Appendix-26
Resolution No. 27 {27-1 (27-1-2)}

INDEX
DEPARTMENT OF COMPUTER SCIENCE
SEMESTER-VI

DEPARTMENT OF COMPUTER SCIENCE

[UG Programme for Bachelor in Computer Science (Honours)]

DISCIPLINE SPECIFIC CORE COURSE – 16 (DSC-16) : Artificial Intelligence

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSC-16 Artificial Intelligence	**4**	**3**	**0**	**1**	Pass in Class XII	DSC 04 Object Oriented Programming with C++/ GE 1a Programming using C++ / GE1b Programming with Python/ DSC 01 Programming using Python/ GE 3b: Java Programming

Learning Objectives

The course objectives of this course are to:

- To introduce basic concepts and techniques of Artificial Intelligence (AI).
- To apply informed search techniques for different applications.
- To learn various knowledge representation techniques and writing Prolog programs.
- To learn about the latest techniques for developing AI systems.

Learning outcomes

On successful completion of this course, students will be able to:

- identify problems that are amenable to solutions by specific AI methods.
- state the utility of different types of AI agents.
- apply different informed search techniques for solving real world problems.
- use knowledge representation techniques for AI systems.

SYLLABUS OF DSC-16

Unit 1 6 Hours

Introduction: Introduction to artificial intelligence, background and applications, Turing test, Weak AI, Strong AI, Narrow AI, Artificial General Intelligence, Super AI, rational agent

approaches to AI, introduction to intelligent agents, their structure, behavior and task environment.

Unit 2 12 Hours

Problem Solving and Searching Techniques: Problem characteristics, production systems, control strategies, breadth-first search, depth-first search, hill climbing and its variations, heuristics search techniques: best-first search, A* algorithm, constraint satisfaction problem, means-end analysis, introduction to game playing, min-max and alpha-beta pruning algorithms.

Unit 3 16 Hours

Knowledge Representation: Propositional logic, First-Order Predicate logic, resolution principle, unification, semantic nets, conceptual dependencies, frames, and scripts, production rules, Introduction to Programming in Logic (PROLOG).

Unit 4 8 Hours

Understanding Natural Languages: Components and steps of communication, the contrast between formal and natural languages in the context of grammar, Chomsky hierarchy of grammars, parsing, and semantics, Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented transition nets.

Unit 5 3 Hours

AI The Present and the Future: Symbolic AI, Data-driven AI and Machine Learning, Introduction to Machine Learning and Deep Learning based AI, some applications of symbolic and data driven AI, Interpretable and Explainable AI, Ethics of AI: benefits and risks of AI.

Essential/recommended readings

1. Russell, Stuart, J. and Norvig, Peter, *Artificial Intelligence - A Modern Approach*, Pearson, 4th edition, 2020..
2. Bratko, Ivan, *Prolog Programming for Artificial Intelligence*, Addison-Wesley, Pearson Education, 4th edition, 2012.
3. Patterson, DAN,W, *Introduction to A.I. and Expert Systems* – PHI, 2007.
4. Clocksin, W., F. and Mellish, *Programming in PROLOG*, 5th edition, Springer, 2003.

Additional references

1. Kaushik, Saroj, *Artificial Intelligence*, Cengage Learning India, 2011.
2. Rich, Elaine and Knight, Kelvin, *Artificial Intelligence*, 3rd edition, Tata McGraw Hill, 2010

Practical List :

Practical exercises such as

1. Write a program in Prolog to implement TowerOfHanoi(N) where N represents the number of disks.
2. Write a program to implement the Hill climbing search algorithm in Prolog.
3. Write a program to implement the Best first search algorithm in Prolog.
4. Write a program to implement A* search algorithm in Prolog.
5. Write a program to implement the min-max search algorithm in Prolog.

6. Write a program to solve the Water-Jug Problem in Prolog.
7. Implement sudoku problem (minimum 9×9 size) using constraint satisfaction in Prolog.
8. Write a Prolog program to implement the family tree and demonstrate the family relationship.
9. Write a Prolog program to implement knowledge representation using frames with appropriate examples.
10. Write a Prolog program to implement conc(L1, L2, L3) where L2 is the list to be appended with L1 to get the resulted list L3.
11. Write a Prolog program to implement reverse(L, R) where List L is original and List R is reversed list.
12. Write a Prolog program to generate a parse tree of a given sentence in English language assuming the grammar required for parsing.
13. Write a Prolog program to recognize context free grammar $a^n b^n$.

DISCIPLINE SPECIFIC CORE COURSE – 17 (DSC-17): Machine Learning

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSC-17 Machine Learning	**4**	**3**	**0**	**1**	Pass in Class XII	DSC01 Programming using Python / A course in Python at plus 2 level

Learning Objectives

The course aims at introducing the basic concepts and techniques of machine learning so that a student can apply machine learning techniques to a problem at hand.

Learning outcomes

On successful completion of the course, students will be able to:

- Differentiate between supervised and unsupervised learning tasks.
- State the need of preprocessing, feature scaling and feature selection.
- Formulate classification, regression and clustering problems as optimization problems
- Implement various machine learning algorithms learnt in the course.

SYLLABUS OF DSC-17

Unit 1 (5 Hours)

Introduction: Basic definitions and concepts, key elements, supervised and unsupervised learning, introduction to reinforcement learning, applications of ML.

Unit 2 (8 Hours)

Preprocessing: Feature scaling, feature selection methods. dimensionality reduction (Principal Component Analysis).

Unit 3 (12 Hours)

Regression: Linear regression with one variable, linear regression with multiple variables, gradient descent, over-fitting, regularization. Regression evaluation metrics.

Unit 4 (12 Hours)

Classification: Decision trees, Naive Bayes classifier, logistic regression, k-nearest neighbor classifier, perceptron, multilayer perceptron, neural networks, back-propagation algorithm, Support Vector Machine (SVM). Classification evaluation metrics.

Unit 5 (8 Hours)

Clustering: Approaches for clustering, distance metrics, K-means clustering, hierarchical clustering.

Essential/recommended readings

1. Mitchell, T.M. *Machine Learning*, McGraw Hill Education, 2017.
2. James, G., Witten. D., Hastie. T., Tibshirani., R. *An Introduction to Statistical Learning with Applications in R*, Springer, 2014.
3. Alpaydin, E. *Introduction to Machine Learning*, MIT press, 2009.

