राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR
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Department of Information Technology

Updated Schemes of B.Tech. Programme as per 49th Senate

BTech (IT) 8th Semester

National Institute of Technology Raipur (Dept of Information Technology)												
Course of Study and Scheme of Examination							B. Tech. 8th Semester				Branch:IT	
S. No.	Subject Code	Subject Name	Periods per Week			TA	Examination Scheme				Total Marks	Credits
							MSE/MTR		ESE/ESVE			
			L	T	P		Theory	Prac.	Theory	Prac.		
1	Open Elective (OXX4)		3	0	0	20	30	-	50	-	100	3
2	Open Elective (OXX5)		3	0	0	20	30	-	50	-	100	3
3	IT108501IT	Project-II	0	0	8	40		20		40	100	4
	IT108701IT	Major Internship*										4(^3+1^^)
									Total Credits =			10

* For semester long internship as per clause number 4.E.6 of CBCS B.Tech Ordinance.
^- Report submission, end semester presentation and viva.
^^-- Mid semester examination (viva/presentation)

Subject Code	Open Elective (0XX4)
IT108301IT	Blockchain
IT108302IT	Cloud Computing
IT108303IT	Medical Imaging
IT108304IT	High Performance Computing
Subject Code	**Open Elective (0XX5)**
IT108305IT	5G Network
IT108306IT	Deep Learning
IT108307IT	Pattern Recognition
IT108308IT	Decision Support System

Blockchain

[8thSemester, Fourth Year]

Course Description			
Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108301IT

[Pre-requisites: Data Structure, Web Technology]

Course Objective:

1. To introduce the concept and the basics of blockchain technologies.
2. To provide knowledge on various applications of blockchain technologies.
3. To enable awareness of the different generations and types of blockchains.

Course Content

UNIT 1: Introduction to Blockchain

Origin of blockchain technology, Block Structure, Blockchain Layer Architecture, Generic Elements of Blockchain, Characteristics of Blockchain, Evolution of Blockchain Technology, Merkle Trees: Construction of Merkle Trees, Bitcoin Cryptocurrency, **Cryptographic concepts for Blockchain:** Symmetric Cryptography Algorithms, Cryptographic Hash Functions, Digital Signatures, Zero-Knowledge Proof.

UNIT 2: Consensus Algorithms for Blockchain: Taxonomy of Consensus Algorithms, Proof-Based Consensus Algorithms, Vote-Based Consensus Algorithms, PAXOS consensus algorithm, Byzantine Fault Tolerance-Based Consensus, Practical Byzantine Fault Tolerance (PBFT), Delegated Byzantine Fault Tolerance (DBFT), Federated Byzantine Fault Tolerance (FBFT), Proof of Work (PoW), Proof of Stake (PoS), Hybrid Consensus

UNIT 3: Ethereum Blockchain and Smart Contract

Fundamentals of Ethereum Blockchain**, Smart Contract,** Fundamentals of Solidity Programming**,** Building Blocks of Solidity, Understanding Data Types in Solidity, Control Flow Statements, Functions, Visibility and Modifiers, Inheritance and Libraries, Building a Simple Smart Contract Example

UNIT 4: Enterprise Blockchain

Hyperledger Fabric Platform, Architecture of Hyperledger Fabric, Fundamentals of Tokenization Concept, Non-Fungible Tokens (NFTs), Use cases of Blockchain: E-Governance, Traceability and Anti-Counterfeiting, blockchain on clouds.

Course Materials

Required Text: Textbooks

1. Bashir, Imran, "*Mastering blockchain"* 3Ed., Packt Publishing Ltd, 2023.
2. Bina Ramamurthy "Blockchain *in action",* Manning Publications, 2020.
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, " *Bitcoin and Cryptocurrency Technologies*" Princeton University Press.
4. Kevin Werbach, The Blockchain and the new architecture of trust, MIT Press, 2018.

Optional Materials: Reference Books

1. Ambadas Tulajadas Choudhari, A. Sarfarz Ariff, Sham M R, "Blockchain for Enterprise Application Developers", Wiley, 2020.
2. Joseph J. Bambara and Paul R. Allen, Blockchain – A practical guide to developing business, law, and technology solutions, Tata McGraw-Hill Education, 2018.

