storey and placement

(12)

Advanced Construction Materials: Geo-synthetics: Various, types; geo-textiles, geo-grids, geo-membranes, geo- composites functions and general applications, advantages , properties of geo-textiles , epoxy resins, polymers, grouts and anchors, special flooring materials ,sealants and adhesives, protective coatings. (04)

Books:

1. Bharat Singh and Varshney RS , Engineering for Embankment Dams - Oxford and IBH.
2. Sharma RK and Sharma TK ; Dam Engineering - Oxford and IBH
3. RS Varshney, SC Gupta and RL Gupta. Theory and Design of Irrigation Structures
4. Naiman P Kurian , Modern Foundations - Introduction to Advanced Techniques Tata McGraw Hill
5. CBRI Roorkee-Application Potential of Geosynthetics in Civil Engineering, Proceedings of workshop January 4-6,1989 Tata McGraw Hill.
6. Engineering with Geosynthetics-Proceedings of Workshop May20-24,1996 Chandigarh Edited by Verma and Dr.G V Rao. organised by-CBIP and committee for international geo-synthetics society. New Delhi.
7. Bungale S Taranath; Structural Analysis and Design of Tall Buildings , Tata McGraw Hill
8. Monohar SN ; Tall Chimneys-Design and Construction Tata McGraw Hill.

9. Cast in place concrete in tall Building Design and construction Council on Tall Buildings and Urban Habitate Committee 21 D Tata McGraw Hill.
10. CBRI Roorkee ,Advances in Building Materials and Construction .
11. Bohdan Lewicki Building with large Prefabricates, Elsevier Publishing Company
12. ASG Bruggeling GF Hugghe Prefabrication with Concrete, AA Balkema/Rotterdam/Brookfield
13. Braja M.. Das, Principles of Foundation Engineering, Thomson, 2007

Paper Title: Structural Dynamics

Paper Code: CE9607

L	T	P
4	0	0

Single Degree of Freedom Systems: Fundamental, Mass spring damper system, Analysis of free vibrations, Response to harmonic loading, periodic loading, Impulsive loading. (10)

Multi Degree of Freedom Systems: Two degree of freedom system – undamped, free & Hozler's method, Stodola's method, Orthogonality condition, Damped system (12)

Dynamic analysis: ResponseModal Analysis, Response spectrum analysis. Structures with Distributed Mass And Load, Axial, shear and transverse vibration due to bending of beams, Uniform shear beam, Beam in bending, Numerical techniques for shear beam, Bending of beams. (14)

Earthquake Motion and Response: Introduction, Strong motion earthquake, Numerical method for spectra, Elastic spectra, Ground velocity and displacement, Inelastic spectra. (08)

Machine Foundations: Introduction to Design of machine foundations. (10)

Books :

1. Dynamics of structures by Anil K Chopra
2. Structural Dynamics by Clough & Penzin
3. Theory of Vibrations by Thomson
4. Elements of vibration analysis by Leonard Mirovitch
5. Structural dynamics by Madhujit Mukhopadyay

Paper Title: Remote Sensing and GIS

Paper Code: CE9608

L	T	P
4	0	0

Introduction to Advanced Surveying: Review of conventional methods of surveying and its limitations, Advancements in technology and its consequences on Surveying, Satellite Images (12)

Geographical Information System (GIS): Definition, Components, Digital Mapping, Spatial and non-spatial data, Importance of GIS in Smart City (14)

Remote Sensing (RS): Definition, Difference between GIS and RS, Ideal and Real RS, Atmospheric windows, Spectral Reflectance Curve (SRC), Types of RS Satellites (12)

Digital Image Processing (DIP): Importance, Uses, Corrections, Classification (08)

Applications of RS/GIS/DIP: Applications in Disaster Management, Smart City, Intelligent Transport System, Water Resources, Environmental Engineering, Digital Mapping (08)

Books:

1. Principal of GIS for Land Resources Assessment- P.A.Vurrough
2. GIS Principal Vol-1- Goodchild
3. Zhong- Ren Peng, Ming-Hsiang Tsou, (2003) Internet GIS: Distributed Geographic
4. Information Services for the Internet and Wireless Networks, Wiley.
5. Concepts and Techniques of Geographic Information Systems, CP Lo Albert K W Yeung, 2005 Prantice Hall of India
6. Principles of GIS for Land Resources Assessment by P.A.Burrough, Oxford: Science publications, 1986.
7. Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.
8. GIS – A computing Perspective by Micheal F. Worboys, Taylor & Francis, 1995.
9. Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
10. Geographical Information Systems – Principles and Applications, Volume I edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
11. Geographical Information Systems – Principles and Applications, Volume II edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991

ELECTIVES
(Group VII: Technical Engineering)

Paper Title: Learning and Instruction

Paper Code: TE9701

L	T	P
4	0	0

Learning : Concept and Types & Conditions of Learning (Gagne) (6)

Learning Theories : (12)

a) Behaviourist Theories : Classical conditioning, Operant Conditioning, Social Learning Theory
b) Cognitivistic Theory : Information Processing Theory, Assimilation Theory, Attribution Theory, Elaboration Theory
c) Constructvist, Social and Situational Theories : Case-based Learning, Discovery Learning, Social Development Theory and Problem based Learning
d) Experential Learning

Learning Stratergies: Deep & Surface Approach to Learning, Rehearsal, Imagery,Mnemonics, Chunking, Concept maps, Metaphors, Analogies (8)

Instruction and Theories of Instruction : Cocept ,Theories of Instruction : Bruner, Ausubel and Gagne (6)

Instruction Design and Development : Systematic Approach to Instructional Design, Development of Instructional Plans andResources (8)

Instructional Evaluation : Evaluation of Learning Outcomes, Course Evaluation, Programme Evaluation, Instructional Effectiveness (10)

Books :

1. Charles K. West, James A. Farmer, Phillips M. Wolff. Instructional Design, Allyn and Bacon, Boston London Toronto Sydney, Tokyo Singapore.
2. Driscoll, MP(2004) Psychology of Learning for Instruction . USA: Allyn and Bacan.
3. Gagne, M and Driscoll, MP(1988) Essentials of Learning for Instruction (2 Edition) NJ Prentice Hall.
4. NIIT(2004) Basics of Instructional Design. ND : Prentice Hall of India
5. Ormord, JE ‘Human Learning’. 4 Ed. Amazon.com.

Paper Title: ICT Enabled Education

Paper Code: TE9702

L	T	P
4	0	0

Introduction to ICT Enables Education: Concept of ICT enabled education, advantages of ICT enabled education, ICT enabled education projects and applications, ICT-based Models of Learning; Learning through :

- 'Correspondence'
- 'Pressure Sensitive Blackboards'
- 'Video Taped Lectures'
- 'Interactive CDs'
- 'Web-based Courseware'
- 'Satellite delivered courses'
- 'Radio, Podcasting, Internet Radio' and
- 'Blended Learning Modes'

Building ICT Enabled Knowledge Transfer Models

ICT Enabled Education : Current Status in India and Prospects

ICT Technologies: Radio, Television, Handheld devices, Computers, Networked Computers and the Internet, Edusat, Mobile Vans, Free Softwares, Audio & Video Conferencing, Hardware & Software needs depending on ICT Technology

ICT Enabled Web-based Learning through Internet: Introduction to Internet, Internet, Addresses and Domain Names, Browsers, Search Engines, SCORM & AICC Standards, Protocols, E-learning & E-management., Virtual Classrooms, Digital Libraries & Repositories, CLMS, LMS, Moodle Software.

Collaboration Mechanisms: Collaboration mechanisms and Webcasts, screen sharing, Response pads, whiteboard, discussion groups, Podcasts, Blogs, Wiki, RSS feeds.

CAI & Multimedia: Introduction to CAI, Introduction to Multimedia elements, Image, Audio, Video, Graphics, Animation, Multimedia Packages.

ICT Based Education, Evaluation : Tests, Grading, Feedback, Certification

Intellectual Property Rights, Copyright.