Additional References

1. Flach, P., *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, Cambridge University Press, 2015.
2. Christopher & Bishop, M., *Pattern Recognition and Machine Learning*, New York: Springer-Verlag, 2016.
3. Sebastian Raschka, *Python Machine Learning,* Packt Publishing Ltd, 2019

Suggested Practical List:

Practical exercises such as

Use Python for practical labs for Machine Learning. Utilize publicly available datasets from online repositories like https://data.gov.in/ and https://archive.ics.uci.edu/ml/datasets.php

For evaluation of the regression/classification models, perform experiments as follows:

- Scale/Normalize the data
- Reduce dimension of the data with different feature selection techniques
- Split datasets into training and test sets and evaluate the decision models
- Perform k-cross-validation on datasets for evaluation

Report the efficacy of the machine learning models as follows:

- MSE and R^2 score for regression models
- Accuracy, TP, TN, FP, TN, error, Recall, Specificity, F1-score, AUC for classification models

For relevant datasets make prediction models for the following

1. Naïve Bayes Classifier
2. Simple Linear Regression multiple linear regression
3. Polynomial Regression
4. Lasso and Ridge Regression
5. Logistic regression
6. Artificial Neural Network
7. *k*-NN classifier
8. Decision tree classification
9. SVM classification
10. K-Means Clustering
11. Hierarchical Clustering

DISCIPLINE SPECIFIC CORE COURSE– 18 (DSC-18): Introduction to Parallel Programming

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSC-18 Introduction to Parallel Programming	**4**	**3**	**0**	**1**	Pass in Class XII	DSC-02 Computer Systems Architecture DSC04 /A course in C/C++ at plus 2 level, DSC-07 Data Structures with C++, DSC-08 Operating Systems

Learning Objectives

The course introduces the students to the basic concepts and techniques of parallel programming. It enables them to design and implement parallel algorithms. The course would give the students hands-on practice to write parallel programs using shared and distributed memory models using OpenMP and Message Passing Interface (MPI).

Learning outcomes

On successful completion of this course, the student will be able to:

- State the need of Parallel algorithms
- Describe architectures for parallel and distributed systems.
- Develop elementary parallel algorithms for shared memory models.
- Develop elementary parallel algorithms for distributed memory models.

SYLLABUS OF DSC-18

Unit 1 (6 Hours)

Introduction to Parallel Computing: Trends in microprocessor architectures, memory system performance, dichotomy of parallel computing platforms, physical organization of parallel platforms, communication costs in parallel machines, SIMD versus MIMD architectures, shared versus distributed memory, PRAM shared-memory model, distributed-memory model.

Unit 2 (15 Hours)

OpenMP programming for shared memory systems: Thread Basics, Controlling Thread and Synchronization Attributes, Multi-thread and multi-tasking, Context Switching, Basic OpenMP thread functions, Shared Memory Consistency Models and the Sequential Consistency Model, Race Conditions, Scoping variables, work-sharing constructs, critical sections, atomic operations, locks, OpenMP tasks, Introduction to tasks, Task queues and task execution, Accessing variables in tasks, Completion of tasks and scoping variables in tasks, Recursive task spawning and pitfalls

Unit 3 (15 Hours)
MPI programming for distributed memory systems: MPI basic communication routines (Introduction to MPI and basic calls, MPI calls to send and receive data, MPI call for broadcasting data, MPI Non-blocking calls, MPI Collectives (MPI Collectives and MPI broadcast, MPI Gathering and scattering collectives, MPI reduction and Alltoall collectives, MPI collectives design), Types of interconnects (Characterization of interconnects, Linear arrays, 2D mesh and torus, cliques)

Unit 4 (9 Hours)
Applications: Matrix-matrix multiply, Odd-Even sorting, distributed histogram, Breadth First search, Dijkstra's algorithm

Essential/recommended readings

1. Grama, A., Gupta, A., Karypis, G., Kumar, V., *Introduction to Parallel Computing*, 2nd edition, Addison-Wesley, 2003.
2. Quinn, M. *Parallel Programming in C with MPI and OpenMP*, 1st Edition, McGraw-Hill, 2017.
3. Revdikar, L., Mittal, A., Sharma, A., Gupta, S., *A Naïve Breadth First Search Approach Incorporating Parallel Processing Technique For Optimal Network Traversal*, International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 5, May 2016.

Additional References

No additional references mentioned

Suggested Practical List :

Practical exercises such as

1. Implement Matrix-Matrix Multiplication in parallel using OpenMP
2. Implement distributed histogram Sorting in parallel using OpenMP
3. Implement Breadth First Search in parallel using OpenMP
4. Implement Dijkstra's Algorithm in parallel using OpenMP

DISCIPLINE SPECIFIC ELECTIVE COURSES

DISCIPLINE SPECIFIC ELECTIVE COURSE: Social Network Analytics

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Social Network Analytics	**4**	**3**	**0**	**1**	Pass in Class XII	DSC 01 Programming using Python, DSC03 Mathematics for Computing

Learning Objectives

The course introduces basic graph theory and draws distinction between graph as an abstract structure and real-life situation modelled as network. This course aims to expose the students to the strengths and capabilities of network analysis and their applications through the use of open source software.

Learning outcomes

On successful completion of the course, students will be able to :

- Model real life situation as networks
- Identify and apply quantitative network measures to characterize social networks at the local and global level
- Generate synthetic networks that satisfy properties of real world networks
- Discover, analyse and evaluate the intrinsic community structure of networks
- Model an information diffusion process for predictive analysis of networks

SYLLABUS OF DSE

Unit 1 (7 Hours)

Introduction to Social Network Analysis: Graph theory, random walk, degree distribution, mapping of real world situation into networks and applications of social network analysis, types of networks

Unit 2 (10 Hours)

Network Measures: Centrality measures, Page Rank, Hubs and Authority, Assortativity, Transitivity and Reciprocity, Similarity and Structural Equivalence

Unit 3 (10 Hours)

Network Models: Properties of Real-World Networks, Random Network Model, Small World Network Model, Preferential Attachment Model

Unit 4 (10 Hours)

Community Structure in Networks: Types of Communities, Community Detection algorithms and evaluation of communities obtained

Unit 5 (8 Hours)

Information Diffusion in Social Media: Information Cascades, Diffusion of Innovations, Basic Epidemic Models

Essential/recommended readings

1. Chakraborty T. *Social Network Analysis***,** 1st edition, Wiley India Pvt. Ltd., 2021.
2. Zafarani R., Abbasi M. A., Liu H. *Social Media Mining: An Introduction***,** 1st edition, Cambridge University Press, 2014.
3. Barabási A. L. , Pósfai M. *Network Science*, 1st edition, Cambridge University Press, 2016.