Cloud Computing

[8thSemester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108302IT

[Pre-requisites: Operating System, DBMS]

Course Objectives

1. To introduce the fundamentals and essentials of Cloud Computing.
2. To understand the deployment of web services from cloud architecture.
3. To provide students a sound foundation of the Cloud computing so that they can start using and adopting Cloud Computing services and tools in their real-life scenarios.
4. To expose the students to frontier areas of Cloud Computing and information systems

Course Content

Unit 1: Introduction To Various Computing Paradigm And Cloud Computing

History of Centralized and Distributed Computing –overview of Distributed Computing, Cluster computing, Utility Computing, Grid Computing, etc. Cloud Computing overview, applications, Intranet and the Cloud, First movers in the Cloud. Cloud Computing – benefits, characteristics, challenges, security concerns, regulatory issues.

Unit 2: Cloud Computing Models and Virtualization

Cloud Computing –service delivery models, deployment models. Cloud resources– Network and API,virtual and physical computational resources, Data storage. Virtualization concepts – types of Virtualizations, introduction to various Hypervisors, High Availability (HA)/Disaster Recovery (DR) using Virtualization, moving VMs.

Unit 3: Cloud Service Delivery Models

Infrastructure as a Service (IaaS) –Resource Virtualization: Server, Storage, Network, Case studies. Platform as a Service (PaaS) – Cloud platform & Management: Computation, Storage, Case studies. Software as a Service (SaaS) – Web services, Web 2.0, Web OS, Case studies. Anything as a service (XaaS).

Unit 4: Cloud Access, Security and Its Standards

Cloud Access: authentication, authorization and accounting. Cloud Provenance and meta-data. Cloud Reliability and fault-tolerance, Cloud Security, privacy, policy and compliance. Cloud federation, interoperability and standards, Cloud Computing Tools & Providers: Introduction and working of various Cloud Computing tools: Cloudsim, Aneka, KVM, OpenNebula, Eucalyptus, OpenStack, etc**.** Amazon AWS, Microsoft Azure, Google App Engine, Salesforce.com, etc.

Course Materials

Required Text: Text books

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, “Cloud Computing – APractical Approach”, Tata McGraw-Hill 2010.
2. Barrie Sosinsky, “ Cloud Computing Bible”, John Wiley & Sons, 2010.
3. RajkumarBuyya, James Broberg, Andrzej Goscinski, “Cloud Computing – Principles and Paradigms”, Wiley indiaPvt. Ltd, 2010

Optional Materials: Reference Books

1. Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance”, O'Reilly 2009.

Medical Imaging

[8thSemester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108303IT

[Pre-requisites: Digital Image Processing]

Course Objectives

1. To understand need for Quality assurance and Quality assurance tests for radiography, methods of recording sectional images.
2. To understand the mathematical concept needed in image processing.
3. To have a clear understanding of concept and components of medical imaging techniques.
4. To have an exposure on Quality assurance tests for X-rays, MRI.

Course Content

Unit 1: Introduction to Digital Image

Signal input, image matrix, digital image quality, digital image processing, picture archiving and communication system (PACS).

Unit 2: X-RAY Computed Tomography

Principles of sectional imaging, scanner configuration, detectors, data acquisition system, image formation principles, conversion of x-ray data in to scan image. 2D image reconstruction techniques: back projection, iterative and analytical methods. Viewing system, image quality and artifacts.

Unit 3: Ultra Sound in Medicine

Introduction, production of ultrasound, acoustic impedance, ultrasonic transducers and types, transmitter and detector principles, probe design, principles of image formation. Display system: principles of A-mode, B-mode and M-mode display. Principles of scan conversion (real time imaging), image processing, Doppler Ultra sound and Color flow mapping. Application of diagnostic ultra sound.

Unit 4: Magnetic Resonance Imaging

Introduction, principles of MRI, MRI instrumentation, magnets, gradient system, RF coils- receiver system. Relaxation processes, pulse sequence, image acquisition and reconstruction techniques, Functional MRI - Application of MRI.

Radio nuclides for imaging, radionuclide production: cyclotron production, reactor production, generator production. Rectilinear scanners, Linear scanners, SPECT, PET, Gamma Camera, Comparison of other tomographic techniques.