Books :

1. Abbot, Chris(2001) ICT : Changing Education. New York : Cengage Learning.
2. Fallons, S and Bhanot, R (2005) Quality Issues in ICT-based Higher Education, Yew York : Cengage Learning.
3. Horton, Williams(2003) Designing Web Based Training. John Wiley and Sons.
4. Kevin, K. Fiedler (1999) Web Based Training. South West Research Institute.
5. Ranjan Parikh 'Principles of Multimedia'.
6. Tinio, VL(2003) ICT in Education. UNDP-APDIP Publication.

Paper Title: Technical and Vocational Education System

Paper Code: TE9703

L	T	P
4	0	0

History of Technical and Vocational Education in India

- Historical developments
- National Policy on Education
- Effect of Liberalisation, Privatisation and Globalisation (LPG) on TVE in India

(10)

Educational Organisation

- Educational System and Infrastructure (central and state level)
- Size and Growth in TVE and higher education
- Technical and Vocational Sub-systems
- Apprenticeship Board, Functions and its Act
- Technical Teacher Training and Vocational Education
- Aims and objectives of different levels of Technical education

(10)

Policy, Planning and Administration

- Structural set up for Policy Making
- National & State level Statutory and Advisory Bodies
- Policy Making Process
- Planning, Administration, Direction and Control
- NBA, NAAC and Accreditation Process

(12)

Major Issues, Challenges and Perspectives in Technical and Vocational Education

- Privatization of Technical and Vocational Education
- Financing and Management
- Quality Management and Assurance
- World Bank Assisted Project for Technician Education (WBAP)
- Technical Education Quality Improvement Programmes (TEQUIP)
- Skill Development Initiatives of Govt. of India (12)

Emerging Trends and Future of Technical Education System

– Curriculum, Management, Instructional Methods, Evaluation, Resources

(10)

Practice Tasks :

1. Organizational structure of technical and vocational articulation between different sub-systems
2. SWOT analysis of technical education in India
3. A study on:
   -Shortcoming of existing technical and vocation education system

   -Future expectations from technical education in view of socio-economic scenario
4. Educational Policy Formulation – An Exercise.
5. Issues, Challenges and Perspectives of Technical and Vocational Education in India.
6. Management Aspects of Technical Education – a write-up.

Books :

1. Chandrakant LS : Polytechnic Education in India, Bombay, DB Tara Porevola Sons and Company (c., 1971).
2. Chandrakant LS: Sandwich Courses Revised: Study on Technical Institution – Industry Cooperation of Indian /setting, Indian Institute of Management, Bangalore, 1982.
3. India, Ministry of Human Resource Development, National Policy on Education – 1986.
4. India, Ministry of Human Resource Development, National Policy on Education – 1986 L : Programme of Action.
5. UNESCO, Studies in Technical and Vocational Education, United Kingdom, Germany, USA and Japan.
6. Technical Education in Independent India, 1947 – 1977, AICTE 1999.
7. Agarwal Pawan : Indian Higher Education – Envisioning the Future, Sage Publications India Pvt. Ltd., 2009.

ELECTIVES
(Group VIII: Information Technology)

Paper Title: Natural Language Processing

Paper Code: IT9801

L	T	P
4	0	0

Objectives: This course facilitates the students in understanding different aspects of natural language processing and its applications to different domains

Part-A

Introduction: Need for Processing Natural languages, Brief history of NLP application development, Machine Learning and NLP, Ambiguity, Models and Algorithms. (7)

Word Level Analysis: Regular Expressions and Automata, English Morphology, Inflectional Morphology, Derivational Morphology, Finite-State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite-State Transducers, N-grams, Smoothing, Entropy, HMM, SVM (8)

Part of Speech Tagging: Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging. HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. (8)

Part-B

Advanced Features and Syntax, Features and Unification: Parsing with Context-Free Grammars, Parsing as search, A Basic Top-Down parser, Problems with the basic Top-Down parser, Finite-State parsing methods, Feature structures, Unification of feature structures, Features structures in the grammar, Implementing unification, Parsing with unification constraints. (8)

Semantic Analysis: Overview of Representing Meaning, Syntax driven semantic analysis, Attachments for a fragment of English, Integrating semantic analysis into the early parser, Lexical semantics, relational among lexemes and their senses, WorldNet: A database of lexical relations, The Internal structure of words, Creativity and the lexicon. (8)