Additional References

1. Easley, Kleinberg J. *Networks, Crowds, and Markets: Reasoning About a Highly Connected World***,** 1st edition, Cambridge University Press, 2012.

Suggested Practical List :

Practical exercises such as

Python Packages like igraph, NetworkX, NDlib etc. may be used for programming

1. Plot a weighted directed network such that node size and edge width is proportional to their degree and edge weight respectively
2. Compute and plot degree distribution of a real-world network. Also compute its local and global properties.
3. Generate three networks of 1000 nodes each using Random Network Model, Small World Network Model, Preferential Attachment Model and compare their characteristics.
4. Compute different centrality measures to identify top-N nodes and compare their ranks with those obtained by PageRank method.
5. Apply community detection algorithms on a small real-world network (e.g. Karate club) and compare modularity using bar plot. Also plot the communities revealed with different colors.
6. Simulate diffusion trends for different epidemic models and present results using appropriate visuals.

DISCIPLINE SPECIFIC ELECTIVE COURSE: Computer Graphics

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Computer Graphics	**4**	**3**	**1**	**0**	Pass in Class XII	DSC 03 (Mathematics for Computing - I), DSC 04 Object Oriented Programming with C++/ GE 1a Programming using C++ / GE1b Programming with Python/ DSC 01 Programming using Python/ GE 3b Java Programming

Learning Objectives

This course introduces fundamental concepts of Computer Graphics with focus on modeling, rendering and interaction aspects of computer graphics. The course emphasizes the basic principles needed to design, use and understand computer graphics system.

Learning outcomes

On successful completion of the course, students will be able to:

- Describe Standard raster and vector scan devices as well as Graphical Input and output devices
- Implement algorithms for drawing basic primitives such as line, circle and ellipse.
- Implement algorithms for line clipping, polygon clipping and polygon filling.
- Implement a 3D object representation scheme, carryout 2D and 3D transformation, 3D projections
- Implement visible surface determination algorithms, Illumination models and surface rendering methods
- Implement a simple computer animation algorithm

SYLLABUS OF DSE

Unit 1 (8 Hours)

Introduction: Introduction to Graphics systems, Basic elements of Computer graphics, Applications of computer graphics. Architecture of Raster and Random scan display devices, input/output devices.

Unit 2 (8 Hours)
Drawing and clipping primitives: Raster scan line, circle and ellipse drawing algorithms, Polygon filling, line clipping and polygon clipping algorithms

Unit 3 (12 Hours)
Transformation and Viewing: 2D and 3D Geometric Transformations, 2D and 3D Viewing transformations (Projections- Parallel and Perspective), Vanishing points.

Unit 4 (9 Hours)
Geometric Modeling: Polygon Mesh Representation, Cubic Polynomial curves (Hermite and Bezier).

Unit 5 (8 Hours)
Visible Surface determination and Surface Rendering: Z-buffer algorithm, List-priority algorithm and area subdivision algorithm for visible surface determination. Illumination and shading models, RGB Color model and Basics of Computer Animation.

Essential/recommended readings

1. Hearn, D & Baker, M.P. *Computer Graphics*, 2nd edition, Prentice Hall of India, 2009.
2. Foley, J. D., Dam, A.V, Feiner, S. K., & Hughes, J. F. *Computer Graphics: Principles and Practice in C*, 2nd edition, Pearson education, 2002.
3. Rogers, D. F. *Mathematical Elements for Computer Graphics*, 2nd edition, McGraw Hill Education, 2017.

Additional References

1. Bhattacharya, S. *Computer Graphics*, Oxford University Press, 2018.
2. Marschner, S., & Shirley, P. *Fundamentals of Computer Graphics,* 4th edition CRC Press, 2017.

Suggested Practical List :

Practical exercises such as

1. Write a program to implement Bresenham's line drawing algorithm.
2. Write a program to implement a midpoint circle drawing algorithm.
3. Write a program to clip a line using Cohen and Sutherland line clipping algorithm.
4. Write a program to clip a polygon using Sutherland Hodgeman algorithm.
5. Write a program to fill a polygon using the Scan line fill algorithm.
6. Write a program to apply various 2D transformations on a 2D object (use homogeneous Coordinates).
7. Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.
8. Write a program to draw Hermite /Bezier curve.

DISCIPLINE SPECIFIC ELECTIVE COURSE: Deep Learning

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Deep Learning	**4**	**3**	**0**	**1**	Pass in Class XII	DSC03 Mathematics for Computing - I, DSC17 Machine Learning

Learning Objectives

The objective of this course is to introduce students to deep learning algorithms and their applications in order to solve real problems.

Learning outcomes

On successful completion of this course, the student will be able to:

- Describe the feed-forward and deep networks.
- Design single and multi-layer feed-forward deep networks and tune various hyper-parameters.
- Implement deep neural networks to solve a problem
- Analyze performance of deep networks.
- Use pre-trained models to solve a problem.

SYLLABUS OF DSE

Unit 1 (8 Hours)

Introduction to neural networks: Artificial neurons, perceptron, computational models of neurons, Structure of neural networks, Multilayer feedforward neural networks (MLFFNN), Backpropagation learning, Empirical risk minimization, bias-variance tradeoff, Regularization, output units: linear, softmax , hidden units:tanh, RELU

Unit 2 (8 Hours)

Deep neural networks: Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNN's, Newer optimization methods for neural networks(AdaGrad, RMSProp, Adam), Regularization methods(dropout, drop connect, batch normalization).

Unit 3 (8 Hours)

Convolution neural networks(CNNs): Introduction to CNN - convolution, pooling, Deep CNNs - LeNet, AlexNet. Training CNNs, weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs, Using a pre trained convnet

Unit 4 (8 Hours)
Recurrent neural networks (RNNs): Sequence modeling using RNNs, Backpropagation through time, LongShort Term Memory (LSTM), Bidirectional RNN, Bidirectional LSTM
Unit 5 (8 Hours)
Unsupervised deep learning: Autoencoders, Generative Adversarial Networks.