Course Materials

Required Text: Text books

1. K. Kirk Shung, Michael Smith & Benjamin M.W. Tsui, “Principle of Medical imaging” Academic Press.
2. Joseph J. Carr&John M. Brown, “Introduction to Biomedical Equipment Technology” Pearson Education, Asia.
3. R. S. Khandpur, “Handbook of Bio-Medical Instrumentation”, Tata McGraw-Hill Education.
4. John G. Webster, “Bioinstrumentation”, Wiley & Sons

Optional Materials: Reference Books

1. Dowsett, Kenny & Johnston, “The Physics of Diagnostic Imaging”, Chapman & Hall Medical, Madras/London.
2. Brown, Smallwood, Barber, Lawford& Hose, “Medical Physics and Biomedical Engineering”, Institute of Physics Publishing, Bristol.
3. Massey &Meredith, “Fundamental Physics of Radiology”, John Wright & Sons.
4. S. Webb, “The Physics of Medical Imaging”, Adam Hilger, Bristol.
5. Sybil M. Stockley, “A Manual of Radiographic Equipments”, Churchill Livingstones.
6. Thomas S. Curry , J.E. Dowdey & R. E. Murry , “ Christensen’s Physics of Diagnostic Radiology”, Lea &febiger,

High Performance Computing Design

[8thSemester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108304IT

[Pre-requisites: Computational Mathematics, Computer Organization, Computer Networks, Micro Processor]

Course Objectives

1. To introduce the fundamentals of high-performance computing with the graphics processing units and many integrated cores using their architectures and corresponding programming environments.
2. To provide systematic and comprehensive treatment of the hardware and the software high performance techniques involved in current day computing.
3. To introduce the fundamental and advanced parallel algorithms

Course Content

Unit 1: Introduction to HPC Systems

Introduction to HPC Systems, Multi-core CPUs, Types of Parallel Computers: Shared Memory Multiprocessor System, Message-Passing Multicomputer, Distributed Shared Memory, MIMD and SIMD Classifications, Cluster Computing, Cache Coherency, Interconnection networks for Parallel Computers.

Unit 2: Principles of Parallel Algorithm Design

Decomposition techniques, Characteristic of Tasks and Interactions, Mapping Techniques for Load Balancing, Parallel Algorithm Model, Basic Communication Operations, and Analytical modeling of program performance: speedup, efficiency, scalability, cost optimality, isoefficiency.

Unit 3: Parallel Programming Model

Programming Using the Message-Passing Paradigm: Principles of Message-Passing Programming, MPI: The Message Passing Interface, Shared Memory Programming: OpenMP, Combing MPI and OpenMP, GPUs as Parallel Computers, Architecture of a Modern GPU, CUDA Program Structure, Data Parallelism

Unit 4: Parallel Algorithm

Sorting, graphs, dense matrix algorithms, sparse matrix algorithms, MapReduce Programming Model, Parallel data processing using Map-Reduce Programming, Parallel Programming with Apache Spark

Course Materials

Required Text: Text books

1. Hesham El-Rewini , “Advanced Computer Architecture and Parallel Processing” Wiley, 2016.
2. AnanthGrama et al. “Introduction to Parallel Computing”, Addison-Wesley, 2003.
3. Michael Quinn“Parallel Programming in C with MPI and OpenMP”, McGraw Hill in 2004.
4. David B. Kirk, Wen-mei, W. Hwu , “Programming Massively Parallel Processors: A Hands-on Approach” Morgan Kaufmann, 2010.

Optional Materials: Reference Books

1. P. Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
2. Kai Hwang, “Advanced Computer Architecture: Parallelism, Scalability, Programmability” Tata McGraw-Hill, New Delhi.
3. Nicholas Wilt, “The CUDA Handbook_ A Comprehensive Guide to GPU Programming”, Addison-Wesley Professional (2013).
4. Donald Miner and Adam Shook “MapReduce Design Patterns: Building Effective Algorithms andAnalytics for Hadoop and Other Systems”, O'Reilly Media, 2012.

5G Networks

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108305IT

[Pre-requisites: Computer Networks, Internet of Things]

Course Objectives

1. To understand the concept of basic cellular system and modern cellular communication.
2. To understand the 5G architecture.
3. To understand radio access networks, Device to Device communication

Unit 1: Introduction

Introduction and fundamentals of wireless communications: evolution of cellular systems requirements, goals, and vision of the next generation wireless communication systems fading, digital modulations, performance metrics. 1G, 2G, 3G and 4G(LTE) overview- Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization -Challenges and Applications.

