DAYALBAGH EDUCATIONAL INSTITUTE

Department of Physics and Computer Science

Academic Council Meeting

May 24, 2022

Curriculum Development Workshop for Computer Science Programmes

- **Held on January 15, 2022.**
- **External Experts:**
  1. *Prof. Prem Kalra, IIT Delhi*
  2. *Prof. Huzur Saran, IIT Delhi*
  3. *Prof. Karmeshu, Shiv Nader University, Noida*
  4. *Prof. Gur Saran Adhar, University of North Carolina, Wilmington, USA*
  5. *Prof. C. Patvardhan, Faculty of Engineering, DEI*
- **Department Faculty members:**
  1. *Prof. Preetvanti Singh*
  2. *Prof. C. Vasantha Lakshmi*
  3. *Prof. Gur Mauj Saran Srivastava*
  4. *Prof. Sandeep Paul*
  5. *Dr. Prem Sewak Sudhish*
  6. *Dr. Sanjay Saini*
  7. *Mr. Amarjeet Singh Chauhan*
  8. *Ms. A. Vandana*
  9. *Mr. Hardik Chaddha*
  10. *Prof. Sukhdev Roy, Head*
- Approved by the Department Board of Studies on January 24, 2022.
- Approved by the Science Faculty Board of Studies on February 3, 2022.
- Submitted for Approval in the Academic Council Meeting on May 24, 2022.

Salient Features

- **Programmes Reviewed:**
  1. *B.Sc. (Hons.) Computer Science*
  2. *M.Sc. Computer Science*
  3. *Post Graduate Diploma in Computer Science and Applications*
- Inclusion of foundation building courses to strengthen the UG program.
- Redistribution of Courses to achieve better flow in learning.
- Major updates in some courses focused on current technologies.
- Removal of overlapping contents in some courses.
- Some existing discipline specific compulsory courses made as elective to enable students to select specific streams.
- New advanced courses included at PG level to strengthen the program.
- The proposed course structure can be easily adapted to new NEP-2020 structure.
- New courses proposed in PGDCA to replace older ones to meet current needs.

BSc. (HONS.) COMPUTER SCIENCE

Code	Courses	Credits	Remarks
Semester I			
CSM101	INT. TO COMPUTER SC. & APPLICATIONS	3	Syllabus updated (Unit 2,3,4,5)
CSM102	COMPUTER PROGRAMMING-I	3	Syllabus is now “Python” based
CSM103	PROGRAMMING LAB I	2	
CSM104	SEMINAR & GROUP DISCUSSION	1	
Semester II			
CSM201	COMPUTER PROGRAMMING-II	3	Syllabus is now “Java” based
CSM202	DIGITAL PRINCIPLES AND APPLICATIONS	3	
CSM203	PROGRAMMING LAB II	2	
CSM204	ACTIVE LEARNING/TUTORIAL	1	
Semester III			
CSM301	DATA STRUCTURES	3	Syllabus will be “C” based
CSM302	COMPUTER SYSTEMS ARCHITECTURE	4	Syllabus updated (Unit 1 and Unit 5)
CSM303	DATABASE MANAGEMENT SYSTEMS	3	
CSM304	PROGRAMMING LAB III	3	
CSM305	SEMINAR & GROUP DISCUSSION	1	

BSc. (HONS.) COMPUTER SCIENCE

Code	Courses	Credits	Remarks
Semester IV			
CSM401	WEB TECHNOLOGIES	3	Title changed from “Internet Technologies”, Syll. updated
CSM402	OPERATING SYSTEMS	4	[Preq. CSA]
CSM403	DESIGN & ANALYSIS OF ALGORITHMS	4	[Preq. Data Structure] Syllabus updated
CSM404	PROGRAMMING LAB IV	3	
CSM405	Active Learning/Tutorial	1	
Semester V			
CSM501	ELECTIVE	4	“Computer Graphics” as elective
CSM502	COMPUTER NETWORKS	4	
CSM503	THEORY OF COMPUTATION	4	[Preq. Discrete Maths] New Course in place of “Signals and Systems”, now an elective.
CSM504	ARTIFICIAL INTELLIGENCE	4	[Preq. Discrete Maths] New Course in place of “Semiconductor Devices and Circuits”, now an elective.
CSM505	NUMERICAL METHODS AND ALGORITHMS	4	[Preq. Linear Algebra] Title changed from “Computational Science”.
CSM506	PROGRAMMING LAB V		
Semester VI			
CSM601	SOFTWARE ENGINEERING	4	Syllabus updated in Unit 2 and Unit 3
CSM602	INFORMATION SECURITY	4	Title changed from “Cryptography & Security“
CSM603	ELECTIVE	4	“Graph Theory” as Elective
CSM604	ELECTIVE	4	
CSM605	HONOURS PROJECT	4	
CSM606	PROGRAMMING LAB VI	5	

