Vidyasagar University

Curriculum for B.Sc. (Honours) in Computer Science [Choice Based Credit System]

Semester-VI

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC- 13		**C13T:** Artificial Intelligence	Core Course-13	4	0	0	6	75
		- **Lab**		0	0	4		
CC- 14		**C14T**: Computer Graphics	Core Course-14	4	0	0	6	75
		- **Lab**		0	0	4		
DSE-3		**DSE-3**: TBD	Discipline Specific Electives -3	4	0	0	6	75
		- **Lab**		0	0	4		
DSE-4		**DSE-4:** TBD	Discipline Specific Electives -4				6	75
		- **Lab**						
Semester Total							**24**	**300**

L= Lecture, **T=** Tutorial, **P =** Practical, **CC -** Core Course, **TBD -** To be decided, **DSE:** Discipline Specific Elective.

Semester-VI

List of Core Course (CC)

CC-13: Artificial Intelligence

CC-14: Computer Graphics

Discipline Specific Electives (DSE)

DSE-3: Digital Image Processing
Or
DSE-3: Introduction to Data Science
Or
DSE-3: Numerical Methods

DSE-4: Systems Programming
Or
DSE- 4: Data Mining
Or
DSE-4: Dissertation / Project work

SEMESTER –VI

Core Courses (CC)

CC-13: Artificial Intelligence — Credits 06

C13T : Artificial Intelligence — Credits 04

Course Contents:

Unit-1. Introduction

Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Intelligent Agents, their structure, behavior and environment.

Unit-2. 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. Knowledge Representation

Introduction to First Order Predicate Logic, Resolution Principle, Unification, Semantic Nets, Conceptual Dependencies, Frames, and Scripts, Production Rules, Conceptual Graphs. Programming in Logic (PROLOG)

Unit-4. Dealing with Uncertainty and Inconsistencies

Truth Maintenance System, Default Reasoning, Probabilistic Reasoning, Bayesian Probabilistic Inference, Possible World Representations.

Unit-5. Understanding Natural Languages

Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.

Suggested Readings:

1. DAN.W. Patterson, Introduction to A.I and Expert Systems – PHI, 2007.

2. Russell &Norvig, Artificial Intelligence-A Modern Approach**,** LPE, Pearson Prentice Hall, 2nd edition, 2005.

3. Rich & Knight, Artificial Intelligence – Tata McGraw Hill, 2nd edition, 1991.

4. W.F. Clocksin and Mellish, Programming in PROLOG, Narosa Publishing House, 3rd edition, 2001.

5. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley, Pearson Education, 3rd edition, 2000.

C13P: Artificial Intelligence Lab Credits 02

List of Practical:

1. Write a prolog program to calculate the sum of two numbers.
2. Write a prolog program to find the maximum of two numbers.
3. Write a prolog program to calculate the factorial of a given number.
4. Write a prolog program to calculate the nth Fibonacci number.
5. Write a prolog program, insert_nth(item, n, into_list, result) that asserts that result is the list into_list with item inserted as the n‘th element into every list at all levels.
6. Write a Prolog program to remove the Nth item from a list.
7. Write a Prolog program, remove-nth(Before, After) that asserts the After list is the Before list with the removal of every n‘th item from every list at all levels.
8. Write a Prolog program to implement append for two lists.
9. Write a Prolog program to implement palindrome(List).
10. Write a Prolog program to implement max(X,Y,Max) so that Max is the greater of two numbers X and Y.
11. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List.
12. Write a Prolog program to implement sumlist(List,Sum) so that Sum is the sum of a given list of numbers List.
13. Write a Prolog program to implement two predicates evenlength(List) and oddlength(List) so that they are true if their argument is a list of even or odd length respectively.
14. Write a Prolog program to implement reverse(List,ReversedList) that reverses lists.
15. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List using cut predicate.

16. Write a Prolog program to implement GCD of two numbers.

17. Write a prolog program that implements Semantic Networks/Frame Structures

CC-14: Computer Graphics Credits 06

C14T: Computer Graphics Credits 04

Course Contents:

Unit-1. Introduction

Basic elements of Computer graphics, Applications of Computer Graphics.

Unit-2. Graphics Hardware

Architecture of Raster and Random scan display devices, input/output devices.