Applications

Word Sense Disambiguation and Information Retrieval, Selection Restriction-Based Disambiguation, Limitations of Selection Restrictions, Robust Word Sense Disambiguation, Machine Learning Approaches, Dictionary-Based Approaches, Information Retrieval. (6)

Text Books:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009
2. James A.. Natural language Understanding 2e, Pearson Education, 1994

Reference Books:

1. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000.
3. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Paper Title: Geographical Information Systems

Paper Code: IT9802

L	T	P
4	0	0

Objectives: To make the students understand how geographical information systems are used for analyzing, mining and modelling spatial and attribute data for solving spatial problems.

Part-A

Introduction: Definitions of Geographical Information Systems (GIS) and Related Terminology, Evolution of GIS, Components of GIS (5)

Digital Representation and Organization of Geospatial Data: Characteristics of Maps, Plane and Geographic Coordinates, Map Projections, Establishing a Georeferencing Framework for Mapping Locations on Earth, Acquisition of Geospatial Data: Topographic Mapping, Raster Geospatial Data Representation, Vector Data Representation, Object-Oriented Geospatial Data Representation, Relationship between Data Representation and Data Analysis in GIS (10)

Raster Geoprocessing: Characteristics of Raster Geoprocessing, Acquiring and Handling Raster Geospatial Data, Raster Geospatial Data Analysis, Output Functions of Raster Geoprocessing, Cartographic Modeling (7)

Part-B

Vector Geoprocessing: Characteristics of Vector Geoprocessing, Vector Data Input Functions, Non-topological GIS Analysis Functions, Feature-Based Topological Functions, Layer-Based Topological Functions, Vector Geoprocessing Output Functions (10)

Spatial Data Analysis, Modeling and Mining: Descriptive Statistics, Spatial Autocorrelation, Quadrat Counts, Nearest-Neighbor Analysis, Trend Surface Analysis, Gravity Models, Network Analysis, GIS Modeling, Pre-processing of Spatial datasets, Spatial Data Mining, Visualization of Geospatial Information (10)

GIS Applications: Applications of GIS in Environment monitoring, Natural hazard management (3)

Textbooks:

1. C.P. Lo, Albert K. W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall IndiaPvt. Ltd, New Delhi, 2nd Edition 2002.
2. Ian Heywood, Sarah Cornelius and Steve carver, " An Introduction to geographical information systems", Pearson Education, 3rd Edition, 2006.

Reference Books:

1. Kang-Tsung Chang, Introduction to Geographic Information Systems, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2008.
2. Peter A. Burrough and Rachael A. McDonnell, Principles of Geographical Information Systems, Oxford University Press, 2005.

Paper Title: Software Defined Networking

Paper Code: IT9803

L	T	P
4	0	0

Objectives: This course introduces software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behavior of an entire network. Recently, SDN is being deployed in data center networks, campus networks, enterprise networks, operator networks, and is expected to play a very important role in Internet of Things (IoT) networks and 5G cellular networks. In this course, we will first introduce the concepts of SDN, its use cases and its applications to give the students an overall picture of this new technology.

Prerequisite:

1. Computer networks or related courses.
2. C, C++, Java, or Python programming skills.
3. Basic Linux operating system skills.

Part-A

Overview of Software Defined Networking: History and Evaluation of SDN, Introduction to SDN, Advantages of SDN over Traditional Network Architecture, Separation of Control and Data Plane, Use Cases of SDN (6)

SDN Components: How SDN Works - SDN Architecture : Data plane, Control plane, Application Plane, Southbound Interface, Northbound Interface, Pure and Hybrid Openflow switches, Software and Hardware based Openflow switches, Programmable Network Hardware (6)

SDN Controllers: Overview, Centralized & Distributed Controllers, Open source SDN Controllers: POX, Ryu, Floodlight, OpenDaylight, Advantages and Disadvantages of each controller (5)