ELECTIVES

1. *Introduction to Soft Computing* *(Same as IOT401)*
2. *Cloud Computing* *(Same as IOT402)*
3. *Big Data Technologies* *(Same as IOT403)*
4. *Introduction to Mobile & Pervasive Computing* *(Same as IOT501)*
5. *Applied Machine Learning* *(Same as IOT009)*
6. *Applied Computer Vision* *(Same as IOT010)*
7. *Natural language Processing* *(Same as CGM501)*
8. *Computer Graphics*
9. *Graph Theory*
10. *Signals and Systems*
11. *Semiconductor Devices and Circuits*
12. *Any other equivalent course offered by SWAYAM/NPTEL with prior approval.*

MSc. COMPUTER SCIENCE

Code	Courses	Credit	Remarks
Semester I			
CSM701	ADVANCED THEORY OF COMPUTING	4	Title changed ”Automata Theory and Formal Languages” ; Syllabus updated [Preq. ToC]
CSM702	ADVANCED COMPUTER NETWORKS	4	
CSM703	PROGRAMMING LANGUAGES	4	Title changed from “Logic and Functional Programming Paradigm”; [Preq. Programming II]
	ELECTIVE	4	MEDIA PROCESSING as elective
	ELECTIVE	4	
CSM704	COMPUTER SYSTEMS LAB I	4	
Semester II			
CSM801	COMPILER DESIGN	4	[Preq: ToC, Programming languages]
CSM803	COMPUTER SYSTEMS LAB II	4	
CSM804	ADVANCED ALGORITHMS		[Preq: DAA] (New-Syllabus designed) New course in place of “Design & Analysis of Algorithms” which is proposed to be shifted at UG level as per UGC Computer Science structure
PHM802	NEURAL NETWORKS	4	
CSM015	PARALLEL COMPUTING	4	
	ELECTIVE	4	

MSc. COMPUTER SCIENCE

Code	Courses	Credit	Remarks
Summer Term			
CSM001	BASIC RES. METH., SC. COMPUT. & ANAL.	4	
CSM002	PRE-DISSERTATION	4	
Semester III			
CSM901	Dissertation	12	
	ELECTIVE	4	
	ELECTIVE	4	

NEW ELECTIVES AT GRADUATE LEVEL

- CSMXXX Deep Learning (New Course)
- CSMXXX Computational Neuroscience (New Course)
- CSMXXX Computational Biology (New Course)
- CSMXXX Network Science (New Course)
- CSMXXX Special Topics in Computer Science (New Course)
- Any other equivalent course offered by SWAYAM/NPTEL with prior approval.

POST GRADUATE DIPLOMA IN COMPUTER SCIENCE AND APPLICATIONS

Code	Approved Courses (Existing)	Credit	Remarks
Semester I			
CSD101	INT. TO COMPUTER SC. & APPLNS	4	
CSD102	COMPUTER PROGRAMMING-I	4	
CSD103	PRINCIPLES OF INTERNET OF THINGS	4	New course to replace “Digital principles & applns”
CSD104	DATABASE MANAGEMENT SYSTEM	4	
CSD105	PRINCIPLES OF AI & MACHINE LEARNING	4	New course in place of “Computer networks”
CSD106	COMPUTER PROGRAMMING LAB-I	6	
Semester II			
CSD201	COMPUTER PROGRAMMING-II	4	
CSD202	BIG DATA ANALYTICS	4	New course in place of “Data Structures”
CSD203	WEB TECHNOLOGIES	4	New course in place of “Internet Technologies”
CSD204	SOFTWARE ENGINEERING	4	Syllabus Updated
CSD205	COMPUTER PROGRAMMING LAB-II	4	
CSD206	PROJECT	6	
Summer Term			
CSD001	SUMMER TRAINING	3	

Proposed name of Program: **Post Graduate Diploma in Advanced Computer Applications**

Thank You

Modified Courses – Syllabus Revised

Course Number: CSM101, Course Title: INT. TO COMPUTER SC. & APPLICATIONS

Class: B.Sc., Status of the Course No.: MAJOR, Session:

Credits: 3, Periods (55 mts. each) per week: 3 (L: 3 + T: 0 + P: 0) Min. Periods/Sem.: 39

UNIT 1: COMPUTER FUNDAMENTALS

Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers.; Basic Computer Organization: Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices.; Types of computing environments,

UNIT 2- COMPUTER SOFTWARE

Classification of software, Application software and System Software, Overview of productivity software, Web designing.

UNIT 3: PLANNING THE COMPUTER PROGRAM

Types of Programming Languages, Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. Techniques of Problem Solving: Flowcharting, decision table, algorithms.; Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

UNIT 4: OVERVIEW OF DBMS

Basic concepts: databases, database systems, DBMS System Environment, overview of relational database, Case study using MS Access

UNIT 5: BASIC SECURITY CONCEPTS

Threats to Users, Threats to Hardware, Threats to Data; Taking Protective Measures

SUGGESTED READINGS:

- Norton, P. Introduction to Computers, TMH.
- Gilbert Brands, Introduction to Computer Science: A Textbook for Beginners in Informatics.
- Kevin P H and Pindar V Arman, Computer Science Principles: The Foundational Concepts of Computer Science.