Unit-3. Fundamental Techniques in Graphics

Raster scan line, circle and ellipse drawing, thick primitives, Polygon filling, line and polygon clipping algorithms, 2D and 3D Geometric Transformations, 2D and 3D Viewing Transformations (Projections- Parallel and Perspective), Vanishing points.

Unit-4.Geometric Modeling

Representing curves & Surfaces.

Unit-5.Visible Surface determination

Hidden surface elimination.

Unit-6.Surface rendering

Illumination and shading models. Basic color models and Computer Animation.

Suggested Readings:

1. J.D.Foley, A.Van Dan, Feiner, Hughes Computer Graphics Principles & Practice 2nd edition Publication Addison Wesley 1990.

2. D.Hearn, Baker: Computer Graphics, Prentice Hall of India 2008.

3. D.F.Rogers Procedural Elements for Computer Graphics, McGraw Hill 1997.

4. D.F.Rogers, Adams Mathematical Elements for Computer Graphics, McGraw Hill 2nd edition 1989.

C14P: Computer Graphics Lab — Credits 02

List of Practical:

1. Write a program to implement Bresenham‘s line drawing algorithm.
2. Write a program to implement mid-point 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 apply various 2D transformations on a 2D object (use homogenous coordinates).
6. Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.
7. Write a program to draw Hermite/Bezier curve.

Discipline Specific Electives (DSE)

DSE-3: Digital Image Processing — Credits 06

DSE3T: Digital Image Processing — Credits 04

Course Contents:

1. Introduction

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.

2. Spatial Domain Filtering

Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.

3. Filtering in the Frequency domain

Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering.

4. Image Restoration

Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

5. Image Compression

Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

6. Wavelet based Image Compression

Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

7. Morphological Image Processing

Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

8. Image Segmentation:

Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

Suggested Readings:

1. R C Gonzalez , R E Woods, Digital Image Processing, 3rd Edition, Pearson Education.2008.
2. A K Jain, Fundamentals of Digital image Processing, Prentice Hall of India.1989.
3. K R Castleman, Digital Image Processing, Pearson Education.1996
4. Schalkoff, Digital Image Processing and Computer Vision, John Wiley and Sons.1989.
5. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.

DSE3P: Digital Image Processing Lab Credits 02

List of Practical:

1. Write program to read and display digital image using MATLAB or SCILAB
   a. Become familiar with SCILAB/MATLAB Basic commands
   b. Read and display image in SCILAB/MATLAB
   c. Resize given image
   d. Convert given color image into gray-scale image
   e. Convert given color/gray-scale image into black & white image
   f. Draw image profile
   g. Separate color image in three R G & B planes
   h. Create color image using R, G and B three separate planes
   i. Flow control and LOOP in SCILAB
   j. Write given 2-D data in image file

2. To write and execute image processing programs using point processing method
   a. Obtain Negative image
   b. Obtain Flip image
   c. Thresholding

d. Contrast stretching

3. To write and execute programs for image arithmetic operations

a. Addition of two images

b. Subtract one image from other image

c. Calculate mean value of image

d. Different Brightness by changing mean value

4. To write and execute programs for image logical operations

a. AND operation between two images

b. OR operation between two images

c. Calculate intersection of two images

d. Water Marking using EX-OR operation

e. NOT operation (Negative image)

5. To write a program for histogram calculation and equalization using

a. Standard MATLAB function

b. Program without using standard MATLAB functions

c. C Program

6. To write and execute program for geometric transformation of image

a. Translation

b. Scaling

c. Rotation

d. Shrinking

e. Zooming

7. To understand various image noise models and to write programs for

a. Image restoration

b. Remove Salt and Pepper Noise

c. Minimize Gaussian noise

d. Median filter and Weiner filter

8. Write and execute programs to remove noise using spatial filters

a. Understand 1-D and 2-D convolution process

b. Use 3x3 Mask for low pass filter and high pass filter

9. Write and execute programs for image frequency domain filtering

a. Apply FFT on given image

b. Perform low pass and high pass filtering in frequency domain

c. Apply IFFT to reconstruct image

10. Write a program in C and MATLAB/SCILAB for edge detection using different edge detection mask

11.Write and execute program for image morphological operations erosion and dilation.

12. To write and execute program for wavelet transform on given image and perform inverse wavelet transform to reconstruct image.