OpenFlow Protocol: OpenFlow Overview- OpenFlow 1.0 and OpenFlow Basics-, OpenFlow 1.1 Additions, OpenFlow 1.2 Additions, OpenFlow 1.3 Additions, Flow table components: matching rules, Actions, Counters, OpenFlow security, Proactive and reactive approach to insert flow table entries, Comparison of Openflow with other Southbound interfaces, OpenFlow Limitations (6)

Part-B

Mininet Emulation Tool: Creating Default & Custom topologies in Mininet using low level API, mid-level API, high level API, Developing Switching and Firewall Applications in Mininet (6)

Programming SDN: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs (5)

SDN Security Challenges and Issues: Characteristics of SDN, Security Analysis and Potential attacks in SDN, Solutions to the security issues in SDN (5)

Software Defined Networks with Network Function Virtualization (NFV): Introduction to Network Function Virtualization, History and Evaluation of NFV, NFV Architecture and its relation with SDN, Similarities and differences in SDN and NFV, NFV use cases (6)

Textbooks:

1. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.
2. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844

Reference Books:

1. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013
2. Software Defined Networking with OpenFlow By SiamakAzodolmolky, Packt Publishing, 2013
3. Software Networks: Virtualization, SDN, 5G, Security by Guy Pujolle, Wiley, 2015
4. “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud” William Stallings Publisher: Addison-Wesley 2015 ISBN: 9780134175393

Paper Title: Advances in Cloud Computing

Paper Code: IT9804

L	T	P
4	0	0

Objectives: This course offers advance cloud computing concepts and prepares students to be in a position to design cloud-based applications for distributed systems.

Part-A

Introduction: Historical development, Vision of Cloud Computing, Characteristics of cloud computing as per NIST, Cloud computing reference model, Cloud computing environments, Cloud services requirements (5)

Cloud Computing Services and Deployment Models: Infrastructure as a Service; Platform as a Service; Software as a Service, Types of Clouds, Cloud Interoperability & Standards, Scalability and Fault Tolerance (5)

Cloud Management & Virtualization Technology: Resiliency, Provisioning, Assetmanagement,Fundamental concepts of compute,storage, networking, desktop andapplication virtualization.Virtualization benefits, Cloud computing load balancing algorithms, Different types of load balancing in cloud computing, Importance of Load Balancing in cloud computing, Load Balancing Techniques in cloud computing, Scheduling Algorithms, Load Balancing Policies (13)

Part-B

Cloud Security: Cloud Information security fundamentals, Cloud security services, Designprinciples, Secure Cloud Software Requirements, Policy Implementation, Cloud ComputingSecurity Challenges, Virtualization security Management, Cloud Computing SecurityArchitecture (10)

Market Based Management of Clouds: Federated Clouds/Inter Cloud: Characterization &Definition, Cloud Federation Stack, Third Party Cloud Services .Case study: Google AppEngine, Microsoft Azure, Hadoop, Amazon, Aneka (12)

Text Books:

1. Buyya,Selvi , “Mastering Cloud Computing “,Tata McGraw Hill Pub, 2013.

Reference Books:

1. RajkumarBuyya, James Broberg, Andrzej Goscinski (Editors), Cloud Computing: Principles and Paradigms, Wiley, 2011.
2. Kumar Saurabh, “Cloud Computing”, Wiley Pub, 2012.
3. Krutz , Vines, “Cloud Security “ , Wiley Pub, 2010
4. Barrie Sosinsky, Cloud Computing Bible, Wiley, 2011.
5. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Cloud Computing forDummies, Wiley, 2010.

Paper Title: Wireless Technologies

Paper Code: IT9805

L	T	P
4	0	0

Objectives: This course makes the students tounderstandthe different wireless network technologies and provide hands on some of them with the help of network simulators.