Unit 2: The 5G architecture

Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, , Integration of LTE and new air interface to fulfil 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.

Unit 3: Device-to-device (D2D) communications

D2D: from 4G to 5G, D2D standardization: 4G LTE D2D, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D, RRM techniques for mobile broadband D2D, RRM and system design for D2D, 5G D2D RRM concept: an example, multi-hop D2D communications for proximity and emergency, services, Device discovery without and with network assistance.

Unit 4: The 5G radio-access technologies

Multiple access technology, Orthogonal multiple-access systems, Spread spectrum multiple access systems, Capacity limits of multiple-access methods,), Radio access for dense deployments, OFDM numerology for small-cell deployments, Small-cell sub-frame structure, , Radio access for massive machine type communication, , Interference management in 5G, Interference management in UDN

Required Text: Text/Reference books:

1. VALDAR, A R: 'Understanding Telecommunications Networks', IET Telecommunications Series 52, 2006.
2. Convergence Technologies for 3G Networks: IP, UMTS, EGPRS and ATM Authors: Jeffrey Bannister, Paul Mather, and Sebastian Coope. . John Wiley & Sons, Ltd. ISBN 0470-86091-X (HB). Copyright 2004. Reprinted with corrections January 2005, February 2005.
3. CDMA2000 Evolution: System Concepts and Design Principles Author: Kamran Etemad. Wiley-Interscience. ISBN 0-471-46125-3. Copyright 2004.

Deep Learning

[8thSemester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108306IT

[Pre-requisites: Computational Mathematics, Data Mining, Artificial Intelligence, Neural Network and Fuzzy Logic]

Course Objectives:

1. To introduce fundamental problems in deep learning.
2. To understand complexity of Deep Learning algorithms and their limitations.
3. To be capable of confidently applying common Deep Learning algorithms in practice and implementing their own.
4. To provide understanding of theoretical foundations, techniques, mathematical concepts, common architectures, and algorithms used in deep learning and the way to apply them to solve problems.

Course Content

Unit 1: Introduction to basic Terminologies

Introduction to basic Terminologies: Types of errors, bias-variance trade-off, overfitting-underfitting, Vector Calculus and optimization, variants of gradient descent, momentum. Issues and Challenges in Deep Learning,Relation and Differences among Deep learning, Neural Networks, Machine Learning, Artificial Intelligence.

Unit 2: Deep Learning Architectures

Introduction to Deep Learning Architectures, Convolutional Neural Networks Architecture, CNN representations: invertibility, stability, invariance, covariance/invariance: capsules and related models. Applications of CNN. Deep Unsupervised Learning: Autoencoders (standard, denoising, contractive, etc.), Variational Autoencoders, Adversarial Generative Networks, Maximum Entropy Distributions.

Unit 3: Recurrent Neural Networks

Recurrent Neural Networks (RNNs), Long-Short Term Memory (LSTM) architectures,Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs, Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

Unit 4: Implications of Deep Learning

Python Programming in Deep Learning, Case studies on Deep Learning in Healthcare, Weather Forecasting, Business Intelligence, Biometrics.

Course Materials

Required Text: Textbooks

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
2. Neural Networks and Deep Learning: A Textbook, Charu C. Aggarwal, Springer 2018.
3. Deep Learning with Python, Francois Chollet, Manning 2017.

Optional Materials: Reference Books

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007

Pattern Recognition

[8thSemester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108307IT

[Pre-requisites: Statistical Methods and Probability]

Course Objectives

1. To understand the basic concepts for probability and optimization for pattern recognition.
2. To understand various dimensionality reduction techniques.
3. To understand various Supervised Learning techniques.
4. To understand various Unsupervised Learning techniques.

Course Content

Unit-1: Basics of Linear Algebra, Probability and Optimization

Vectors, Inner product, Outer product, Inverse of a matrix, Eigen analysis, Singular value decomposition, Probability distributions - Discrete distributions and Continuous distributions, Independence of events, Conditional probability distribution and Joint probability distribution, Bayes theorem, Unconstrained optimization, Constrained optimization - Lagrangian multiplier method.

Unit 2: Methods for Function Approximation and Dimensionality Reduction Techniques

Methods for Function Approximation: Linear models for regression, Parameter estimation methods - Maximum likelihood method and Maximum a posteriori method, Regularization, Ridge regression, Lasso, Bias-Variance decomposition, Bayesian linear regression. Dimensionality Reduction Techniques: Principal component analysis, Fisher discriminant analysis, Multiple discriminant analysis.

