SCHEME & SYLLABUS OF UNDERGRADUATE DEGREE COURSE of B. Tech. (Data Science) VII & VIII Semester

[Draft Syllabus Subjected to approval]

Effective for the students admitted in year 2021-22 and onwards
Approved by ……. academic council meeting held on …….

Teaching & Examination Scheme
B. Tech. (Data Science)
4rd Year – VII Semester
(Effective for the students admitted in year 2021-22 and onward)

S. No.	Category	Course Code	Course Title	Hours			Exam Hours	Marks			Credit
				L	T	P		IA	ETE	Total	
	THEORY										
1	DC	7DS4-01	Statistical Modeling and Forecasting	3	-	-	3	30	70	100	**3**
2	UE	**University Elective subject** ***Course code and title to be selected from the university elective pool of subjects***		3	-	-	3	30	70	100	**3**
3	DE	7DS5-11	Mobile Computing	2	-	-	3	30	70	100	**2**
		7DS5-12	Soft Computing and Evolutionary Algorithms								
		7DS5-13	Generative AI								
Sub Total				**8**	**00**	**00**	**-**	**90**	**210**	**300**	**8**
PRACTICAL & SESSIONAL											
4	DC	7DS4-21	Statistical Modeling and Forecasting Lab	-	-	2	-	60	40	100	**1**
5	UI	7DS7-30	Industrial Training	-	-	1	-	60	40	100	**3**
	UI	7DS7-50	B.Tech. Project - I	-	-	3	-	60	40	100	**2**
6	CCA	7DS8-00	SODECA / Co-Curricular Activity	-	-	-	-	-	100	100	**1**
Sub Total				**00**	**00**	**06**	**-**	**180**	**220**	**400**	**7**
Total				**8**	**00**	**06**	**-**	**270**	**430**	**700**	**15**

L = Lecture, **T** = Tutorial, **P** = Practical, **IA**=Internal Assessment**, ETE**=End Term Exam,**Cr**=Credits

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S. No.	Category	Course Code	Course Title	Hours			Exam Hours	Marks			Credit
				L	T	P		IA	ETE	Total	
	THEORY										
1	UE		**University Elective subject** *Course code and title to be selected from the university elective pool of subjects*	3	-	-	3	30	70	100	**3**
Sub Total				**3**	**00**	**00**		**30**	**70**	**100**	**3**
	PRACTICAL & SESSIONAL										
10	UI	8DS7-40	Seminar	-	-	2	-	60	40	100	**2**
	UI	8DS7-50	B.Tech. Project - II	-	-	3	-	60	40	100	**4**
12	CCA	8DS8-00	SODECA / Co-Curricular Activity	-	-	-	-	-	100	100	**2**
Sub Total				**00**	**00**	**05**	**-**	**120**	**180**	**300**	**8**
Total				**03**	**00**	**05**	**-**	**150**	**250**	**400**	**11**

L = Lecture, **T** = Tutorial, = Practical, **IA**=Internal Assessment**, ETE**=End Term Exam,**Cr**=Credits

VII Semester B. Tech. (Data Science)	
7DS4-01: Statistical Modeling and Forecasting	
Credit: 3	**Max. Marks: 100 (IA:30, ETE:70)**
3L+0T+ 0P	**End Term Exams: 3 Hours**

Course Objectives:

As a result of successfully completing this course, students will :

- Able to understand basic property of time-series data.
- Able to handle seasonality and trend in time series data.
- Able to use and deploy various models for time series data.
- Able to select best model for time series data.

Course Outcomes:

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

CO-1: Discuss the challenges and their solutions for Time Series Data.

CO-2: Understanding impact of seasonality in time series data.

CO-3: Understand role of drift and trend.

CO-4: Understand to working of various models used for time series data.

