Semester V

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V.5.1 Health Data Analysis

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		
Health Data Analysis# DSE-3, V.5.1	**4**	**0**	**0**	**4**	**12th Pass**	**NIL**

 # This course will also be available to the students in semester III

Learning Objectives

This is a practical based module is designed to:

- Introduce students to the complexity of data related to health and diseases.
- Introduce to the students the method of collection of data, their visualization and analysis

Learning outcomes

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

- Comprehend and handle complex data related to health and diseases, which are usually large.
- Do survey-based research for data collection, their visualization by different methods and their analysis including the statistical analysis

Syllabus

Practicals - (120 Hours)

- Art and Science of preparation of questionnaire for collection of health data: types and ethical consideration
- Types of data: Likert scale data and quantitative data related to health and diseases their collection methods
- Understanding how data is organized to facilitate analysis in the healthcare setting.
- Data visualization through histograms and tables
- Data visualization through heat maps

- Integration, understanding and selection of appropriate data visualization techniques to effectively communicate results
- Identifying ways in which data quality can be compromised and applying remedies
- Evaluation of data from varying sources to create meaningful presentations.
- A survey-based research on epidemiology and public health by collecting real data from the field area. It will include study designing, data collection, visualization and analyses of the data
- The results will be used for the preparation of a project report/manuscript.

Essential/recommended readings

- Introduction to Data Science in Healthcare Reading: https://www.r2library.com/Resource/detail/1584265329/ch0007s0170
- Analytics and (Precision Medicine) Decision Support Reading: https://www.r2library.com/Resource/detail/0128006811/ch0014s0163
- Hype Cycle for Healthcare Providers, 2019 (Gartner) Reading: Pages 3-7
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- https://www.r2library.com/Resource/detail/0340950056/ch0004s0092
- Principal components analysis https://www.r2library.com/resource/detail/0803625642/ch0006s0141 ANOVAhttps://www.r2library.com/Resource/detail/0781781531/ch0015s0490

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V. 5.2. Game Development using UNITY

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		
Game Development using UNITY#, DSE 3, V. 5.2	**4**	**0**	**0**	**4**	**Class XII pass with Mathematics**	**C^{++}**

 # This course will also be available to the students in semester III

Learning Objectives

The Learning Objectives of this course are

- to introduce the students to the game engine platform UNITY
- to give a basic on how to develop a game using this game engine.
- to design, develop and finalize a game on either an Android or an IOS platform

Learning outcomes

This course gives students an insight into developing a game either on a mobile or a desktop platform. Upon completion of the course the students would be able to-

- Possess basic ability to convert game idea into a working prototype
- Learn basic techniques for animation and simulation
- Extend the concept of game development on Web, console or VR platforms
- Develop a creative and aesthetic mindset by creating a good looking functional UI for the developed game

Practicals - **(120 Hours)**

The course will be conducted completely on a hands- on mode. The basic concepts will be explained and each concept will be augmented by small tasks initially on UNITY before designing and developing a game. The following tasks will be performed in lab:

- Introduction to Unity's Interface and Unity's Basics
- Rigid Bodies and Colliders
- Audio Source and UI Elements
- Moving Character with Code
- Introduction to Variables; Operations with Variables; Functions; Conditional Statements; Loops; Coroutines; Classes
- Creating animations, simulations and background
- Designing, developing and finalizing a game

Essential/recommended readings

- *Learning C# by Developing Games with Unity 5.x*, G. Lukosek, Packt publishing Ltd, 2016
- *Developing 2D Games with Unity: Independent Game Programming with C#*, Jared Halpern, Apress, 1st Edition, 2018
- *Unity in Action: Multiplatform Game Development in C# with Unity 5*, Joe Hocking, Manning publications, 3rd Edition, 2022
- *Unity From Zero to Proficiency (Foundations)*, Patrick Felicia, LPF publishing, 4th Edition, 2015

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V. 5.3. 3D printing using Blender

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		

3D printing using Blender#, DSE 3, V. 5.3	**4**	**0**	**0**	**4**	**Class XII pass with Mathematics**	**NIL**

 # This course will also be available to the students in semester III

Learning Objectives

The Learning Objectives of this course are

- to introduce the students to Blender
- to understand the basic concepts of 3D modelling and printing using Blender
- to identify the pitfalls in 3D printing
- to apply the slicing techniques and generate G code

Learning outcomes

This course gives students an insight into using the free and open source ware Blender for 3D printing. Upon the successful completion of the course the students are expected to generate 3D models of some simple objects like flower vase, geometrical figures, tessellation tiles, bottle lids, etc.