Part A

Overview of Wireless Networks: Introduction to Wireless Communication,Types of Wireless Communication Systems, IEEE 802.11, Wireless ATM, IEEE 802.16 and IEEE 802.20. (5)

Cellular Design Fundamentals: Frequency reuse, Channel alignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems, mechanism for capacity improvement-cell splitting, cell sectoring, and micro cell zone concept. (7)

GSM: GSM Architecture& Protocols, GSM Burst structure, Carrier and Burst Synchronization, Design Consideration. Security Aspects, Power Control strategies. (6)

CDMA Digital Cellular Standards: Services and Security Aspects, Network Reference Model and Key Features, Advantages over TDMA, CDMA WLL System, Recent developments. (5)

Part B

WiMAX Networks: Architecture, MAC layer, physical layer, spectrum allocation issues, comparison with WiFi and limitations. (8)

Mobile Ad hoc Networks (MANETs): Introduction to Ad hoc wireless networks and sensor networks, Various MANET issues. (7)

Network Simulation: Elements of queuing model, Role of exponential distribution, Event graphs of queuing model, Discrete-event and Continuous Simulation, Introduction to Network Simulation Software. (7)

Books:

1. Raj Pandya,"Mobile and personal Communication Systems and services", PHI
2. Theodore S Rappaport," Wireless Communication," PHI
3. William Stallings," Wireless Communication and Networks", Pearson Education.
4. C. Siva Ram Murthy and B. S Manoj," Adhoc Wireless Networks-Architecture and Protocols", Pearson Education.
5. Journals: IEEE Journal on Selected Areas in Communications, IEEE Transactions on Communication, ACM/IEEE Transactions on Networking

Paper Title: Data Acquisition and Interfacing

Paper Code: IT9806

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Objectives: This course will introduce various data acquisition systems and techniques and their application using different hardware interfacing mechanisms.

Part-A

Signal conditioning and data acquisition: Analog-to-digital and digital-to-analog converters; sampling rate, multiplexing, resolution, range, and code width; grounding, isolation and noise; single-ended and differential measurements; attenuation, amplification, and filtering; excitation and linearization; impedance mismatch and loading; digital signal conditioning; signal transmission (voltage vs. current loop); and hardware architecture of a modern multi-function data acquisition card. Various DAS Configurations, Single Channel DAS, Multi-Channel DAS, IC Based DAS, Data Acquisition, Data Acquisition in PLC (12)

Fundamentals of programming logic: Labview: Virtual instruments; indicators and controls; front panel and block diagram; data types and data flow programming; case and sequence structures; arrays, loops, and clusters; graphs and charts; sub VIs; and file I/O (10)

Part-B

Instrument control: Components of an instrument control system (GPIB and RS-232); detecting and configuring instruments; and instrument drivers. (7)

Instrumentation system design: Design specifications; functional block representation; design, debugging, and testing; interpretation and presentation of data; user interface; temperature control system design; motor speed control system design; and instrumentation project incorporating multiple sensors, signal interfacing electronics, data-acquisition hardware, instrument control (8)

Buses: Industry standard architecture (ISA), peripheral component Interconnect (PCI) – Instrumentation Buses: Serial (RS232C, USB) and Parallel (GPIB) Accelerated Graphics port (AGP) – plug-and-play devices – SCSI concepts – USB architecture. (8)

Books:

1. Rangan C. S., Sarma G. R. and Mani V. S. V., "Instrumentation Devices And Systems", Tata McGraw-Hill.
2. Helfrick Albert D. and Cooper W. D., "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall India.

Reference Books:

1. A.J. Bouvens, "Digital Instrumentation", McGraw-Hill.
2. Johnson Curtis D., "Process Control Instrumentation Technology", Prentice Hall.
3. Shawhney A. K. "A Course In Electrical And Electronics Measurements And Instrumentation", Dhanpat Rai & Sons.
4. Data acquisition technique using personal computers by Howard Austurlitz

Paper Title: Machine Learning

Paper Code: IT9807

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Objectives: To study various machine learning techniques and to get an insight of various machine learning approaches and mathematically analyze various machine learning approaches.