Unit 6 (5 Hours)
Applications: Computer vision, Speech recognition and NLP.

Essential/recommended readings

1. Ian Goodfellow, Yodhua Bengio and Aaron Courville, *Deep Learning,* MIT Press Book**,** 2016.
2. Francois Chollet, *Deep Learning with python***,** *2nd edition*, Meaning Publications Co, 2021.

Additional References

1. Bunduma, N., *Fundamentals of Deep Learning*, 1st edition, O'reilly Books, 2017.
2. Heaton, J., *Deep Learning and Neural Networks*, 1st edition, Heaton Research Inc., 2015.

Suggested Practical List :

Practical exercises such as

The following practicals are to be conducted using Python.

1. Implement a feed-forward neural networks for classifying movie reviews as positive or negative(using IMDB dataset)
2. Implement a deep-neural feed-forward network for estimating the price of house, given real-estate data(Boston Housing Price)
3. Implement a deep-neural network for classifying news wires by topic (Reuters dataset).
4. Implement CNN for classifying MNIST dataset
5. Create a model for time-series forecasting using RNN/LSTM
6. Implement an auto-encoder

DISCIPLINE SPECIFIC ELECTIVE COURSE: Ethical Hacking

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Ethical Hacking	**4**	**3**	**0**	**1**	Pass in Class XII	Any Programming Language at plus 2 level or above

Learning Objectives

The objective of this course is to enable students to be part of such a team that can conduct the security assessment of an organization through the process of ethical hacking. This course will introduce the students, the idea of security assessment of systems and networks under investigation and how to perform them under the legal and ethical framework. Further, this course will outline the importance of various stages of ethical hacking, including but not limited to tasks such as penetration testing, and usage of various tools at each stage.

Learning outcomes

On successful completion of this course, the student will be able to:

- Understand and acknowledge the relevance of legal, ethical, and professional challenges faced by an ethical hacker.
- Apply fundamental principles of system, application, and network security to ethically attack / penetrate the system to uncover the security flaws.
- Perform evaluation of security systems through a systematic ethical hacking process and recommend countermeasures to improve security.
- Understand and use various tools and techniques used in various stages of the ethical hacking process.

SYLLABUS OF DSE

Unit 1 (4 Hours)

Introduction: Overview of information security threats and attack vectors, vulnerability assessment and penetration testing concepts, information security controls, security laws and standards. OWASP.

Unit 2 (6 hours)

Footprinting and Reconnaissance: Introduction to network reconnaissance tools such ipconfig, ifconfig, domain tools, nmap, Wireshark, etc.

Unit 3 (6 hours)

Scanning and Enumeration: Network penetration testing, Password cracking techniques and countermeasures, NetBIOS tools

Unit 4 (6 hours)

Gaining and Maintaining Access: Network level attacks and countermeasures, Metasploit framework, Burp Suite

Unit 5 (6 hours)

Exploitation and Covering Tracks: Privilege escalation, social Engineering**,** identity theft, countermeasures, Covering tracks using attrib command and creating Alternate Data Stream (ADS) in Windows, Erasing evidence from Windows logs, Strategies for maintaining access.

Unit 6 (6 hours)

Advanced stages: Denial of service, Session hijacking, hacking web servers, hacking web applications, sql injection etc.

Unit 7 (6 hours)

NIST Cybersecurity framework and ISO standards: NIST cybersecurity framework, Cyber Kill chain, ISO/IEC 27001 and related standards.

Unit 8 (5 Hours)

Cyber Defense and Reporting: Preparing vulnerability assessment reports, presenting post testing findings, preparing recommendations

Essential/recommended readings

1. Patrick Engbretson, The Basics of Hacking and Penetration Testing, 2nd Edition, Syngress, 2013.
2. Georgia Weidman, Penetration TEsting: A Hands-On Introduction to Hacking, 1st Edition, No Starch Press, 2014.

Additional References

1. Peter Kim, The Hacker Playbook 3: Practical Guide to Penetration Testing, Zaccheus Entertainment, 2018.
2. Jon Erickson, Hacking: The Art of Exploitation, No Starch Press, 2008.
3. Online Resources:
    a. https://www.sans.org/cyberaces/
    b. https://skillsforall.com/
    c. https://www.hackingloops.com/ethical-hacking/

Suggested Practical List

Practical exercises such as

Perform the following activities.

(NOTE: Exercise extra caution while performing these exercises and codes)

1. Perform various Virtual Machine based exercises on https://vulnhub.com/
2. Perform exercises from https://www.hacker101.com/
3. Follow the lessons and activities from https://www.hackingloops.com/ethical-hacking/
4. Activities on Google site for hacking https://google-gruyere.appspot.com/
5. ACtivities on OWASP WebGoat https://github.com/WebGoat/WebGoat

DISCIPLINE SPECIFIC ELECTIVE COURSE: Cloud Computing

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Cloud Computing	**4**	**3**	**0**	**1**	Pass in Class XII	NIL

Learning Objectives

The objective of an undergraduate cloud computing course is to provide students with a comprehensive understanding of cloud computing technologies, services, and applications.

Learning outcomes

On successful completion of this course, the student will be able to:

- Knowledge of the fundamental concepts and principles of cloud computing, including virtualization, scalability, reliability, and security.
- Ability to design, develop, and deploy cloud-based applications using popular cloud platforms and services.
- Familiarity with cloud computing architectures, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
- Understanding of the economic, legal, and ethical implications of cloud computing, including issues related to data privacy, ownership, and security.
- Ability to evaluate and select cloud-based solutions based on their technical, economic, and business requirements.
- Understanding of the broader societal and environmental impacts of cloud-based services and applications.

SYLLABUS OF DSE

Unit 1

Overview of Computing Paradigm: Recent trends in Computing : Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing,

Unit 2

Introduction to Cloud Computing: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Benefits and limitations of Cloud Computing,

Unit 3

Cloud Computing Architecture: Comparison with traditional computing architecture (client/server), Services provided at various levels, Service Models- Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), How Cloud Computing Works, Deployment Models- Public cloud, Private cloud, Hybrid cloud, Community cloud, Case study of NIST architecture.

Unit 4

Case Studies: Case study of Service model using Google Cloud Platform (GCP), Amazon Web Services (AWS), Microsoft Azure, Eucalyptus.