Modified Courses – Syllabus Revised

Course Number: CSM102, Course Title: COMPUTER PROGRAMMING I
Class: B.Sc., Status of the Course No.: MAJOR, Approved Since Session:
Credits: 3, Periods(55 mts. each) per week: 3 (L: 3 + T: 0 + P: 0) Min. Periods/Sem.: 52

UNIT 1

Program development steps, a simple program, identifiers and basic data types, relational and logical perators, precedence and order of evaluation, input output statements.

UNIT 2

Loops and control statements.

UNIT 3

Basics of Data Analysis, types, process, methods and techniques, introduction to libraries/packages.

UNIT 4

Basics of data manipulation and visualization, tools and methods for data manipulation and visualization.

UNIT 5

Introduction to object oriented programming concepts, Classes, Objects, Scopes and Namespaces, Class Definition Syntax, Class Objects, Instance Objects, Method Objects, Class and Instance Variables, Inheritance.

SUGGESTED READINGS: 1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 9781111822705.

2. Python is an open-source language with excellent documentation. Use the Python Tutorial, the Python Programming wiki book, and the free Think Python book.

Modified Courses – Syllabus Revised

Course Number: CSM302, Course Title: COMPUTER SYSTEMS ARCHITECTURE

Class: B.Sc. Honours, Status of the Course No.: MAJOR, Session:

Credits: 4, Total Periods(55 mts. each) per week: 4 (L:4 + T: 0 + P: 0) Min. Pds/Term: 50

Unit 1: Review of Digital Systems, General purpose machine, history, programming-architecture-logic design viewpoints, machine classification, instruction formats, computer instruction sets (data movement, ALU, branch instructions), addressing modes, Simple RISC Computer (SRC), formal description using Register Transfer Notation (RTN), data path, control path.

Unit 2: Processor design, register transfers, single bus SRC microarchitecture, data path implementation, logic design, control sequences, control unit, clocks, timing, multi-bus microarchitecture, exceptions.

Unit 3: Pipelining basics, hazards, instruction level parallelism, microprogramming, examples of CISC/RISC processors.

Unit 4: Memory system design, RAM structure, SRAM, DRAM, ROM, memory hierarchy, cache design, cache policies, Virtual memory, I/O, programmed I/O, interrupts, DMA, error control, peripheral devices.

Unit 5: Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Communication and Synchronization, Cache Coherence, Multicore Processors.

Suggested Reading

1. Heuring V.P. and Jordan, H.F., Computer Systems Design and Architecture, Addison Wesley. (Recent Edition)

2. Stallings, W., Computer Organization and Architecture, PHI. (Recent Edition)

3. Mano, M., Computer System Architecture, Prentice Hall of India.

4. J. L. Hennessey, D. A. Patterson. Computer Architecture: A Quantitative Approach, Elsevier.

Modified Courses – Syllabus Revised

Course Number: CSM501, Course Title: COMPUTER GRAPHICS

Class: B.Sc. Honours, Status of the Course No.: MAJOR, Session:

Credits: 4, Periods(55 mts. each) per week: 4 (L: 4 + T: 0 + P: 0), Min. Periods/Sem.: 52

UNIT 1 INTRODUCTION

Overview of computer graphics, Image representation: RGB color model, Techniques for image representation, Aliasing and Antialiasing; Overview of Graphics hardware and software. Animation and Realism: Animation methods, soft modeling of objects, image based rendering.

UNIT 2: SCAN CONVERSION

Scan conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

UNIT 3: TRANSFORMATION & VIEWING

Transformations and Matrices, Transformation Conventions, 2D Transformation: Basic transformations, transformations between coordinate systems; Homogeneous Coordinates and Matrix Representation of 2D Transformations; 3D transformations; Projections.

Viewing pipeline, Window to viewport co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, 3D viewing: Stages in 3D viewing, Canonical View Volume (CVV), Specifying an Arbitrary 3D View, Examples of 3D Viewing.

UNIT 4: Visible-Surface Determination

Techniques for efficient Visible-Surface Algorithms, Categories of algorithms: Back face removal, The z-Buffer Algorithm, Scan-line method, Painter's algorithms (depth sorting); Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods.

UNIT 5 Plane Curves and Surfaces

Curve Representation, Nonparametric Curves, Parametric Curves, Parametric Representation of a Circle, Parametric Representation of an Ellipse, A Procedure for using Conic Sections; Representation of Space Curves, Cubic Splines, Bezier Curves, B-spline Curves, B-spline Curve Fit, B-spline Curve Subdivision, Parametric Cubic Curves, Quadric Surfaces. Bezier Surfaces

SUGGESTED READING:

Hearn, Baker – " Computer Graphics (OpenGL version)" – Pearson education

D. F. Rogers, J. A. Adams – " Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH

Dave Shreiner, Graham Sellers, John Kessenich, and Bill Licea-Kane. OpenGL Programming Guide: The Official Guide to Learning OpenGL. Addison-Wesley.

