Semester VIII

DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE):

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 (if any)
		Lecture	Tutorial	Practical/ Practice		
Computer Art and Design Techniques (DSE)	4	1	0	3	Class XII pass	Programming languages

Learning Objectives

This course provides an introduction to the principles of computer graphics. In particular, the course will consider methods for modeling 3-dimensional objects and efficiently generating photorealistic renderings on color raster graphics devices. The emphasis of the course will be placed on understanding how the various elements that underlie computer graphics (algebra, geometry, algorithms and data structures, optics, and photometry) interact in the design of graphics software systems.

Learning outcomes

After completing this course, student should be able to;

- Understand all Display devices and their background
- Understand and implement the Transformation algorithms
- Understand basics of Ray Tracing and shading.
- Understand the process of Camera and image formation and implementationUnderstand the concept of 2D and 3D transformation modeling
- have the basics of the Animations and Motion Pictures
- Have basic understanding of video databases and understanding indexing and retrieval of video.

SYLLABUS

Theory

Unit I: Basic Introduction, Overview of Graphics systems - Refreshing display devices, Random and raster scan display devices, Colour Models: RGB, HSV, etc., coordinates systems, Devices, plotters, Drawing techniques, projections, 2D & 3D Transformations, clipping, viewing curves and shading basics. (15 hours)

Practice /LAB

Unit II: Implementation of DDA Line drawing algorithm, Bresenham's Line Drawing Algorithm, Midpoint circle algorithm, Mid-point Ellipse algorithms. Performing basic Transformation, Matrix representations, Composite Transformations, reflection and shear transformations. (30 hours)

Unit III: Implementing Barky line clipping algorithm, Algorithm for polygon clipping, Sutherland-Hodgeman polygon clipping, Curves - Bezier Curves, 4 point and 5 point Bezier curves using Bernstein Polynomials (30 hours)

Unit IV: Perform Shading and Hidden Surface Removal - Shading, Guard Shading, Phong Model, Back Face Detection, Depth Buffer (Z-Buffer, A-Buffer) Method (30 hours)

Essential/recommended readings

1. Watt, Alan, 3D Computer Graphics. Addison-Wesley, 1999.
2. Shirley, Peter, Michael Ashikhmin, Steve Marschner, Fundamentals of Computer Graphics. 3rd ed. A K Peters/CRC Press, 2009.
3. The Illusion of Life – Disney Animations, Frank Thomas, Ollie Johnston, Walt Disney, 1981
4. Computer Graphics, C Version, 2nd Edition, Hearn & Baker, Pearson Education, 1997
5. Computer Graphics: Principles and Practice in C, 2nd Edition, J. Foley, Addison Wesley, 1995

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Machine Learning for Business Intelligence (DSE)	**4**	**1**	**0**	**3**	**Class XII pass**	**Programming languages, AI/ML Basic Concepts, and Linear Algebra**

Learning Objectives

Data analytics and business intelligence (BI) are very important in today's world. Data analysis is required to understand organisational problems and to explore data. At the same time, business intelligence helps companies make better decisions by showing current and historical data within their business context. Course aims to leverage Data Analysis and Business Intelligence skills to help understand trends and derive actionable insights from data, thus allowing us to make data-driven, strategic and tactical business decisions.

Keywords: Data Analytics, Machine Learning, Management, Social Media, Business Intelligence

Learning Outcomes

- Develops business analytics foundation through machine learning for data analysis.
- Students will be able to enhance their skills in data analysis, Python programming for machine learning and Python/ R programming for statistical methods.
- They will also be able to find answers to the questions they don't know the answers to.
- It will help them to adapt to the automated future of business intelligence.

SYLLABUS

Theory and Practice

Unit I: Fundamentals of Data and Analytics, Overview of data types, sources, and collection methods for business applications, Basics of data analytics, Role of data in driving business intelligence and decision-making. (12 hours)

Unit II: Machine Learning for Business Intelligence: Introduction to machine learning concepts and algorithms for business, Building predictive and classification models for business decision support, Applications of machine learning in forecasting, optimisation, and customer insights. (15 hours)

Unit III: Data Analytics for Business Functions: Applications in product strategy, sales, marketing, consumer behaviour analysis, Financial decision-making using advanced data analytics techniques, (12 hours)

Unit IV: Advanced Applications of Business Analytics: Data analytics for

digital and social media strategy, including content optimisation, Innovation and entrepreneurship supported by analytics-driven insights, Operational analytics for supply chain management, logistics, and resource allocation. (12 hours)