S. No.	Contents	Hours
1	**Basic Properties of time-series data**: Distribution and moments, Stationarity, Autocorrelation, Heteroscedasticity, Normality **Introduction of Time Series Analysis**: Introduction to Time Series and Forecasting, Different types of data, Internal structures of time series. Models for time series analysis, Examples of Time series Nature and uses of forecasting, Forecasting Process, Data for forecasting, Resources for forecasting.	**7**
2	**Statistics Background for Forecasting**: Graphical Displays, Time Series Plots, Plotting Smoothed Data, Numerical Description of Time Series Data, Use of Data Transformations and Adjustments, General Approach to Time Series Modelling and Forecasting, Evaluating and Monitoring Forecasting Model Performance. **Random walk model**: Non-stationarity and unit-root process, Drift and Trend models	**7**
3	**Introduction to Autoregressive models and forecasting**: Autocorrelation and Partial autocorrelation, Autoregressive Moving Average (ARMA) Models , Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA , Seasonal Data, Seasonal ARIMA Models Forecasting using Seasonal ARIMA Models **Introduction to Vector Auto-regressive (VAR) models**: Impulse Response Function (IRF), Error Correction Models, Co-integration, Vector ARIMA Models, Vector AR (VAR) Model **Model Selection Criteria**: Finding the "BEST" Model , Impulse Response Function to Study the Differences in Models Comparing Impulse Response Functions for Competing Models .	**10**
4	**Time Series Regression Model**: Introduction Least Squares Estimation in Linear Regression Models, Statistical Inference in Linear Regression, Prediction of New Observations, Model Adequacy Checking, Variable Selection Methods in Regression, Generalized and Weighted Least Squares, Regression Models for General Time Series Data, Exponential Smoothing, First order and Second order.	**8**
5	**Multivariate Time Series Models and Forecasting:** Multivariate Time Series Models and Forecasting, Multivariate Stationary Process **Panel data models**: Fixed-Effect and Random-Effect models	**10**

	Introduction to Neural Networks and Forecasting Spectral Analysis, Bayesian Methods in Forecasting, Principal Component Analysis (PCA) and Factor Analysis	
Total		**42**

Suggested Books:

1. Introduction To Time Series Analysis And Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015)
2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017)
3. Chris Brooks "Introductory Econometrics for Finance," Fourth Edition, Cambridge University Press 2019
4. Ruey S. Tsay "Analysis of Time-series data," Third Edition, Wiley 2014
5. John Fox and Sanford Weisberg "An R Companion to Applied Regression," Third Edition, SAGE 2018
6. Yves Croissant and Giovanni Millo "Panel Data Econometrics with R," First Edition, Wiley 2018

VII Semester B. Tech. (Data Science)	
7DS5-11: Mobile Computing	
Credit: 2	**Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+ 0P	**End Term Exams: 3 Hours**

Course Objectives:

As a result of successfully completing this course, students will:

• To make the student understand the concept of the mobile computing paradigm, its novel applications, and limitations.

• To understand the typical mobile networking infrastructure through a popular GSM protocol

• Understand the issues and solutions of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer

• To understand the database issues in mobile environments & data delivery models.

• Understand the ad hoc networks and related concepts.

• To understand the platforms and protocols used in the mobile environment.

Course Outcomes:

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

CO-1: Think and develop a new mobile application.

CO-2: Take any new technical issue related to this new paradigm and come up with a solution(s).

CO-3: Develop new ad hoc network applications and/or algorithms/protocols.

CO-4: Understand & develop any existing or new protocol related to the mobile environment

S. No.	Contents	Hours
1	**Introduction:** Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices. GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS	**5**
2	**(Wireless) Medium Access Control (MAC):** Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Wireless LAN/(IEEE 802.11)	**6**
3	**Mobile Network Layer:** IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP	**6**
4	**Mobile Transport Layer:** Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks. Database Issues: Database Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing	**6**
5	**Data Dissemination and Synchronization:** Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization – Introduction, Software, and Protocols.	**5**
	Total	**28**

Suggested Books:

1. Jochen Schiller, “Mobile Communications”, Addison-Wesley, Second Edition, 2009.
2. Raj Kamal, “Mobile Computing”, Oxford University Press, 2007, ISBN: 0195686772
3. ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, “Mobile Computing, Technology Applications and Service Creation” Second Edition, Mc Graw Hill.
4. UWE Hansmann, Lother Merk, Martin S. Nicklaus, Thomas Stober, “Principles of Mobile Computing,” Second Edition, Springer.
5. “GENESIS : Personal Communication Device”. GENESIS 191A321 Document, 1993.
6. “Intelligent Vehicle Highway Systems Projects”. Department of Transportation, Minnesota Document, March 1994.