Modified Courses – Syllabus Revised

Course Number: CSM601, Course Title: Software Engineering

Class: B.Sc. Hons, Status of the Course No.: Major,

Credits 4, Periods (55 mts. each) per week: 4 (L: 4 + T: 0 + P: 0), Min. Periods/Sem.: 52

(Same as PHM807 and IOT008)

Unit 1: Introduction

Introduction to software: Its Nature and qualities; Software Engineering concepts; Software Engineering principles; Software development lifecycle; Process models; Formal Methods: Basics, Mathematics in Software Development, mathematical preliminaries, applying mathematical notations for formal specification, Object Constraint language.

Unit 2: Software Requirements Specification

Requirement Analysis Concepts; Analysis Tools: Structured Analysis Tools, UML Modelling; software requirements specification: formal requirements specification and verification - axiomatic and algebraic specifications; Case Study.

Unit 3: System Design

Objectives and Principles; Function-oriented software design; object-oriented design; design patterns; user interface design; Structured Design: Structured Charts, Transform and Transaction Analysis; Design Heuristics; Module specifications; Detailed Design; Case Study.

Unit 4: Coding and Testing

Coding: Programming style; validation; verification; Testing: Goals, foundations; unit testing; integration and systems testing; debugging techniques; test case design; metrices: complexity metrices – Halstead's Theory and Cyclomatic complexity, Case Study.

Unit 5: Software Project Management

The software management process; Software Measurement: Function points and Code size estimation,; Software cost estimation models; software quality - SEI CMM and ISO-9001; Software reliability and fault-tolerance, software project planning, monitoring, and control, software maintenance, computer-aided software engineering (CASE), software reuse; Product Metrics: Software Quality, Framework for product metrics, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance

Suggested Readings

1. Pressman, R.S., Software Engineering: A practitioner's approach, McGraw Hill.
2. Sommerville, I., Software Engineering, Addison-Wesley.
3. Jalote, P. An integrated approach to Software Engineering, Narosa.

New Course

CSMXXX ARTIFICIAL INTELLIGENCE

UNIT 1: Artificial Intelligence and its Issues

Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems

with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems.

UNIT 2: Overview to Problem Solving

Local Search and Optimization Problems, Problem solving by Search, Problem space - State space, Blind Search - Types, Performance measurement. Heuristic Search- Types, Game playing mini-max algorithm, Alpha-Beta Pruning.

UNIT 3: Knowledge Representation and Reasoning

Logical systems, Knowledge Based systems, Propositional Logic Constraints, Predicate Logic, First Order Logic, Inference in First Order Logic, Ontological Representations and applications.

UNIT 4: Uncertainty and knowledge Reasoning

Definition of uncertainty, Bayes Rule Inference, Utility Based System, Decision Network, Learning Systems: Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Learning Decision Trees.

UNIT 5: Philosophy, Ethics, and Safety of AI

Ethics of AI: Surveillance, security and privacy, trust and transparency of AI systems, Limits of AI, application domains, recent trends.

Suggested Readings

1. Russell, S. and Norvig, P. 2020. Artificial Intelligence - A Modern Approach, 4th edition, Prentice Hall.

2. Poole, D. and Mackworth, A. 2010. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press.

3. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.

New Electives

Course Number: IOT401, Course Title: Introduction to Soft Computing

Class: B.Voc IOT., Status of the Course No.: MAJOR, Approved Since Session: 2017-18

Credits: 3, Periods (55 mts. each) per week: 3 (L: 3 + T: 0 + P: 0) Min. Periods/Sem.: 45

Unit-I Neural Networks-1(Introduction & Architecture) Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

[8 Pds]

Unit-II Neural Networks-II (Back propagation networks) Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications, Associative theory, Adaptive Resonance Theory (ART-1, ART2) [11 Pds]

Unit-III Fuzzy Logic-I (Introduction) Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

[7 Pds]

Unit-IV Fuzzy Logic –II (Fuzzy Membership, Rules) Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

[8 Pds]

Unit-V Genetic Algorithm (GA) Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

[8 Pds]

Text Books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India.

2. N.P.Padhy,"Artificial Intelligence and Intelligent Systems" Oxford University Press.

3 Siman Haykin,"Neural Netowrks"Prentice Hall of India

4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.

5. Kumar Satish, "Neural Networks" Tata Mc Graw Hill

Course Number: IOT402, Course Title: Cloud Computing

Class: B.Voc IOT., Status of the Course No.: MAJOR, Approved Since Session: 2017-18

Credits: 3, Periods (55 mts. each) per week: 3 (L: 3 + T: 0 + P: 0) Min. Periods/Sem.: 45

UNIT I - CLOUD INTRODUCTION (9 hours) Cloud Computing Fundamentals: Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing , usage scenarios and Applications , Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus - Open Nebula, CloudSim.