Unit 3: Probabilistic Models for Classification

Bayesian decision theory, Bayes classifier, Minimum error-rate classification, Normal (Gaussian) density - Discriminant functions, Decision surfaces, Maximum-Likelihood estimation, Maximum a posteriori estimation; Gaussian mixture models, Expectation-Maximization method for parameter estimation, Naive Bayes classifier, Non-parametric techniques for density estimation, Parzen-window method, K-nearest neighbors method, Hidden Markov models (HMMs) for sequential pattern classification, Discrete HMMs and Continuous density HMMs.

Unit 4: Discriminative Learning, Non-Metric based Classification, Ensemble Methods for Classification, and Clustering

Discriminative Learning based Models for Classification: Logistic regression, Perceptron, Multilayer feedforward neural network - Gradient descent method, Error backpropagation method; Support vector machine. Non-Metric Methods for Classification: Decision trees, CART, Ensemble Methods for Classification: Bagging, Boosting, Gradient boosting. Pattern Clustering: Criterion functions for clustering, Techniques for clustering - K-means clustering, Hierarchical clustering, Density based clustering and Spectral clustering; Cluster validation.

Course Materials

Required Text: Text books

1. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
2. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001

Optional Materials: Reference Books

1. S. Theodoridis and K. Koutroumbas, Pattern Recognition, Academic Press, 2009
2. E. Alpaydin, Introduction to Machine Learning, Prentice-Hall of India, 2010.
3. G. James, D. Witten, T. Hastie and R. Tibshirani, Introduction to Statistical Learning, Springer, 2013.

Decision Support System

[8thSemester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT108308IT

[Pre-requisites: Data Structures, Data Mining, Data Science & Machine Learning]

Course Objectives

1. To review and clarify the fundamental terms, concepts and theories associated with DSS, computerized decision aids, expert systems, group support systems and executive information systems.
2. To discuss and develop skills in the analysis, design and implementation of computerized DSS.
3. To understand that most DSS are designed to support rather than replace decision makers and the consequences of this perspective for designing DSS.

Course Content

Unit 1: Introduction to DSS

Strategic, tactical and operational, Consideration of organizational structures, Mapping of databases, MIS, EIS, KBS, expert systems, OR modeling systems and simulation, decision analytic systems onto activities within an organization, Extension to other 'non organizational' areas of decision making, Relationship with knowledge management systems.

Unit 2: Decision Making & Management Support System

Studies of human cognition in relation to decision making and the assimilation of information, Cultural issues, Implications for design of decision-making support, Communication issues.

Unit 3: Modelling and Analysis

Normative, descriptive and prescriptive analysis: requisite modelling, Contrast with recognition primed decision tools.

Unit 4: Data Mining in Business

Database, MIS, EIS, KBS, Belief nets, data mining, OR modeling tools: simulation and optimization, History, design, implementation: benefits and pitfalls, Risk assessment, Decision analysis and strategic decision support.Group decision support systems and decision conferencing, Intelligent decision support systems: tools and applications, Cutting-edge decision support technologies, History, design, implementation: benefits and pitfalls, Deliberative e-democracy and e-participation.

Course Materials

Required Text: Textbooks

1. P.R. Kleindorfer, H.C. Kunreuther, P.J.H. Schoemaker “Decision Sciences: an integration perspective' Cambridge University Press 1993.
2. G.M. Marakas, Decision support Systems in the 21st Century, Prentice Hall, 1999.

Optional Materials: Reference Books

1. E. Turban and J.E. Aronson (2001) Decision support Systems and Intelligent Systems. 6th Edition. PHI
2. V.S.Janakiraman and K.Sarukesi, Decision Support Systems, PHI.
3. Efrem G. Mallach, Decision Support and Data Warehouse Systems, tata McGraw-Hill Edition

Project-II ((for BTech 8A scheme))

[8thSemester, Fourth Year]

Course Description Offered by Department	Credits	Status	Code
Information Technology	0-0-8, (4)	Project	IT108501IT

Major Internship (for BTech 8B scheme)

[8thSemester, Fourth Year]

Course Description Offered by Department	Credits	Status	Code
Information Technology	0-0-0, (4)	Internship	IT108701IT