Unit 5

Cloud Computing Management: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling.

Unit 6

Cloud Computing Security: Infrastructure Security- Network level security, Host level security, Application level security, Data security and Storage- Data privacy and security Issues, Jurisdictional issues raised by Data location, Authentication in cloud computing.

Essential/recommended readings

1. Thomas Erl, Ricardo Puttini and Zaigham Mahmood, Cloud Computing: Concepts, Technology and Architecture, Publisher: PHI, 2013.
2. Rajkumar Buyya, James Broberg, and Andrzej Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2013.
3. Boris Scholl, Trent Swanson, and Peter Jausovec, Cloud Native: Using Containers, Functions, and Data to Build Next-Generation Applications, Publisher : Shroff/O'Reilly, 2019.

Additional References

1. *Cloud Computing Bible,* Barrie Sosinsky*, Wiley-India,* 2010
2. *Cloud Computing: Principles and Paradigms,* Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski*, Wile,* 2011
3. *Cloud Computing: Principles, Systems and Applications, Editors:* Nikos Antonopoulos, Lee Gillam*, Springer,* 2012
4. *Cloud Security: A Comprehensive Guide to Secure Cloud Computing,* Ronald L. Krutz, Russell Dean Vines*, Wiley-India,* 2010

Suggested Practical List:

Practical exercises such as

1. Create virtual machines that access different programs on same platform.
2. Create virtual machines that access different programs on different platforms

3. Working on tools used in cloud computing online:
    a. Storage
    b. Sharing of data
    c. manage your calendar, to-do lists,
    d. a document editing tool
4. Exploring Google cloud
5. Exploring Microsoft cloud
6. Exploring Amazon cloud

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

GENERIC ELECTIVES (GE-6a): Computer Networks

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
GE6a Computer Networks	**4**	**3**	**0**	**1**	Pass in Class XII	DSC 04 Object Oriented Programming with C++/ GE 1a Programming using C++ / GE1b Programming with Python/ DSC 01 Programming using Python/ GE 3b Java Programming

Learning Objectives

The course objectives of this paper are to understand the concepts behind computer networks and data communication. learn the different types of networks, network topologies and their characteristics. learn the working of protocols used at various layers. understand the utility of different networking devices.

Learning outcomes

On successful completion of the course, students will be able to:

- differentiate between various types of computer networks and their topologies.
- understand the difference between the OSI and TCP/IP protocol suit.
- distinguish between different types of network devices and their functions.
- design/implement data link and network layer protocols in a simulated networking environment.

SYLLABUS OF GE-6a

Unit 1

Introduction: Types of computer networks, Internet, Intranet, network topologies (bus, star, ring, mesh, tree, hybrid topologies), network classifications. layered architecture approach, OSI Reference Model, TCP/IP Reference Model. Transmission Modes: simplex, half duplex and full duplex.

Unit 2

Physical Layer: Analog signal, digital signal, the maximum data rate of a channel, transmission media (guided transmission media, wireless transmission, satellite

communication), multiplexing (frequency division multiplexing, time-division multiplexing, wavelength division multiplexing). Guided Media (Wired) (Twisted pair, Coaxial Cable, Fiber Optics. Unguided Media (Radio Waves, Infrared, Micro-wave, Satellite).

Unit 3

Data Link and MAC Layer: Data link layer services, error detection and correction techniques, error recovery protocols (stop and wait, go back n, selective repeat), multiple access protocols with collision detection, MAC addressing, Ethernet, data link layer switching, point-to-point protocol.

Unit 4

Network layer: Networks and Internetworks, virtual circuits and datagrams, addressing, subnetting, Dijkstra Routing algorithm, Distance vector routing, Introduction to Network Layer protocol- (ARP, IPV4, ICMP).

Unit 5

Introduction to Transport and Application Layer: Introduction to Process to process Delivery- (client-server paradigm, connectionless versus connection-oriented service); User Datagram Protocols, TCP/IP protocol, Flow Control. FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), Telnet (Remote login protocol), WWW (World Wide Web), HTTP (HyperText Transfer Protocol), URL (Uniform Resource Locator).

Essential/recommended readings

1. Tanenbaum, A.S. & Wetherall, D.J., *Computer Networks*, *5th edition*, Pearson Education, 2012.

2. Forouzan, B. A., *Data Communication and Networking*, *4th edition*, McGraw-Hill Education, , 2017.

Additional References

1. Comer, D. E., *Computer Networks and Internet,* 6th edition*,* Pearson Publication, 2015.

2. (ii) Stallings, W., *Data and Computer Communications*, 10th edition, Pearson education India, 2017.

Suggested Practical List :

Practical exercises such as

Introduce students to CISCO Packet Tracer and do the following:

1. To Study basic network command and Network configuration commands.
2. To study and perform PC to PC communication.
3. To create Star topology using Hub and Switch.
4. To create Bus, Ring, Tree, Hybrid, Mesh topologies.
5. Perform an initial Switch configuration.
6. Perform an initial Router configuration.
7. To implement Client Server Network.
8. To implement connection between devices using router.
9. To perform remote desktop sharing within LAN connection.

GENERIC ELECTIVES (GE-6b): Internet Technologies: Web App Design and Development

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
GE6b: Internet Technologies: Web App Design and Development	**4**	**3**	**0**	**1**	Pass in Class XII	NIL

Learning Objectives

The course aims at:

- Develop understanding of Web Development Architecture.
- Using React components in Web applications
- Introduce REST APIs Design
- Understanding of Angular Architecture, data-binding and dependency injection
- Understand form validations and application of templates

Learning outcomes

On successful completion of the course students will be able to

- Develop interfaces for single page applications
- Develop a complete client side solutions using angular js
- Develop a RESTful web services.
- Apply form validations

SYLLABUS OF GE-6b

Unit 1

Introduction to React: Definition of React, React library, React Developer tools, Introduction to ES6, Declaring variables, Arrow Functions, Objects and Arrays, modules, Introduction to AJAX, Functions in AJAX Pure React: Page setup, virtual DOM, React Element, React DOM, Constructing Elements with Data, React Components, DOM Rendering, First React Application using Create React App, React with JSX, React Element as JSX Props, State and Component Tree: Property Validation, Validating Props with createClass, Default Props, ES6 Classes and stateless functional components, React state management, State within the component tree, state vs props, Forms in React

Unit 2

Rest APIs: JSON: Introduction, Syntax, Data Types, Objects, Schema. REST API:

Introduction, WRML, REST API Design, Identifier Design with URIs, Interaction Design with HTTP, Representation Design, Caching, Security.