UNIT II - CLOUD SERVICES AND FILE SYSTEM (9 hours) Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as services. Service providers- Google App Engine, Amazon EC2, Microsoft Azure, Sales force. Introduction to MapReduce, GFS, HDFS, Hadoop Framework.

UNIT III - COLLABORATING WITH CLOUD (9 hours) Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing ,Databases – Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks – Collaborating via Blogs and Wikis.

UNIT IV - VIRTUALIZATION FOR CLOUD (9 hours) Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.

UNIT V - SECURITY, STANDARDS, AND APPLICATIONS (9 hours) Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

TEXT BOOKS 1.

Bloor R., Kanfman M., Halper F. Judith Hurwitz "Cloud Computing for Dummies" (Wiley India Edition),2010 (UNIT-I)

2. John Rittinghouse & James Ransome, "Cloud Computing Implementation Management and Strategy", CRC Press, 2010.(UNIT-II)

3. Antohy T Velte ,Cloud Computing : "A Practical Approach", McGraw Hill,2009(UNIT-II-3 ,11)

4. Michael Miller, Cloud Computing: "Web-Based Applications That Change the Way You Work and Collaborate Online", Que Publishing, August 2008.(UNITIII)

5. James E Smith, Ravi Nair, "Virtual Machines", Morgan Kaufmann Publishers, 2006.(UNIT-IV)

Course Number: IOT403, Course Title: Big Data Technologies

Class: B.Voc IOT., Status of the Course No.: MAJOR, Approved Since Session: 2017-18

Credits: 3, Periods (55 mts. each) per week: 3 (L: 3 + T: 0 + P: 0) Min. Periods/Sem.: 45

[Same as DBD 204]

UNIT 1

Introduction to big data, Sources of big data, characteristics of big data, importance of big data, big data in enterprise, big data enterprise model, building big data platforms.

UNIT 2

HDFS, MapReduce, relationship between HDFS and MapReduce, Hadoop Implementation, Hadoop clusters

UNIT 3

PIG, SQOOP, HIVE, HBASE, MongoDB.

UNIT 4

Understanding Big Data Analysis with Machine Learning: Supervised, unsupervised machine learning using R and Hadoop, Recommendation algorithms with R and Hadoop

UNIT 5

Linked Big Data, Credit Risk Modelling, Churn Prediction, Business Process Analytics Fraud Detection and other Real Time Applications.

SUGGESTED READING:

HADOOP: THE DEFINITIVE GUIDE-Tom White- O'Reilly

Bart Baesens, ANALYTICS IN A BIG DATA WORLD: THE ESSENTIAL GUIDE TO DATA SCIENCE AND ITS APPLICATIONS

VigneshPrajapati: BIG DATA ANALYTICS WITH R AND HADOOP

Course Number: IOT501, Course Title: Introduction to Mobile and Pervasive Computing

Class: B.Voc IOT., Status of the Course No.: MAJOR, Approved Since Session: 2017-18

Credits: 3, Periods (55 mts. each) per week: 3 (L: 3 + T: 0 + P: 0) Min. Periods/Sem.: 45

UNIT I - PERVASIVE COMPUTING :

Basics and vision – Architecture and Applications requirements – Smart devices and operating systems , secure services – Smart mobiles, cards and device networks.

UNIT II - MOBILE APPLICATIONS

History – Mobile Ecosystem – Designing for context – Mobile strategy – Mobile applications – Information Architecture – Design – Mobile Web apps vs Native Apps – Adapting to devices – Supporting devices – Application development on Android and iPhone.

UNIT III - MEDIUM ACCESS AND TELECOMMUNICATIONS

Frequencies – Signals – Antennas – Signal propagation – Media Access Control: Motivation, SDMA, FDMA, TDMA, CDMA – GSM: Mobile services, System architecture, Protocols, Localization and calling, Handover – GPRS.

UNIT IV - WIRELESS NETWORKS

Infrared vs radio transmission – Infrastructure and ad hoc networks – WLAN, IEEE 802.11 standards protocols. Piconet- Bluetooth-architecture and services. Wireless Broadband networks and satellites networks.

UNIT V - MOBILE NETWORK AND TRANSPORT LAYERS

Mobile IP – DHCP – Routing in Mobile ad hoc networks – TCP improvements – TCP over 2.5/3G.

TEXT BOOKS:

1. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions", Wiley, 2009.

2. Brian Fling, "Mobile Design and Development", O'Reily, 2009.

3. Jochen Schiller, "Mobile Communications", 2nd ed., Pearson Education, 2003.

4. Frank Adelstein, Sandeep KS Gupta, Golden Richard, "Fundamentals of Mobile and Pervasive Computing", Tata McGraw-Hill, 2005.