Practical Component **(60 hours)**

1. Collect data from open business datasets (e.g., Kaggle, UCI) and perform data cleaning and preprocessing using Python (Pandas).
2. Perform basic descriptive statistics and data visualisation to understand business trends.
3. Use regression algorithms to predict future sales based on historical data.
   Apply classification models (e.g., Decision Trees, Logistic Regression) to segment customers.
4. Forecast product demand using time series data and ARIMA/exponential smoothing.
5. Use association rule mining (Apriori algorithm) for cross-selling and product bundling.
6. Perform customer segmentation using K-means clustering for targeted marketing.
7. Analyze financial statements and build a model to predict credit risk.
8. Analyze Twitter or YouTube comments to assess public sentiment towards a brand or product.
9. Supply Chain Optimisation Using Analytics through real-world problems.

Essential/recommended readings

1. Sherman, R. (2014). Business intelligence guidebook: From data integration to analytics. Newnes.
2. Negash, S., & Gray, P. (2008). Business intelligence. *Handbook on decision support systems 2*, 175-193.
3. Moss, L. T., & Atre, S. (2003). Business intelligence roadmap: the complete project lifecycle for decision-support applications. Addison-Wesley Professional.
4. Chaudhuri, S., Dayal, U., & Narasayya, V. (2011). An overview of business intelligence technology. *Communications of the ACM*, *54*(8), 88-98.
5. Minelli, M., Chambers, M., & Dhiraj, A. (2013). *Big data, big analytics: emerging business intelligence and analytic trends for today's businesses* (Vol. 578). John Wiley & Sons.

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		Lecture	Tutorial	Practical / Practice		
Crafting Digital Experiences: A Practical Approach to Web Design and Programming **(DSE)**	**4**	**0**	**0**	**4**	**Class XII pass**	**Database Management System, Data Communication and Networking**

Learning Objectives

The objective is to introduce with the fundamentals of how the Internet and the Web function, a basic understanding of graphic production with specific stress on creating graphics for the Web, and a general grounding introduction to more advanced topics such as programming and scripting. This will also expose students to the basic tools and applications used in Web publishing.

Learning outcomes

After completing this course, student should be able to;

- Acquire knowledge of web protocols and develop understanding of concepts of Internet security.
- Able to implement studied technologies in systematically developing a website with due regard to ethical and environmental issues.
- Understand the significance of emerging web technologies for the advancement of society.

Syllabus

Practice/Labs - (120 hours)

The course will be conducted completely in a hands-on mode and project-based learning. The following tasks will be covered in the lab:

• Exercise based on developing websites and portals using HTML.

• Exercise based on developing websites and portals using CSS.

• Exercise based on developing websites and portals using JavaScript.

• Projects based on PHP and MySQL to be implemented.

• Domains: Healthcare, Criminal, resource management projects, etc.

Essential/recommended readings

1. Data Communication and Networking, Forouzan, B.A., Tata McGraw-Hill. 2013
2. Internet and World Wide Web: How to Program, 5th Edition, Deitel and Deitel, Pearson Education. 2008
3. List of Web links prescribed by instructor

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Partial Differential Equations (DSE)	**4**	**3**	**1**	**0**	**Class XII pass**	**Ordinary differential equations**

Learning Objectives

This course helps to develop Partial differential equation models, in the context of modeling heat and mass transport and, in particular, wave phenomena, such as sound and water waves. This course develops students' skills in the formulation; find a solution, understanding and interpretation of PDE models. As well as developing analytic solutions, this course establishes general structures and characterizations of PDEs. The course will also expose the students to various applications of the partial differential equations.

Learning outcomes

- Understand how partial differential equations (PDEs) represent real-world problems.
- Able to use computational tools to solve problems and applications of PDEs.
- Understand the importance of Laplace's equation, heat equation, wave equation,

conduction of heat, gravitational potential, telegraph equation, dispersion of contaminants, Fourier series, Fourier transforms, etc. in the theory of PDEs.