Unit 3

Angular.js.: Introduction to Angular: Angular architecture; introduction to components, component interaction and styles; templates, interpolation and directives; forms, user input, form validations; data binding and pipes; retrieving data using HTTP; Angular modules

Essential/recommended readings

1. D. Brad, B. Dayley and C. Dayley, *Node. js, MongoDB and Angularjs Web Development: The definitive guide to using the MEAN stack to build web applications*, 2nd edition, Addison-Wesley, 2018.
2. D. Herron, *Node.js Web Development*, 5th edition, Packt Publishing, 2020.
3. A. Banks and E. Porcello, *Learning React: Functional Web Development with React and Redux*, 1st edition, O'Reilly, 2017.
4. M. Masse, *REST API – Design Rulebook*, 1st edition, O'Reilly, 2011.

Additional References

No additional references mentioned.

Suggested Practical List :

Practical exercises such as

1. Angular.js:
a. Build a simple Angular.js application that displays a list of items.
b. Create a form in Angular.js to add new items to the list.
c. Implement filtering and sorting functionality in Angular.js to manipulate the displayed list.
d. Integrate Angular.js with a RESTful API to fetch data and display it in the application.
e. Implement authentication and authorization using Angular.js routing and services.

2. React:
a. Create a basic React component that displays "Hello, World!" on the screen.
b. Build a React application that fetches data from a REST API and renders it in a list.
c. Implement form handling in React to create, update, and delete items from the list.
d. Create a search functionality using React to filter the displayed list based on user input.
e. Implement routing in React to navigate between different pages within the application.

3. REST API:
a. Build a simple REST API using a framework like Node.js and Express.
b. Create endpoints to perform CRUD operations (Create, Read, Update, Delete) on a specific resource (e.g., users, products).
c. Implement authentication and authorization mechanisms using JSON Web Tokens (JWT) to secure the API.
d. Develop endpoints that handle file uploads and downloads.

GENERIC ELECTIVES (GE-6c): Artificial Intelligence

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
GE6c: Artificial Intelligence	**4**	**3**	**0**	**1**	Pass in Class XII	DSC 04 Object Oriented Programming with C++/ GE 1a Programming using C++ / GE1b Programming with Python/ DSC 01 Programming using Python/ GE 3b: Java Programming

Learning Objectives

The course objectives of this course are to:

- To introduce basic concepts and techniques of Artificial Intelligence (AI).
- To apply informed search techniques for different applications.
- To learn various knowledge representation techniques and writing Prolog programs.
- To learn about the latest techniques for developing AI systems.

Learning outcomes

On successful completion of this course, students will be able to:

- identify problems that are amenable to solutions by specific AI methods.
- state the utility of different types of AI agents.
- apply different informed search techniques for solving real world problems.
- use knowledge representation techniques for AI systems.

SYLLABUS OF GE-6c

Unit 1 6 Hours

Introduction: Introduction to artificial intelligence, background and applications, Turing test, Weak AI, Strong AI, Narrow AI, Artificial General Intelligence, Super AI, rational agent approaches to AI, introduction to intelligent agents, their structure, behavior and task environment.

Unit 2 12 Hours

Problem Solving and Searching Techniques: Problem characteristics, production systems, control strategies, breadth-first search, depth-first search, hill climbing and its variations, heuristics search techniques: best-first search, A* algorithm, constraint satisfaction problem, means-end analysis, introduction to game playing, min-max and alpha-beta pruning algorithms.

Unit 3 16 Hours

Knowledge Representation: Propositional logic, First-Order Predicate logic, resolution principle, unification, semantic nets, conceptual dependencies, frames, and scripts, production rules, Introduction to Programming in Logic (PROLOG).

Unit 4 8 Hours

Understanding Natural Languages: Components and steps of communication, the contrast between formal and natural languages in the context of grammar, Chomsky hierarchy of grammars, parsing, and semantics, Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented transition nets.

Unit 5 3 Hours

AI The Present and the Future: Symbolic AI, Data-driven AI and Machine Learning, Introduction to Machine Learning and Deep Learning based AI, some applications of symbolic and data driven AI, Interpretable and Explainable AI, Ethics of AI: benefits and risks of AI.

Essential/recommended readings

1. Russell, Stuart, J. and Norvig, Peter, *Artificial Intelligence - A Modern Approach*, Pearson, 4th edition, 2020..
2. Bratko, Ivan, *Prolog Programming for Artificial Intelligence*, Addison-Wesley, Pearson Education, 4th edition, 2012.
3. Patterson, DAN,W, *Introduction to A.I. and Expert Systems* – PHI, 2007.
4. Clocksin, W., F. and Mellish, *Programming in PROLOG*, 5th edition, Springer, 2003.

Additional references

1. Kaushik, Saroj, *Artificial Intelligence*, Cengage Learning India, 2011.
2. Rich, Elaine and Knight, Kelvin, *Artificial Intelligence*, 3rd edition, Tata McGraw Hill, 2010

Practical List :

Practical exercises such as

14. Write a program in Prolog to implement TowerOfHanoi(N) where N represents the number of disks.
15. Write a program to implement the Hill climbing search algorithm in Prolog.
16. Write a program to implement the Best first search algorithm in Prolog.
17. Write a program to implement A* search algorithm in Prolog.
18. Write a program to implement the min-max search algorithm in Prolog.
19. Write a program to solve the Water-Jug Problem in Prolog.
20. Implement sudoku problem (minimum 9×9 size) using constraint satisfaction in Prolog.
21. Write a Prolog program to implement the family tree and demonstrate the family relationship.
22. Write a Prolog program to implement knowledge representation using frames with appropriate examples.
23. Write a Prolog program to implement conc(L1, L2, L3) where L2 is the list to be appended with L1 to get the resulted list L3.
24. Write a Prolog program to implement reverse(L, R) where List L is original and List R is reversed list.
25. Write a Prolog program to generate a parse tree of a given sentence in English language assuming the grammar required for parsing.
26. Write a Prolog program to recognize context free grammar $a^n b^n$.