Or

DSE-3: Introduction to Data Science — Credits 06

DSE3T: Introduction to Data Science — Credits 04

Course Contents:

1. Data Scientist's Tool Box: Turning data into actionable knowledge, introduction to the tools that will be used in building data analysis software: version control, markdown, git, GitHub, R, and RStudio.

2. R Programming Basics: Overview of R, R data types and objects, reading and writing data, Control structures, functions, scoping rules, dates and times, Loop functions, debugging tools, Simulation, code profiling

3. Getting and Cleaning Data: Obtaining data from the web, from APIs, from databases and from colleagues in various formats. basics of data cleaning and making data ―tidy‖.

4. Exploratory Data Analysis: Essential exploratory techniques for summarizing data, applied before formal modeling commences, eliminating or sharpening potential hypotheses about the world that can be addressed by the data, common multivariate statistical techniques used to visualize high-dimensional data.

5. Reproducible Research: Concepts and tools behind reporting modern data analyses in a reproducible manner, To write a document using R markdown, integrate live R code into a literate statistical program, compile R markdown documents using knitr and related tools, and organize a data analysis so that it is reproducible and accessible to others.

Suggested Readings:

1. Rachel Schutt, Cathy O'Neil, "Doing Data Science: Straight Talk from the Frontiline" by Schroff/O'Reilly, 2013.

2. Foster Provost, Tom Fawcett, "Data Science for Business" What You Need to Know About Data Mining and Data-Analytic Thinking" by O'Reilly, 2013.

3. John W. Foreman, "Data Smart: Using data Science to Transform Information into Insight" by John Wiley & Sons, 2013.

4. Ian Ayres, "Super Crunchers: Why Thinking-by-Numbers Is the New Way to Be Smart" Ist Edition by Bantam, 2007.

5. Eric Seigel, "Predictive Analytics: The Power to Predict who Will Click, Buy, Lie, or Die", 1st Edition, by Wiley, 2013.

6. Matthew A. Russel, "Mining the Social Web: Data mining Facebook, Twitter, Linkedln, Goole+, GitHub, and More", Second Edition, by O'Reilly Media, 2013.

DSE3P: Introduction to Data Science Lab Credits 02

List of Practical:

1. Write a program that prints _Hello World‘to the screen.

2. Write a program that asks the user for a number n and prints the sum of the numbers 1to n

3. Write a program that prints a multiplication table for numbers up to 12.

4. Write a function that returns the largest element in a list.

5. Write a function that computes the running total of a list.

6. Write a function that tests whether a string is a palindrome.

7. Implement linear search.

8. Implement binary search.

9. Implement matrices addition, subtraction and Multiplication

10. Fifteen students were enrolled in a course. There ages were:
20 20 20 20 20 21 21 21 22 22 22 22 23 23 23

    i. Find the median age of all students under 22 years
    ii Find the median age of all students
    iii Find the mean age of all students
    iv. Find the modal age for all students
    v. Two more students enter the class. The age of both students is 23. t is now mean, Whamode and median ?

11. Following table gives a frequency distribution of systolic blood pressure. Compute all the measures of dispersion.

Midpoint	95.5	105.5	115.5	125.5	135.5	145.5	155.5	165.5	175.5
Number	5	8	22	27	17	9	5	5	2

12. Obtain probability distribution of , where X is number of spots showing when a six- sided symmetric die (i.e. all six faces of the die are equally likely) is rolled. Simulate random samples symmetric die (i.e. all six faces of the die are equally likely) is rolled. Simulate random samples of sizes 40, 70 and 100 respectively and verify the frequency interpretation of probability.

13. Make visual representations of data using the base, lattice, and ggplot2 plotting systems in Rapply basic principles of data graphics to create rich analytic graphics from available datasets

14. Use Git / Github software to create Github account. Also, create a repo using Github.

Or

DSE-3: Numerical Methods — Credits 06

DSE3T: Numerical Methods — Credits 04

Course Contents:

Floating point representation and computer arithmetic, Significant digits, Errors: Round-off error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, efficient computations

Bisection method, Secant method, Regula-Falsi method Newton- Raphson method, Newton‘s method for solving nonlinear systems Gauss elimination method (with row pivoting) and Gauss- Jordan method, Gauss Thomas method for tridiagonal systems Iterative methods: Jacobi and Gauss-Seidel Interative methods Interpolation: Lagrange‘s form and Newton‘s form Finite difference operators, Gregory Newton forward and backward differences Interpolation