Course No: CGM501, Course Title: NATURAL LANGUAGE PROCESSING

Class: B.A. So. Sc. (Cog. Science), Status of Course: Major, Approved since session: 2019-20

Credits: 5, Periods (55 mts. each) per week: 5 (L: 5+T: 0+P: 0), Min. periods / Semester: 78

UNIT 1

Introduction to NLP, NLP applications such as information extraction, question answering, and machine translation, Main approaches in NLP, Text processing, Feature extraction from text, The problem of ambiguity, The role of machine learning and brief history of the field.

UNIT 2

Language Modelling: The role of language models, Simple N-gram models, Hidden Markov Models, Viterbi algorithm, Neural language models

UNIT 3

Sequence Tagging: Determining Parts of Speech tags, Named entities and other tags using methods based on probabilistic graph models or neural models, Syntactic parsing

Unit 4

Semantic Analysis: An overview of traditional models, Modern tools for word and sentence embeddings such as word2vec, FastText, StarSpace etc., word analogies, An overview of Topic modelling

Unit 5

Sequence to Sequence Tasks: Word alignment models, General encoder-decoder architecture, sequence to sequence learning

SUGGESTED READINGS:

Jurafsky and Martin, SPEECH and LANGUAGE PROCESSING: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Second Edition, McGraw Hill, 2008

Manning and Schütz, Foundation of Statistical Natural Language Processing, MIT Press. Cambridge, MA: May 1999.

CSMXXX Deep Learning

Class: M.Sc./M.Tech.; Status of the Course: ELECTIVE, Credits: 4, Periods (50 mts. each) per week: 4 (L: 4 + T: 0 + P: 0) Min. Periods/Sem.: 50

UNIT 1: Deep Feedforward Networks: Introduction, architecture design, gradient based learning, back propagation and other differentiation algorithms, Perspectives, and issues in deep learning framework.

UNIT 2: Regularization and Optimization for Deep Learning, parameter norm penalties, early stopping, parameter tying and parameter sharing sparse representations, dropout, ensemble methods. Challenges in neural networks optimization- basic algorithms, parameter initialization strategies, algorithms with adaptive learning rates.

UNIT 3:

Convolutional Networks: motivation, pooling, handling vanishing gradient problem, dropout, greedy layer-wise pre-training, weight initialization methods, batch normalization efficient convolution algorithms, recent applications

UNIT 4:

Recurrent Networks: sequence modelling-unfolding computational graphs, recurrent neural networks, challenges of long-term dependencies, Gated RNN, Long short-term memory (LSTM), recent applications

UNIT 5:

Autoencoders, denoising autoencoders, applications of autoencoders, Generative Modeling: Generative adversarial network. Zero Shot Learning. Applications. Recent trends.

SUGGESTED READINGS:

Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Michael A. Nielsen, Neural Networks and Deep Learning, Determination Press, 2015

CSMXXX Computational Neuroscience

Class: M.Sc./M.Tech.; Status of the Course: ELECTIVE, Credits: 4, Periods (50 mts. each) per week: 4 (L: 4 + T: 0 + P: 0) Min. Periods/Sem.: 50

UNIT 1

Introduction to Neuroscience, Spike trains and firing rates, Encoding of sensory information in neural spiking activity, spikes, tuning curves, Neural Encoding Models.

UNIT 2

Extracting Information from Neurons-Neural Decoding, Signal detection theory, Population and Spike-Train Decoding, Entropy and Mutual Information, Information and Entropy Maximization for Spike Trains.

UNIT 3

Biophysical Modeling Single Neuron, Dendritic Computation and reduced Neuron Models, Single-Compartment Models, Integrate and Fire Models, Hodgkin – Huxley Model

UNIT 4

Synapse and Network Models: Feed-forward and Recurrent Networks Modeling Synapses and Networks of Neurons

UNIT 5

Adaptation and Learning: Modeling Synaptic Plasticity and Learning, Unsupervised and Supervised Learning, Reinforcement Learning

SUGGESTED READINGS:

1. Dayan, Abbott; Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems; MIT Press, 2001

2. Wulfram Gerstner, Werner M. Kistler, Richard Naud and Liam Paninski, Neuronal Dynamics - From Single Neurons to Networks and Models of Cognition, Cambridge University Press, 2014

3. Trappenberg; Fundamentals of Computational Neuroscience; Oxford University Press

Course No. CSD101, Course Title: DATA MANAGEMENT, VISUALIZATION AND R
Class: PGDCSA. Status of the Course: MAJOR, Approved Since Session:
Credits: 04, Periods (50 mts.) per week: 04 (L:4 + T:0 + P:0), Min. periods per semester: 50
[Same as DBD104]

UNIT 1 [10 pds]

Basic concepts: Database systems, data models, schemas, database systems architecture, ER modelling.
UNIT 2
Relational model: Domains, relations, keys, normalization, relational algebra, calculus.
UNIT 3
SQL: Select statements, displaying data from single and multiple tables, Creating and managing tables, controlling access, advanced subqueries: Multiple column subqueries, Subqueries in FROM clause, Scalar and correlated subqueries.
UNIT 4
Visualization: Value of Visualization, Visual Display of Quantitative Information, Visualization Design, Narrative, Text Visualization, Visual Analytics.
UNIT 5
An Introduction to R, Visualizing and Manipulating Data, Introduction to Programming and Modelling with R.