Prerequisites: Basics of Mathematics

Part-A

Introduction: Introduction Supervised Learning, Introduction Unsupervised Learning, Linear Regression With One Variable and Model Representation, Linear Regression With One Variable: Cost Function, Cost Function Intuition, Gradient Descent, Gradient Descent Intuition, Gradient Descent For Linear Regression. (3)

Linear Algebra Review: Matrices And Vectors, Addition And Scalar Multiplication, Matrix Vector Multiplication, Matrix-Matrix Multiplication , Matrix Multiplication Properties, Inverse and Transpose. (3)

Linear Regression With Multiple Variables - (Multiple Features): Gradient Descent For Multiple Variables, Gradient In Practical Feature Scaling and Learning Rate, Features And Polynomial Regression, Normal Equation, Normal Equation Non Invertibility. (3)

Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost Function, Simplified Cost Function and Gradient Descent, Advanced Optimization, MultiClass Classification One Vs All. (3)

Regularization: The Problem of Overfitting, Cost Function, Regularized Linear Regression, Regularized Logistic Regression. (3)

Neural Networks: Representation, Non Linear Hypotheses, Neurons And The Brain, Model Representation, Examples And Intuitions, Multi Class Classification. (3)

Neural Networks Learning: Cost Function, Backpropagation Algorithm, Backpropagation Intuition, Implementation Note Unrolling Parameters, Gradient Checking, Random Initialization, Autonomous Driving Example. (3)

Applying Machine Learning: Evaluating A Hypothesis, Model Selection and Train, Validation, Test Sets, Diagnosing Bias Vs Variance, Regularization and Bias Variance, Learning Curves. (3)

Part-B

Machine Learning System Design: Error Analysis, Error Metrics for Skewed Classes, Trading off Precision and Recall, Data For Machine Learning. (2)

Support Vector Machines: Optimization Objective, Large Margin Intuition, Mathematics Behind Large Margin Classification, Kernels, Using An SVM. (3)

Clustering (Unsupervised Learning): Introduction, K-Means Algorithm, Optimization Objective, Random Initialization, Choosing the Number of Clusters. (2)

Dimensionality Reduction Motivation: Data Compression, Visualization, Principal Component Analysis, Principal Component Analysis Algorithm, Reconstruction From Compressed Representation, Advice for Applying PCA. (3)

Anomaly Detection Problem: Motivation, Gaussian Distribution, Anomaly Detection Algorithm, Developing And Evaluating An Anomaly Detection System, Anomaly Detection Vs Supervised Learning, Choosing What Features To Use, Multivariate Gaussian Distribution, Anomaly Detection Using The Multivariate Gaussian Distribution. (4)

Recommender Systems: Problem Formulation, Content Based Recommendations, Collaborative Filtering, Collaborative Filtering Algorithm, Vectorization Low Rank Matrix Factorization, Implementational Detail Mean Normalization. (3)

Large Scale Machine Learning: Learning With Large Datasets, Stochastic Gradient Descent, Mini Batch Gradient Descent, Stochastic Gradient Descent Convergence, Map Reduce And Data Parallelism. (4)

Application Example Photo OCR: Problem Description and Pipeline, Sliding Windows, Getting Lots of Data Artificial Data Synthesis, Ceiling Analysis. (2)

Text Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer.

Reference Books:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer.
2. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press.

Paper Title: Advanced Digital Image Processing

Paper Code: IT9808

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Objectives: The course introduces the concepts and techniques of image processing & computer vision. The students will get acquainted with its various applications in different domains and current research trends.

Prerequisites: Computer Graphics

Part-A

Introduction: Building blocks of Digital Image Processing System, Digital Image representation, Sampling and Quantization, Digital Image fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Basic Relationships Between Pixels, Linear And Nonlinear Operations, Color Models. What is Computer Vision - Low-level, Mid-level, High-level, Overview of Diverse Image Processing and Computer Vision Applications (5)

Image Enhancement and Restoration: Intensity transform functions, Histogram processing, Spatial Domain and frequency domain approaches, Image subtraction, image average, Low-pass spatial filters, Median filters, High-pass spatial filters, derivative filters , Frequency domain ideal low-pass filters, Butterworth Low pass filters, high pass filters , homomorphic filters, Image degradation and restoration process, Noise models, Noise filters (6)

Image Morphology and Segmentation: *Morphology:* Introduction to basic operation on binary and grayscale images: Dilation, Erosion, Opening & Closing, Morphological Algorithms: Boundary & Region Extraction, Convex Hull, Thinning, Thickening, Skeletons
Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, edge detections using gradient operator &laplacian operator, region oriented segmentation, segmentation using threshold. (6)

Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. (6)

Part-B

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. (6)

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods. (6)

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation. (6)

Case Studies and Applications: CBIR, CBVR, Activity Recognition, Image and Video Forensics, Computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS. (5)

Text Books:

1. Gonzalez and Woods: Digital Image processing, Pearson educations, 2nd Edition.
2. Szeliski, R., Computer Vision: Algorithms and Applications, Springer-Verlag London Limited latest edition.
3. Forsyth, A., D. and Ponce, J., Computer Vision: A Modern Approach, Pearson Education latest edition

Reference Books:

1. Jain, A.K. Kasturi and Scunk, "Fundamental of Digital Image Processing", Tata McGraw-Hill,1995
2. Trucco &Verri, "Introductory techniques for 3-D Computer Vision", Prentice Hall.
3. Sonka, Hlavac, Boyle, " Image Processing, Analysis and Machine Vision", 2nd Edition, PWS Publishing.
4. S.Annadurai& R. Shanmugalakshmi , "Fundamentals of digital image processing", Pearson Education, Latest edition.
5. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.
6. Madhuri A. Joshi,"Digital Image Processing: An Algorithmic Approach ",PHI learning Private Limited.
7. S. Jayaraman, S.Esakkirajan, T. Veerakumar," Digital Image Processing",Tata McGrawHill,2010

Paper Title: Optical Communication Technologies

Paper Code: IT9809

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Objectives: This course facilitates the students in understanding different aspects of Optical Communication Technologies and its applications in different domains

Part A

Optical Fiber Waveguides and Transmission Characteristics: Ray Theory, Electromagnetic mode theory, Types of fiber, Advantages of Fiber optic communication. Attenuation, Losses in fibers, Mid-infrared and far-infrared transmission, Dispersion, Polarization, Nonlinear effects, Soliton propagation. (6)

Optical Sources:*Laser:* Absorption and emission of radiation, Einstein relations, Population inversion, Optical feedback and laser oscillation, Threshold condition for laser oscillation, Optical emission from semiconductors, Semiconductor injection laser.
Light-emitting diode: LED power and efficiency, Double-heterojunction LED, LED structures, Planar LED, Dome LED, Surface emitter LEDs, Edge emitter LEDs, LED characteristics, Optical output power, Output spectrum, Modulation bandwidth, Reliability, Modulation. (9)

Optical Detectors: Optical detection principles, Absorption, Quantum efficiency, Responsivity, Semiconductor photodiodes with and without internal gain, Mid-infrared and far-infrared photodiodes. (5)

Part B

Optical Amplifiers: Concepts of Optical amplifiers, Semiconductor optical amplifiers, Fiber and waveguide amplifiers (5)

Optical fiber Systems: Optical transmitter circuit, Optical receiver circuit, System design considerations, Distribution systems, Multiplexing strategies, Modulation formats, Demodulation schemes, Differential phase shift keying, Receiver sensitivities. (5)

Optical Networks: Optical network concepts, Optical network transmission modes, layers and protocols, Wavelength routing networks, Optical switching networks, Optical circuit-switched networks, Optical network deployment, Optical Ethernet, Network protection, restoration and survivability. (7)

Advanced Systems and Techniques: Wavelength Division Multiplexing, Local Area Networks: Optical Fiber Bus, Ring Topology, Star Architectures, Fail Safe Fiber Optic Nodes, Photonic Switches: Mechanical Switches, Integrated-Optical Switches. (8)

Reference Books:

1. John M. Senior, M. Yousif Jamro “Optical Fiber Communications: Principles and Practice” (Third edition), Prentice Hall, Pearson Education Limited.
2. Gerd Keiser “Optical Fiber Communication” , McGraw Hill.

3. Joseph C. Palais, “Fiber Optic Communications” (Fifth edition), Pearson.
4. Govind P. Agrawal, “Fiber-Optic Communication Systems” (Third edition), Wiley.
5. S.C. Gupta, “Textbook on Optical Fiber Communication and its Applications”, PHI.
6. Harold B. Killen, “Fiber Optic Communications”, Pearson College Div.