SYLLABUS

Theory

Unit I: Familiarities with different type of first order linear and non-linear PDEs - Examples of PDEs arising in transport equation, conservation laws, spread of epidemic cholera - Cauchy problem for first order PDE (12 hours)

Unit II: Method of characteristics, Classical methods for simple PDE models (12 hours)

Unit III: Second order PDE arising in wave equations, conduction of heat, gravitational potential, telegraph equation, dispersion of contaminants - classification of second order PDE and their solution (12 hours)

Unit IV: Fourier Series and Fourier transforms - Boundary Value Problem: Dirichlet and Neumann Problems (12 hours)

Essential/recommended readings

1. *Partial Differential Equations*, E.DiBenedetto, Birkhauser, Boston,1995.
2. *Partial Differential Equations*,Fritz John,NarosaPubl.Co.,NewDelhi,1979.
3. *Linear Partial Differential Equation for Scientists and Engineers*, TynMyint-U and Lokenath Debnath, Springer, Indian reprint, 2006.
4. *Partial Differential Equations: An Introduction with Mathematica and MAPLE*, Ioannis P Stavroulakis and Stepan A Tersian, World Scientific, 2004

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Brain and Cognition: Computational Neurosciences (DSE)	4	1	0	3	12th Pass	Understanding in Python, Networks

Learning Objectives

This module is designed to:

- Introduce students to the field of neuroscience
- Introduce students to the components of Learning, Memory and Neuroplasticity
- Differentiate between Neural Network and Artificial Neural Network
- Understand Neurological Disorders, Neural Coding and Neuroimaging

Learning outcomes

- After studying this course, the students will be able to:
  - Comprehend Neural Network of the Brain and Artificial Neural Network
  - Understand the different aspects of Neurosciences and its applications
  - Develop knowledge about Neuroplasticity, Learning, Memory
  - Understand Different Neurological Disorders,

Phobia SYLLABUS

Theory:

Unit I: Introduction to Neuroscience (15 hours)

Introduction to Neurobiology; Brain, Synapse and Neurons; Gut-Brain Connection; Recent developments in Neurosciences

Practice/Labs/Projects:

Unit II: Networks (Neural, Artificial Networks) (30 hours)

Networks and Patterns; Feedback and Feed Forward Loops; Artificial neural Network; Perceptrons, Multilayer Feed Forward Neural Networks; Neuro Dynamics

Unit III: Learning, Memory, Neuroplasticity (30 hours)

Learning and Memory; Short term and Long term memory; Associative and Dissociative Learning; Memory based Learning, Neural plasticity; Cognitive and Neural modeling

Unit IV: Sleep, Neurological Disorders, Neural Imaging (30 hours)

Different stages of sleep, Sleep Disorders, Coma; Phobia; Common NeurologicalDisorders; NeuroImaging, Functional Magnetic Resonance Imaging (fMRI), Computed Tomography (CT), Positron Emission Tomography (PET)

Essential/recommended readings

1. ***Neuroscience: Exploring The Brain, Enhanced Edition*, Bear M et al., Jones and Bartlett Publishers, 2020.**
2. ***Fundamentals of Computational Neuroscience*, Thomas Trappenberg, Oxford University Press, 2010.**

3. *Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems*, Peter Dayan and Larry Abbott, MIT Press, 2005.

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Systems Biology (DSE)	**4**	**1**	**0**	**3**	**12th Pass**	**Network Biology, Python**

Learning Objectives

This module is designed to:

- Develop an understanding of the biological equations and events as a whole and combines different streams of biosciences to get a bigger picture
- Explore cutting-edge technologies of biosciences to novel findings that travel to hitherto unexplored fields

Learning outcomes

After studying this course, the students will be able to:

- Comprehend biological networks and organization of biological systems
- Develop an understanding of designing simple organisms
- Perform biological data analysis, protein-protein interaction networks etc.

SYLLABUS

Unit I: Introduction to Systems Biology (9 hours)

Biological complexity, Biological circuits, Bio-physical properties of macromolecules, Biomolecular interaction analysis, Developmental biology, Data integration and hypothesis generation, Reversible reactions and feedback loops

Unit II: Network and Modelling (9 hours)

Transient networks, Behavioral networks, Cognitive and neural modelling, Memory and Learning, Neural models (vision, memory function, rhythm), Synapse and networks, Neural plasticity and computational learning, Artificial intelligence, Neural imaging

Practical components/Projects (90 hours)

Interaction studies

Biological complexity, biological circuits - Biophysical properties of macromolecules - Biomolecular interaction analysis

1. Building Gene Regulation/Interaction networks models.
2. Intercellular signalling network analysis using relevant software's and data bases.
3. Creating biological databases and software.
4. Small projects integrating different biological parameters.

Essential/recommended readings

1. *An Introduction to Systems Biology: Design Principles of Biological Circuits*, Uri Alon, Chapman & Hall
2. *Fundamentals of Computational Neuroscience*, Thomas Trappenberg, Oxford University edition, 2010.
3. *Handbook of Systems Biology: Concepts and Insights*, Marian Walhout, Marc Vidal, Job Dekker (Edited), Academic Press; 1 edition, 2012.