(Computer Science Courses for Undergraduate Programme of study with Computer Science discipline as one of the three Core Disciplines)

DISCIPLINE SPECIFIC CORE COURSE (DSC06): Computer Networks

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSC06: Computer Networks	**4**	**3**	**0**	**1**	Pass in Class XII	DSC 04 Object Oriented Programming with C++/ GE 1a Programming using C++ / GE1b Programming with Python/ DSC 01 Programming using Python/ GE 3b: Java Programming

Learning Objectives
The course objectives of this paper are to:

- Understand the concepts behind computer networks and data communication.
- Learn the different types of networks, network topologies and their characteristics.
- Learn the working of protocols used at various layers.
- Understand the utility of different networking devices.

Learning outcomes

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

- differentiate between various types of computer networks and their topologies.
- understand the difference between the OSI and TCP/IP protocol suit.
- distinguish between different types of network devices and their functions.
- design/implement data link and network layer protocols in a simulated networking environment.

SYLLABUS OF DSC06

Unit 1 (8 hours)
Introduction: Types of computer networks, Internet, Intranet, network topologies (bus, star, ring, mesh, tree, hybrid topologies), network classifications. layered architecture approach,

OSI Reference Model, TCP/IP Reference Model. Transmission Modes: simplex, half duplex and full duplex.

Unit 2 (9 hours)
Physical Layer: Analog signal, digital signal, the maximum data rate of a channel, transmission media (guided transmission media, wireless transmission, satellite communication), multiplexing (frequency division multiplexing, time-division multiplexing, wavelength division multiplexing). Guided Media (Wired) (Twisted pair, Coaxial Cable, Fiber Optics. Unguided Media (Radio Waves, Infrared, Micro-wave, Satellite).

Unit 3 (10 hours)
Data Link and MAC Layer: Data link layer services, error detection and correction techniques, error recovery protocols (stop and wait, go back n, selective repeat), multiple access protocols with collision detection, MAC addressing, Ethernet, data link layer switching, point-to-point protocol.

Unit 4 (8 hours)
Network layer: Networks and Internetworks, virtual circuits and datagrams, addressing, subnetting, Dijkstra Routing algorithm, Distance vector routing, Network Layer protocol- (ARP, IPV4, ICMP).

Unit 5 (10 hours)
Transport and Application Layer: Process to process Delivery- (client-server paradigm, connectionless versus connection-oriented service); User Datagram Protocols, TCP/IP protocol, Flow Control. FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), Telnet (Remote login protocol), WWW (World Wide Web), HTTP (HyperText Transfer Protocol), URL (Uniform Resource Locator).

Essential/recommended readings

1. Tanenbaum, A.S. & Wethrall, D.J.. *Computer Networks*, 5th edition, Pearson Education, 2012.

2. Forouzan, B. A.. *Data Communication and Networking*, 4th edition, McGraw-Hill Education, 2017.

Additional References

1. Comer, D. E.. *Computer Networks and Internet,* 6th edition*,* Pearson education, 2015.

2. Stallings, W., *Data and Computer Communications,* 10th edition, Pearson education India, 2017.

Suggested Practical List :

Practical exercises such as

Introduce students to any network simulator tool and do the following:

1. To Study basic network command and Network configuration commands.
2. To study and perform PC to PC communication.

3. To create Star topology using Hub and Switch.
4. To create Bus, Ring, Tree, Hybrid, Mesh topologies.
5. Perform an initial Switch configuration.
6. Perform an initial Router configuration.
7. To implement Client Server Network.
8. To implement connection between devices using router.
9. To perform remote desktop sharing within LAN connection.

(B.A. Programmes with Computer Science as Major discipline)

Computer Science Major

DISCIPLINE SPECIFIC CORE COURSE (DSC06): Computer Networks

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSC06 Computer Networks	**4**	**3**	**0**	**1**	Pass in Class XII	DSC 04 Object Oriented Programming with C++/ GE 1a Programming using C++ / GE1b Programming with Python/ DSC 01 Programming using Python/ GE 3b: Java Programming

Learning Objectives
The course objectives of this paper are to:

- Understand the concepts behind computer networks and data communication.
- Learn the different types of networks, network topologies and their characteristics.
- Learn the working of protocols used at various layers.
- Understand the utility of different networking devices.

Learning outcomes

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

- differentiate between various types of computer networks and their topologies.
- understand the difference between the OSI and TCP/IP protocol suit.
- distinguish between different types of network devices and their functions.
- design/implement data link and network layer protocols in a simulated networking environment.

SYLLABUS OF DSC06

Unit 1 (8 hours)
Introduction: Types of computer networks, Internet, Intranet, network topologies (bus, star, ring, mesh, tree, hybrid topologies), network classifications. layered architecture approach,

OSI Reference Model, TCP/IP Reference Model. Transmission Modes: simplex, half duplex and full duplex.

Unit 2 (9 hours)
Physical Layer: Analog signal, digital signal, the maximum data rate of a channel, transmission media (guided transmission media, wireless transmission, satellite communication), multiplexing (frequency division multiplexing, time-division multiplexing, wavelength division multiplexing). Guided Media (Wired) (Twisted pair, Coaxial Cable, Fiber Optics. Unguided Media (Radio Waves, Infrared, Micro-wave, Satellite).

Unit 3 (10 hours)
Data Link and MAC Layer: Data link layer services, error detection and correction techniques, error recovery protocols (stop and wait, go back n, selective repeat), multiple access protocols with collision detection, MAC addressing, Ethernet, data link layer switching, point-to-point protocol.

Unit 4 (8 hours)
Network layer: Networks and Internetworks, virtual circuits and datagrams, addressing, subnetting, Dijkstra Routing algorithm, Distance vector routing, Network Layer protocol-(ARP, IPV4, ICMP).

Unit 5 (10 hours)
Transport and Application Layer: Process to process Delivery- (client-server paradigm, connectionless versus connection-oriented service); User Datagram Protocols, TCP/IP protocol, Flow Control. FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), Telnet (Remote login protocol), WWW (World Wide Web), HTTP (HyperText Transfer Protocol), URL (Uniform Resource Locator).