VII Semester B. Tech. (Data Science)	
7DS5-12: Soft Computing and Evolutionary Algorithms	
Credit: 2	**Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+ 0P	**End Term Exams: 3 Hours**

Course Objectives:

As a result of successfully completing this course, students will:

- Able to understand basics of Fuzzy Set
- Able to understand the concepts of the genetic algorithms.
- Able to understand the idea of the evolutionary algorithms.

Course Outcomes:

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

CO-1: Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.

CO-2: Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic

CO-3: Describe with genetic algorithms and other random search procedures useful while seeking global optimum in self learning situations.

CO-4: Develop some familiarity with current research problems and research methods in Soft Computing Techniques

S. No.	Contents	Hours
1	**Introduction to Soft Computing:** Aims of Soft Computing-Foundations of Fuzzy Sets Theory-Basic Concepts and Properties of Fuzzy Sets- Elements of Fuzzy Mathematics-Fuzzy Relations-Fuzzy Logic	**5**
2	**Application of Fuzzy Sets**: Applications of Fuzzy Sets-Fuzzy Modeling – Fuzzy Decision Making-Pattern Analysis and Classification-Fuzzy Control Systems-Fuzzy Information Processing- Fuzzy Robotics.	**6**
3	**Genetic Algorithms**: Main Operators- Genetic Algorithm Based Optimization-Principle of Genetic Algorithm- Genetic Algorithm with Directed Mutation- Comparison of Conventional and Genetic Search Algorithms Issues of GA in practical implementation. Introduction to Particle swarm optimization-PSO operators-GA and PSO in engineering applications	**6**
4	**Neuro-Fuzzy Technology:** Fuzzy Neural Networks and their learning-Architecture of Neuro-Fuzzy Systems- Generation of Fuzzy Rules and membership functions - Fuzzification and Defuzzyfication in Neuro-Fuzzy Systems- Neuro-Fuzzy Identification - Neuro Fuzzy Control-Combination of Genetic Algorithm with Neural Networks- Combination of Genetic Algorithms and Fuzzy Logic-Neuro-Fuzzy and Genetic Approach in engineering applications.	**6**
5	**Basic Evolutionary Processes, EV:** A Simple Evolutionary System, Evolutionary Systems as Problem Solvers, A Historical Perspective, Canonical Evolutionary Algorithms - Evolutionary Programming, Evolution Strategies, A Unified View of Simple EAs- A Common Framework, Population Size	**5**
	Total	**28**

Suggested Books:

1. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
2. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
4. Sivanandam, Deepa, " Principles of Soft Computing", Wiley
5. Jang J.S.R, Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill

VII Semester B. Tech. (Data Science)	
7DS5-13: Generative AI	
Credit: 2	**Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+ 0P	**End Term Exams: 3 Hours**

Course Objectives:

As a result of successfully completing this course, students will be:

- Understand the fundamentals of generative AI and its applications in computer vision and natural language processing.
- Develop skills in designing and implementing generative models using deep learning frameworks.
- Analyze and evaluate the performance of generative models in various applications.

Course Outcomes:

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

CO-1: Design and implement generative models for image and text generation, and other applications.

CO-2: Understand the strengths and limitations of various generative models and be able to select appropriate models for specific tasks.

CO-3: Develop problem-solving skills using generative AI and be able to apply them to real-world problems.

CO-4: Critically evaluate the performance of generative models and develop strategies for improvement.

S. No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course	**1**
2	**Overview of Generative AI**: Types of Generative Models (VAE, GAN, RNN, etc.), Applications of Generative AI (Image Generation, Text Generation, etc.)	**6**
3	**Generative Models for Computer Vision** : Convolutional Neural Networks (CNNs) for image processing, Generative Adversarial Networks (GANs) for image generation, Variational Autoencoders (VAEs) for image compression and generation, Case studies: Image generation, Image-to-image translation, etc.	**7**
4	**Generative Models for Natural Language Processing:** Recurrent Neural Networks (RNNs) for text processing, Transformers for text generation and language modeling, Generative models for text summarization, chatbots, and language translation	**7**
5	**Advanced Generative AI Topics:** Generative models for multimodal data (images, text, audio, etc.), Generative models for sequential data (time series, videos, etc.), Advanced techniques: Style transfer, CycleGAN	**7**
	Total	**28**