Practicals - (120 Hours)

The course will be conducted completely on a hands- on mode. The basic concepts will be explained and each concept will be augmented by small tasks initially on Blender before moving on to 3D printing. The following tasks will be performed in lab:

- Introduction to the User Interface and navigation in blender
- Creating simple geometrical objects like planes, cube, cylinder, cone, spheres, spirals, etc. on blender
- Movement, scaling and rotation transformations
- Simulation, animation and rendering
- Polygonal modelling for 3D printing
- 3D printing of simple geometrical objects
- Moving on to more complex 3D printing

Essential/recommended/ suggested readings

1. *Blender 3D printing tutorials for beginners,* https://all3dp.com/2/blender-3d-printing-tutorial/
2. *Blender for 3D printing design* https://www.youtube.com/watch?v=5CyaeBBQIkc&list=PLvCZK2JKGQlNt8uEM5_J12Qj7eO5MqV03
3. *3D printing from zero to hero in Blender* https://www.udemy.com/course/learn-3d-printing/

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V. 5.4. Applications of Data Science: A Case Study Approach

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		
Application of Data Science: A Case Study Approach, DSE 3, V. 5.4.	**4**	**0**	**0**	**4**	**Class XII pass with Mathematics**	**Linear Algebra; Probability and Statistics; Basic programming**

Learning Objectives

- Introduce the students to Python based toolkits
- Understand the application of mathematics concepts to data science
- Formulate hypothesis for the case study under consideration
- Inculcate problem solving mind-set among students

Learning outcomes

The students will be enabled to identify a case study (for e.g. weather forecasting, stock market prediction, sentimental analysis, crime prediction, etc) and apply the fundamentals of mathematics and programming languages. The students will also understand the use of various Python tools such as NumPy, Matplotlib, etc.

Practicals - (120 Hours)

The course will be conducted completely on a hands- on mode. The basic concepts will be explained and each concept will be augmented by small exercises on lab either using Python/ MATLAB or R. A case study would be identified to implement all the concepts. Following tasks will be done in the computer lab

- Introduction to programming tools (Python/ MATLAB/ R)
- Visualising Data through Bar Charts, Line Charts, Box Plots, Histogram
- Scrapping web for data (Eg, Various social media sites)
- Cleaning the data
- Using models like K nearest neighbours; Naïve Bayes, Linear and Logistic

Regression, Decision Trees, Neural Network, Clustering., Random forest to analyse the data

- Identifying a case study (for e.g. weather forecasting, stock market prediction, sentimental analysis, crime prediction, health data analytics etc) for a mini project

Essential/recommended/ suggested readings

- Data Science from Scratch: First principles with Python, Joel Grus, 2nd Edition, O'Rielly Media Inc, 2019. https://all3dp.com/2/blender-3d-printing-tutorial/
- Python Data Science Handbook: Essential Tools for working with Data, 2nd Edition, O'Rielly Media Inc, 2022
- Practical Statistics for Data Scientist, Peter Bruce, Andrew Bruce and Peter Gedeck, 2nd Edition, O'Rielly Media Inc, 2020
- Python for Data Science, L.M. John Paul Mueller, Wiley, 2019.

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V. 5.5. Urban Computing

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit-distribution of the course			Eligibility criteria	Prerequisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Urban Computing# DSE 3, V.5.5	**4**	**0**	**0**	**4**	**12th Pass**	**Programming languages, data Structure, Algorithm design and analysis**

Learning Objectives:

This course introduces an interdisciplinary filed, is the science of using computing technology in solving urban challenges such as crowds, traffic, and pollution, governance issues etc. Urban computing research also focuses on acquiring an understanding of the nature of urban phenomena, predict the future of cities, and plan their development.