Essential/recommended readings

3. Tanenbaum, A.S. & Wethrall, D.J.. *Computer Networks*, 5th edition, Pearson Education, 2012.

4. Forouzan, B. A.. *Data Communication and Networking*, 4th edition, McGraw-Hill Education, 2017.

Additional References

3. Comer, D. E.. *Computer Networks and Internet,* 6th edition*,* Pearson education, 2015.

4. Stallings, W., *Data and Computer Communications,* 10th edition, Pearson education India, 2017.

Suggested Practical List :

Practical exercises such as

Introduce students to any network simulator tool and do the following:

1. To Study basic network command and Network configuration commands.
2. To study and perform PC to PC communication.

3. To create Star topology using Hub and Switch.
4. To create Bus, Ring, Tree, Hybrid, Mesh topologies.
5. Perform an initial Switch configuration.
6. Perform an initial Router configuration.
7. To implement Client Server Network.
8. To implement connection between devices using router.
9. To perform remote desktop sharing within LAN connection.

DISCIPLINE COURSE (A6): Deep Learning

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
A6: Deep Learning	**4**	**3**	**0**	**1**	Pass in Class XII	A5 Machine Learning

Learning Objectives

The objective of this course is to introduce students to deep learning algorithms and their applications in order to solve real problems.

Learning outcomes

On successful completion of this course, the student will be able to:

- Describe the feed-forward and deep networks.
- Design single and multi-layer feed-forward deep networks and tune various hyper-parameters.
- Implement deep neural networks to solve a problem
- Analyze performance of deep networks.
- Use pre-trained models to solve a problem.

SYLLABUS OF A6

Unit 1 (15 hours)
Introduction to neural networks: Artificial neurons, perceptron, computational models of neurons, Structure of neural networks, Multilayer feedforward neural networks (MLFFNN), Backpropagation learning, Empirical risk minimization, bias-variance trade-off, Regularization, output units: linear, softmax, hidden units:tanh, RELU

Unit 2 (15 hours)
Deep neural networks: Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNN's, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Regularization methods (dropout, drop connect, batch normalization).

Unit 3 (15 hours)
Convolution neural networks (CNNs): Introduction to CNN - convolution, pooling, Deep CNNs - LeNet, AlexNet. Training CNNs, weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs, Using a pre-trained convnet

References

1. Heaton, J., Deep Learning and Neural Networks, 1st edition, Heaton Research Inc., 2015.
2. Francois Chollet, *Deep Learning with python*, *2nd edition*, Meaning Publications Co, 2021.

Additional References

(i) Ian Goodfellow, Yodhua Bengio and Aaron Courville, *Deep Learning,* MIT Press Book, 2016.
(ii) Bunduma, N., *Fundamentals of Deep Learning*, 1st edition, O'reilly Books, 2017.

Suggested Practical List

The following practicals are to be conducted using Python.

1. Implement a feed-forward neural networks for classifying movie reviews as positive or negative (using IMDB dataset)
2. Implement a deep-neural feed-forward network for estimating the price of house, given real-estate data (Boston Housing Price)
3. Implement a deep-neural network for classifying news wires by topic (Reuters dataset).
4. Implement CNN for classifying MNIST dataset.

Computer Science Courses for Undergraduate Programme of study with Computer Science discipline as one of the two Core Disciplines: non-Major
(For e.g. courses for B.A. Programmes with Computer Science as Non-major discipline)

DISCIPLINE SPECIFIC CORE COURSE (DSC06): Computer Networks

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSC06 Computer Networks	**4**	**3**	**0**	**1**	Pass in Class XII	DSC 04 Object Oriented Programming with C++/ GE 1a Programming using C++ / GE1b Programming with Python/ DSC 01 Programming using Python/ GE 3b: Java Programming

Learning Objectives

The course objectives of this paper are to:

- Understand the concepts behind computer networks and data communication.
- Learn the different types of networks, network topologies and their characteristics.
- Learn the working of protocols used at various layers.
- Understand the utility of different networking devices.

Learning outcomes

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

- differentiate between various types of computer networks and their topologies.
- understand the difference between the OSI and TCP/IP protocol suit.
- distinguish between different types of network devices and their functions.
- design/implement data link and network layer protocols in a simulated networking environment.

SYLLABUS OF DSC06

Unit 1

Review of: Types of computer networks, Internet, Intranet, network topologies (bus, star, ring, mesh, tree, hybrid topologies), network classifications. layered architecture approach,

OSI Reference Model, TCP/IP Reference Model. Transmission Modes: simplex, half duplex and full duplex.

Unit 2

Physical Layer: Analog signal, digital signal, the maximum data rate of a channel, transmission media (guided transmission media, wireless transmission, satellite communication), multiplexing (frequency division multiplexing, time-division multiplexing, wavelength division multiplexing). Guided Media (Wired) (Twisted pair, Coaxial Cable, Fiber Optics. Unguided Media (Radio Waves, Infrared, Micro-wave, Satellite).

Unit 3

Data Link and MAC Layer: Data link layer services, error detection and correction techniques, error recovery protocols (stop and wait, go back n, selective repeat), multiple access protocols with collision detection, MAC addressing, Ethernet, data link layer switching, point-to-point protocol.

Unit 4

Network layer: Networks and Internetworks, virtual circuits and datagrams, addressing, subnetting, Dijkstra Routing algorithm, Distance vector routing, Network Layer protocol-(ARP, IPV4, ICMP).

Unit 5

Transport and Application Layer: Process to process Delivery- (client-server paradigm, connectionless versus connection-oriented service); User Datagram Protocols, TCP/IP protocol, Flow Control. FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), Telnet (Remote login protocol), WWW (World Wide Web), HTTP (HyperText Transfer Protocol), URL (Uniform Resource Locator).

Essential/recommended readings

1. Tanenbaum, A.S. & Wethrall, D.J. *Computer Networks*, 5th edition. Pearson Education, 2012

2. Forouzan, B. A. *Data Communication and Networking*, 4th edition. McGraw-Hill Education, 2017

Additional References

1. Comer, D. E. *Computer Networks and Internet,* 6th edition. Pearson Education, 2015.

2. Stallings, W. *Data and Computer Communications,* 10th edition. Pearson education India, 2017.

Suggested Practical List :

1. Simulate Cyclic Redundancy Check (CRC) error detection algorithm for noisy channel.
2. Simulate and implement stop and wait protocol for noisy channel.
3. Simulate and implement go back n sliding window protocol.
4. Simulate and implement selective repeat sliding window protocol.
5. Simulate and implement distance vector routing algorithm.
6. Simulate and implement the Dijkstra algorithm for shortest-path routing.