Piecewise polynomial interpolation: Linear interpolation, Cubic spline interpolation (only method),

Numerical differentiation: First derivatives and second order derivatives, Richardson extrapolation

Numerical integration: Trapezoid rule, Simpson‘s rule (only method), Newton–Cotes open formulas

Extrapolation methods: Romberg integration, Gaussian quadrature, Ordinary differential equation: Euler‘s method

Modified Euler‘s methods: Heun method and Mid-point method, Runge-Kutta second methods: Heun method without iteration, Mid-point method and Ralston‘s method Classical 4th order Runge-Kutta method, Finite difference method for linear ODE.

Suggested Readings:

1. Laurence V. Fausett, Applied Numerical Analysis, Using MATLAB, Pearson, 2/e (2012)

2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publisher, 6/e (2012)
3. Steven C Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, Tata McGraw Hill, 2/e (2010)

DSE3P: Numerical Methods Lab — Credits 02

List of Practical:

1. Find the roots of the equation by bisection method.
2. Find the roots of the equation by secant/ Regula -Falsi method.
3. Find the roots of the equation by Newton‘s method.
4. Find the solution of a system of nonlinear equation using Newton‘s method.
5. Find the solution of tridiagonal system using Gauss Thomas method.
6. Find the solution of system of equations using Jacobi/Gauss-Seidel method.
7. Find the cubic spline interpolating function.
8. Evaluate the approximate value of finite integrals using Gaussian/Romberg integration.
9. Solve the boundary value problem using finite difference method.

Note: Programming is to be done in any one of Computer Algebra Systems: MATLAB / MATHEMATICA / MAPLE.

DSE-4: Systems Programming — Credits 06

DSE4T: Systems Programming — Credits 04

Course Contents:

1. Introduction:

Overview of compilation, Phases of a compile.

2. Assemblers & Loaders, Linkers:

One pass and two pass assembler, design of an assembler, Absolute loader, relocation and linking concepts, relocating loader and Dynamic Linking.

3. Lexical Analysis:

Role of a Lexical analyzer, Specification and recognition of tokens, Symbol table, lex.

4. Parsing:

Bottom up parsing- LR parser, yacc.

5. Intermediate representations

Three address code generation, syntax directed translation, translation of types, control statements.

6. Storage organization:

Activation records stack allocation.

7. Code Generation:

Object code generation

Suggested Readings:

1. Santanu Chattopadhyaya, *Systems Programming*, PHI, 2011.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, *Compilers: Principles, Techniques, and Tools*, 2nd edition, Prentice Hall, 2006.
3. D. M. Dhamdhere, *Systems Programming*, Tata McGraw Hill, 2011.
4. Leland Beck, D. Manjula, *System Software: An Introduction to System Programming*, 3rd edition, Pearson Education, 2008.
5. Grune D, Van Reeuwijk . K, Bal H. E, Jacobs C J H, Langendoen K, *Modern Compiler Design*, 2nd edition, Springer, 2012

DSE4P: Systems Programming Lab — Credits 02

List of Practical:

1. To implement an assembler for a hypothetical language.

2. To get familiar with lex: write a program to recognize numbers, identifiers.

3. To get familiar with yacc: write a desk calculator.

Or

DSE- 4: Data Mining — Credits 06

DSE4T: Data Mining — **Credits 04**

Course Contents:

Overview: Predictive and descriptive data mining techniques, supervised and unsupervised learning techniques, process of knowledge discovery in databases, pre-processing methods.

Data Mining Techniques: Association Rule Mining, classification and regression techniques, clustering, Scalability and data management issues in data mining algorithms, measures of interestingness

Suggested Readings:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education.2005.
2. Richard Roiger, Michael Geatz, Data Mining: A Tutorial Based Primer, Pearson Education 2003.
3. G.K. Gupta, Introduction to Data Mining with Case Studies, PHI,2006.
4. Soman K P, Diwakar Shyam, Ajay V Insight Into Data Mining: Theory And Practice, , PHI, 2006

DSE4P: Data Mining Lab Credits 02

Practical:

Practical exercises based on concepts listed in theory.

Or

DSE-4: Dissertation / Project work Credits 06 (0+6)

The students will be allowed to work on any project based on the concepts studied in core / elective or skill based elective courses.