Learning Outcomes:

- Learn to formulate challenges urban problems.
- Understand ways of data acquisitions, integration, and modeling skills necessary for urban computing research.

- Learn to model cities, develop large-scale statistical models, and use visualization technologies to pose and answer questions.
- Solve issues related to public health, sustainable use of limited energy resources, emergency preparedness, and societal stability etc
- Work in blended project teams with people from a variety of disciplines.
- Understand ways to solve practical hands-on problems faced by urban spaces/cities. activities.

Practicals - **(120 Hours)**

The course will be conducted completely on a hands- on mode and project based learning. The basic concepts of Urban Computing will be explained and associated real world challenging problems will be identified.

- Problem solving on Urban context text analytics including Smart mobility and smart environments.
- Acquisition and processing of high resolution remotely sensed data for urban applications;
- Practical work on Location-based service in smart cities
- Experiments on Data acquisition, storage, management, analysis, sharing
- Agent-based simulation for urban dynamics
- Hands on working on Urban sensor network data and applications.
- Students will be exposed to the practical application of Urban Computing concepts and learn how to solve real world urban problems.

Essential/recommended readings

- Zheng, Y. (2019). *Urban computing*. MIT Press.
- Yin, H. (2023). An overview of urban data variety and respective value to urban computing. *Handbook of Mobility Data Mining*, 1-13.
- Haldorai, A., Ramu, A., & Murugan, S. (2019). *Computing and Communication Systems in Urban Development: A Detailed Perspective*. Springer Nature.
- Zheng, Y., Capra, L., Wolfson, O., & Yang, H. (2014). Urban computing: concepts, methodologies, and applications. *ACM Transactions on Intelligent Systems and Technology (TIST)*, *5*(3), 1-55.

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V. 5.6. IT Project Leadership

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit-distribution of the course			Eligibility criteria	Prerequisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		

IT Project Leadership#, DSE 3, V.5.6	**4**	**0**	**0**	**4**	**12th Pass**	**NIL**

 # This course will also be available to the students in semester III

Learning Objectives

The key focus of this project-based course is to develop a deep understanding of facilitators and obstructions while developing and managing IT developments as a product and its life cycle. Innovations in IT have led some businesses to flourish, while others have faltered due
to massive changes brought by information technology. IT is hard to manage, therefore understanding its applications, planning and management are ensuring intended changes where innovations are realized and the unintended ones are kept under control. The course covers information system, information management, IT strategy, and IT governance

Learning outcomes

After completing this course, student should be able to;

- contribute to information system planning and strategy formulation in corporate enterprises and complex administrations.
- have a deeper understanding of a socio-technical approach to the deployment of IT in organisations
- understand frameworks for analysing strategic issues of IS deployment
  and a familiarity with the most relevant current issues.
- develop insight into cases of the strategic planning of information systems often demand

Syllabus **(120 Hours)**

Practical -

- Understanding IT and software characteristics and applications. processes, methods and
  tools. Scenario based view of IT manager's role and KRA's.
- Understanding evolving IT landscape and dynamics, IT and networking as applied to enterprises in public and commercial sector.
- Software management, Software life cycle, Process and Project metrics, Software quality management and assurance, software cost estimation, the make or buy decision, Automated estimation tools.
- IT enabled products or services, ITIL service management model, software as a service, software as a platform, IT service strategy, new service designing and development process, common IT setups and Systems.
- Fundamental aspects of daily IT operations, human factors in
  organization, acquisition and procurement, research and Development, Logical

planning.
Managing digital networks and security.