SUGGESTED READING:
Elmasri&Navathe: FUNDAMENTALS OF DATABASE SYSTEMS, 3/e. Addison Wesley.
Soren V: SQL AND RELATIONAL DATABASE, Galgotia.
E. Tufte:The Visual Display of Quantitative Information (2nd Edition). Graphics Press, 2001

Zuur, Alain, Ieno, Elena N., Meesters, Erik: A Beginners Guide to R, Springer

SQL Reference, Oracle Press

Course No. CSD103, Course Title: DATA MINING

Class: PGDCSA. Status of the Course: MAJOR, Approved Since Session:
Credits: 04, Periods (50 mts.) per week: 04 (L:4 + T:0 + P:0), Min. periods per semester: 50
[Same as DBD103]

Unit I Introduction to Data Mining (DM) [10 pds]

Introduction, Kind of data, DM Functionalities, Classification of DM Systems, Issues in DM, What is Data warehousing (DW)? Multidimensional data model: Data cubes, Stars, snowflakes and fact constellations, defining schemas, concept hierarchies, OLAP, DW architecture: Steps for design and construction, Three-tier architecture, Types of OLAP servers, DW Implementation, back-end tools and utilities

Unit 2. Data Preprocessing and Concept Description [10 pds]

Data cleaning: Missing Values, Noisy Data, Data Integration and transformation, Data Reduction Data Compression, Numerosity Reduction Discretization and Concept Hierarchy Generation Data Mining Primitives, System Architectures: Task relevant data, Kind of Knowledge to be mined, DM Query languages: Syntax, Designing GUI, architectures of DM Systems Data Generalization and summarization-based characterization, Attribute relevance, class comparisons Association Rule Mining: Market basket analysis, basic concepts, Finding frequent item sets: Apriori algorithm, generating rules, mining Multi-level Association rules from relational databases and Warehouses, Correlational analysis, constraint-based association mining.

Unit 3. Classification and Prediction [10 pds]

Issues in classification and prediction, Classification using Decision trees, Classification by Bayesian and Backpropagation, K-Nearest Neighbor classifiers, case-based reasoning, genetic algorithms, Rough and Fuzzy set approaches, Linear and nonlinear regression, classifier comparison, Introduction of OLE DB /DBMiner/ORACLE DM Tools, Combining Multiple Classification models: Bagging and Boosting

Unit 4. Clustering [10 pds]

Introduction to clustering, types of data, partitioning methods: k-Means, Hierarchical clustering: and Model based clustering: Statistical and Neural network approach, Self Organizing Feature Maps Principle Components

Unit 5. Mining Spatial Databases [10 pds]

Spatial Data Cube and OLAP, Spatial Association, Clustering and classification Mining Text Databases: Text Data Analysis and Information Retrieval, Text Mining: Keyword-based Association and Document Classification Mining the WEB: Mining Web's link structure, Classification of Web pages, Web Usage Mining

Suggested Readings:

1. Berson, A. and Stephen, J. S. : Data Warehousing, Data Mining and OLAP, McGraw Hill, 1997.
2. Adriaans, P. and Zantinge, D. : Data Mining, Addison Wesley, 1996.
3. Hand, Mannila, and Smyth. Principles of Data Mining. Cambridge, MA: MIT Press, 2001. ISBN: 026208290X.
4. Berry and Linoff. Mastering Data Mining. New York, NY: Wiley, 2000. ISBN: 0471331236.
5. J. Han, M. Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers, 2001.
6. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms, John Wiley & Sons Inc., 2003.
7. M. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education, 2003.

Course No.: CSD104, Course Title: MACHINE INTELLIGENCE
Class: PGDCSD. Status of the Course: MAJOR, Approved Since Session:
Credits: 04, Periods (50 mts.) per week: 04 (L:4 + T:0 + P:0), Min. periods per semester: 50
[Same as DBD105]

UNIT 1

Introduction to Machine Learning; Review of Linear Algebra; Univariate linear regression; Multivariate linear regression.Practical aspects of implementation.

UNIT 2

Logistic regression; Multi-class classification; Regularization; Support Vector Machines; Naive Bayes; Decision trees; Boosting.

UNIT 3

Applying learning algorithms: development, debugging, feature and model design, experiment structure set up. Unsupervised learning: Agglomerative clustering, K-means, PCA, ICA.

UNIT 4

Anomaly detection.Combining supervised and unsupervised learning; Recommender systems.Learning to rank.