Suggested Books:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play by David Foster, O'Reilly Media
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3. Generative Adversarial Networks by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
4. Natural Language Processing (almost) from Scratch" by Collobert et al.
5. Neural Network Methods for Natural Language Processing" by Yoav Goldberg
6. Deep Learning for Computer Vision with Python" by Adrian Rosebrock

VII Semester B. Tech. (Data Science)	
7DS4-21: Statistical Modeling and Forecasting Lab	
Credit: 1	**Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+ 2P	**End Term Exams: 2 Hours**

Course Objectives:

As a result of successfully completing this course, students will :

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- Able to use and deploy various models for time series data.
- Able to select best model for time series data.

Course Outcomes:

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

CO-1: Discuss the challenges and their solutions for Time Series Data.

CO-2: Understanding impact of seasonality in time series data.

CO-3: Understand role of drift and trend.

CO-4: Understand to working of various models used for time series data.

S. No.	List of Experiments
1	Cleaning, Preprocessing and Handling Time Series Data • Time Series Data Cleaning • Loading and Handling Times series data Preprocessing Techniques
2	How to Checking Stationarity of a Time Series and making Time Series data Stationary Estimating & Eliminating Trend. • Aggregation • Smoothing • Polynomial Fitting Eliminating Trend and Seasonality • Differencing Decomposition
3	Time Series analysis **a)** Moving Average time analysis data. **b)** Smoothing the Time analysis Data. Check out the Time series Linear and non-linear trends.
4	Time Series Modelling and Forecasting • Moving average • Exponential smoothing • ARIMA Seasonal autoregressive integrated moving average model (SARIMA)
5	Dependence Techniques • Multivariate Analysis of Variance and Covariance • Canonical Correlation Analysis • Structural Equation Modeling Inter-Dependence Techniques • Factor Analysis Cluster Analysis

Suggested Books:

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2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017)
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VII Semester B. Tech. (Data Science)	
7DS7-50 : B.Tech. Project – I	
Credit: 2	**Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P	**Mode of evaluation: Report and presentation**

Assessment or Evaluation

The evaluation criteria for B. Tech. Project - I

S. No.	Category	IA marks bifurcation Max Marks in %	ETE marks bifurcation Max Marks in %
1	Project Motivation, Conceptual Design, Innovativeness, and utility in actual life application	10%	10%
2	Project Ideation, Project Formulation, and Design	10%	10%
3	Project Prototyping & Finalization, Project Planning & Timeline (Project Viability for 2 semesters)	10%	10%
4	Technology Used and Method	10%	10%
5	Project Execution, Development, Deployment, Demonstration and Delivery (Working and completeness) required to justify current semester work and presentation	30%	30%
6	Report writing and project documentation (organization of the report, clarity, use of figure/diagram, writing skills, presentation of result, paper publication, patent application, etc.)	20%	20%
7	Professional ethics (teamwork, punctuality, novelty, etc.)	10%	10%
Total		**100%**	**100%**

VIII Semester B. Tech. (Data Science)	
8DS7-50 : B.Tech. Project -II	
Credit: 4	**Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P	**Mode of evaluation: Report and presentation**

Assessment or Evaluation

The evaluation criteria for B. Tech. Project - II

S. No.	Category	IA marks bifurcation Max Marks in %	ETE marks bifurcation Max Marks in %
1	Project Motivation, Conceptual Design, Innovativeness, and utility in actual life application	10%	10%
2	Project Ideation, Project Formulation, and Design	10%	10%
3	Technology Used and Method	10%	10%
4	Project Execution, Development, Deployment, Demonstration and Delivery (Working and completeness) required to justify current semester work and presentation	30%	30%
5	Report writing and project documentation (organization of the report, clarity, use of figure/diagram, writing skills, presentation of result, paper publication, patent application, etc.)	20%	20%
6	Professional ethics (teamwork, punctuality, novelty, etc.)	10%	10%
7	Paper Published in reputed journals (SCE, SCIE, Scopus, UGC care or any peer-reviewed journal), Paper publications (International or National conferences [IEEE, ACM, Springer, etc]), and presentations at Hackathon (Institute level or SIH) or any institute, state or national level project presentation competitions.	10%	10%
Total		**100%**	**100%**