- Management Information Systems, Strategic planning in regulated and competitive IT industries, the management and marketing of a technology-based enterprise,
- Evaluating their legal constraints, responsibilities and ethics, Social and ethical aspects of IT, The principles and methods of asset valuation, Interpretation and measurement, financial statements risk assessment, Capital market, Capital budgeting and the effects of economic regulation on capital formation, IT Policy and Regulation

Essential/recommended readings

- Managing the Internet of Things: Architectures, Theories, and Applications Editors: Jun Huang & Kun Hua, Chongqing University, China & Lawrence Technological University, USA, ISBN9781785610288.
- "Management" by Stoner J A and Freeman R E, ISBN 10: 8131707040 / ISBN 3: 9788131707043
- "Management: Principles and Practice" by S K Mandal ISBN: 9788184952209, 8184952201 Edition: 1stEdition, 2011, Pages: 500.
- "Principles and Practices of Management" by Khusboo Manoj ISBN-10: 9380921128
  ISBN-13: 978-9380921129.
- "Principles and Practice of Sport Management" by Carol A Barr, ISBN-13: 9781284034172 Product With Access Code, 606 pages.
- "Better Software Practice for Business Benefit: Principles and Experiences" by Colin Tully and Richard Messnarz, ISBN-10: 0769500498 ISBN-13: 978-0769500492.

V.5.7. Fabrication of nanomaterials for devices

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		

Fabrication of nanomaterials for devices[#], DSE-3, V.5.7	**4**	**1**	**0**	**3**	**Class XII pass**	**Basic knowledge of science**

 # This course will also be available to the students in semester III

Learning Objectives

This course is designed to expose students regarding the fabrication and applications of various types of nanomaterials. Students will be performing hands-on experiments and will get themselves acquainted with the fascinating world of nanotechnology and it's interdisciplinary applications.

Learning outcome

Through this paper, students would be learning:

- About the basics of nanomaterials and characterization techniques
- To fabricate nanomaterials using chemical or green synthesis
- To characterize nanomaterials using various physicochemical techniques
- To explore the interdisciplinary applications of fabricated nanomaterials in electronic devices, optical devices, computing devices, health devices, drug delivery, environmental remediation and energy etc.

Syllabus

Theory **(15 Hours)**

Introduction of Nanoscience and nanomaterials; synthesis (Chemical as well green methods) and characterization techniques (including spectroscopic, X-RD, Zetasizer, electron micrography etc.); Discussion on basic, innovative and recent advancements in the field of nanostructures / Nano-formulations/ Nano-devices / Nano-sensors etc. for targeting various applications related to the interdisciplinary fields

Practicals - **(105 Hours)**

- Identifying a research problem based on fabrication of devices using nanotechnology
- Identifying the requirement of type of nanomaterials (nanoparticles, quantum dots, nanostructures etc.) depending upon their physical and chemical properties as per the identified research problem
- Chemical or green synthesis of nanomaterials based on the selective, identified protocols, which may later be modified for the novel method of synthesis
- Characterization of nanomaterials using various physicochemical techniques like UV-absorption spectroscopy, FT-IT spectroscopy, X-ray diffraction, Zetasizer, Dynamic light scattering, Scanning electron microscope (SEM), HR-TEM, FESEM etc. for understanding their size, shape, charge, morphology etc.

- Exploring the role of fabricated nanomaterials in electronic devices, optical devices, computing devices, drug delivery, environmental remediation and energy etc.

Essential/recommended readings

- Nanotechnology For Dummies; By Richard D. Brooker, Earl Boysen (2011), Wiley Publisher
- Nanotechnology: An Introduction; By Jeremy Ramsden (2011), Elsevier Science Publisher
- Research papers and reviews from journals of international repute like Nanotechnology Reviews (NTREV) journal, NANO Reviews, Nature Nanotechnology

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V. 5.8. IoT, Security and Machine Learning

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit-distribution of the course			Eligibility criteria	Prerequisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
IoT, Security and Machine Learning, DSE 3, V.5.8	**4**	**1**	**0**	**3**	**12th pass with Physics and Mathematic**	**Programming Fundamentals, Probability and statistics, Computer System Architecture**

Learning Objectives

This course introduces students to the field of machine learning, deep learning, security with python and its interaction with the Internet of Things (IoT) devices/ sensors. The course will cover topics such as security models, attacks, concept of privacy preservation, threats to machine learning models, and IoT devices. Students will be implementing various privacy preserving machine learning techniques with Python/ C or in MATLAB. The students will also learn to use various IoT devices in real applications.