UNIT 5

Large-scale parallel machine learning and large data.System design; Practical methods.Team design of machine learning systems.

SUGGESTED READINGS:

1. Mitchell, T.,Machine Learning, McGraw Hill

2. Alpaydin, E., Introduction To Machine Learning, MIT Press

3. Marsland, S., Machine Learning: An Algorithmic Perspective, CRC Press

4. Rogers, S., Girolami,M., A First Course In Machine Learning, Taylor and Francis

Course: CSD202, Title: BIG DATA ANALYTICS

Class: PGDCSA, Status of Course: MAJOR COURSE, Approved since session:

Total Credits:4, Periods (55 mts. each)/week:4(L-4-0+P/S-1), Min.pds./sem:50
[Same as DBD204]

UNIT 1

Introduction to big data, Sources of big data, characteristics of big data, importance of big data, big data in enterprise, big data enterprise model, building big data platforms.

UNIT 2

HDFS, MapReduce, relationship between HDFS and MapReduce, Hadoop Implementation, Hadoop clusters

UNIT 3

PIG, SQOOP, HIVE, HBASE, MongoDB.

UNIT 4

Understanding Big Data Analysis with Machine Learning:Supervised, unsupervised machine learning using R and Hadoop, Recommendation algorithms with R and Hadoop

UNIT 5

Linked Big Data, Credit Risk Modelling, Churn Prediction, Business Process Analytics Fraud Detection and other Real Time Applications.

SUGGESTED READING:

Hadoop: The Definitive Guide-Tom White- O'Reilly

Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications

VigneshPrajapati: Big Data Analytics with R and Hadoop

Automata Theory and Formal Languages

1. Languages (4 Lectures)

Alphabets, string, language, Basic Operations on language, Concatenation, Kleene Star

2. Finite Automata and Regular Languages (20 Lectures)

Regular Expressions, Deterministic and non-deterministic finite automata, Transition diagram of Finite Automata, NFA to DFA Conversion, Regular languages and their relationship with finite automata, Pumping lemma and closure properties of regular languages.

3. Context free languages (17 Lectures)

Context free grammars, ambiguities in grammars and languages, Pushdown automata (Deterministic and Non-deterministic), Pumping Lemma, Properties of context free languages, normal forms. Parse tree and Derivation Trees.

4. Grammar Transformations and Normal Forms

Removing Lambda Rules, Removing Chain rules, Removing Useless symbols, Removing Direct Left Recursion, Conversion of Grammar to Chomsky Normal Form (CNF)

5.Turing Machines and Models of Computations (10 Lectures)

RAM, Turing Machine as a model of computation, Universal Turing Machine, Language acceptability, decidability, halting problem, recursively enumerable and recursive languages, unsolvable problems.

Recommended Books:

a. Daniel I.A.Cohen, Introduction to computer theory, John Wiley,1996

b. Lewis & Papadimitriou, Elements of the theory of computation , PHI 1997.

c. Hoperoft, Aho, Ullman, Introduction to Automata theory, Language & Computation –3rd Edition, Pearson Education. 2006

d. P. Linz, An Introduction to Formal Language and Automata 4th Bartlett, 2006

Design and Analysis of Algorithm

1. Introduction (5 Lectures)

Basic Design and Analysis techniques of Algorithms, Correctness of Algorithm.

2. Design Techniques

Algorithm Design by Induction, Design by Divide and Conquer, Dynamic Programming method, Greedy Technique

3. Sorting and Searching Techniques (20 Lectures)

Elementary sorting techniques–Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques - Heap Sort, Quick Sort, Sorting in Linear Time - Bucket Sort, Radix Sort and Count Sort, Searching Techniques, Medians & Order Statistics, complexity analysis.

4. Graph Algorithms (10 Lectures)

Depth First and Breadth First Navigation of Graphs, Minimum Spanning Trees, Single Source Shortest Path and All Pair Shortest Paths in Graphs..

5. String Processing (5 Lectures)

String Matching using Finite Automata, Knuth Morris Pratt (KMP) Technique for String matching.

6. Lower Bounding Techniques (3 Lectures)

Decision Trees

7. Balanced Trees (5 Lectures)

Red-Black Trees

8. Advanced Analysis Technique (2 Lectures)

Amortized analysis

Recommended Books:

1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein Introduction to Algorithms, PHI, 3 Edition 2009

2. Sarabasse A.V. Gelder Computer Algorithm – Introduction to Design and Analysis, Publisher – Pearson 3 Edition 1999

CSM804 - Advanced Algorithms

Pre-Requisites UG level course in Algorithm Design and Analysis

Total Number of Lectures:48

Unit1

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Unit 2

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit 3

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit 4

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit 5

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness. Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

References:

1. "Introduction to Algorithms" byCormen, Leiserson, Rivest, Stein.

2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.

3. "Algorithm Design" by Kleinberg and Tardos.