Learning Outcomes

- Understand the fundamental concepts of machine learning, security and IoT.
- Identify deep learning and privacy preserving machine learning models, IoT platforms.
- Implement various security techniques for IoT and machine learning applications
- Understand current research trends and developments in the field of machine learning, security and IoT
- Explore on Interacting with digital outputs with C/ Python.

Syllabus

Theory **(15 Hours)**

Basic introduction to IoT, IoT- devices and related security, IoT communication protocols, principles of security, Vulnerability in IoT, CIA triad, Viruses and their types, Machine learning principles, Deep learning, CNN and other models. Concepts of privacy preservation, privacy preserving machine learning models.

Practicals: **(105 Hours)**

- Implementing IoT devices for various sensing applications
- Training deep learning models on sensed data
- Implementing IoT communication protocols
- Designing and testing IoT based systems
- Implementing IoT in wearables/ healthcare systems
- Using Python based application for IoT device control**.**
- Implementing basic deep learning models
- Implementing Privacy Preserving Machine Learning (PPML) models on available data

Essential/ recommended Readings:

- "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes, Gonzalo Salgueiro, Patrick Grossetete
- "Building IoT Projects with Raspberry Pi and Python" by Matthew Poole
- "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
- "Machine Learning Yearning" by Andrew Ng
- Adrian McEwen, Hakim Cassimally, ―Designing the Internet of Things‖, John Wiley and Sons, 1st Edition, 2014
- Matt Richardson, Shawn Wallace, ―Getting Started with Raspberry Pi‖, O'Reilly (SPD), 3rd Edition, 2014.

DISCIPLINE SPECIFIC ELECTIVE COURSE -3 (DSE-3)
V.5.9. Integral Transform: Applications to Digital Signal Processing

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		
Integral Transforms: Applications to Digital Signal Processing, DSE 3, V. 5.9	**4**	**1**	**0**	**3**	**12th Pass with Maths**	**Calculus, Linear Algebra, Differential equations**

Learning Objectives

Signal processing is, in a sense, application of various mathematical tools that primarily consist of Fourier Transforms, Laplace Transforms and z – Transforms. This is a practical-based course and students will :

- learn to utilize integral transformations to solve and analyze problems in digital signal processing
- comprehend and deploy signal processing techniques in an applied environment
- be able to design different types of filters

Learning outcomes

- Identification, understanding and differentiation between discrete time system and continuous time system
- Be able to apply mathematical tools – Laplace transform, Z transform and Fourier transform to various signals
- Implementation different signal types on matrix based numerical based software
- Designing different low pass, band pass and high pass filters
- Reconstruction of signal from its samples using natural sampling

Syllabus

Theory – (15 Hours)

LTI system; Convolution; Impulse response representation of LTI system; Fourier Series and Fourier coefficients; Complex exponential function; Fourier Transforms and their basic properties; Some Fourier transform pairs, Nyquist Sampling theorem

Practicals – (105 Hours)

- Representation of elementary signals (periodic and non-periodic)
- Basic operations on signals
- MATLAB implementation of different signal types
- Output of convolution of two signals
- Impulse response of an LTI system
- Simulations of difference equations
- Frequency response of LTI system from impulse response

- Representation of DTFS and FS of a signal
- Frequency response of LTI system described by a differential or difference equation
- Relating DTFS to DTFT
- Transform analysis of LTI system
- Computational structures for implementing discrete time LTI systems
- FIR & IIR Filter Implementation using the DSP Processors.
- Sampling theorem and reconstruction of signal from its samples using natural sampling

Essential/ Recommended readings:

- C. L. Byrne, "Signal Processing: A Mathematical Approach", 2 Ed., CRC Press, 2015.
- Haykin, S. and Van Been, B., "Signals and Systems" 2 Ed., John Wiley & Sons, 2003.
- Sundararajan, D., "A Practical Approach to Signals and Systems", Wiley, 2008.
- Padmanabhan, K., Ananthi, S. and Vijayarajeswaran, R., "A Practical Approach to Digital Signal Processing", New Ag International, 2003.