Semester II

Course Title: Advanced Computer Network & Security	Code: PGCSE201
Type of Course: Theory	Course Designation: Elective
Semester:2	Contact Hours: 3L/week
Credit: 3	
Continuous Assessment: 20+20	Final Exam: 60

PREREQUISITES:

Course Title	Code
1. Computer Networks	PCC-CS602

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Bloom's Level
PGCSE202.CO1	Explain the basic concepts of wireless network and the security.	Explain	L2
PGCSE202.CO2	Analyze the advantages of various topology over different types of wireless network.	Analyze	L4
PGCSE202.CO3	Analyze the role of various routing and data/packet traffic management policies.	Analyze	L4
PGCSE202.CO4	Explain the energy management policies.	Explain	L2
PGCSE202.CO5	Apply and evaluate various cryptographic algorithms for network and explain network security	Evaluate	L5

SYLLABUS:

Unit	Content	Hrs/ Unit	Text/Reference book serial no.
1.	Overview and Introduction, Fundamental of wireless networks and security	3	T1, T3, R1, R2
2	Wireless LANS and PANS, Wireless WANS and MANS, AD-HOC Wireless Networks, Wireless Sensor Networks, Wireless Body Area Networks	9	T1, T3, R1, R2
3	IEEE 802.11 MAC Layer Fundamentals: CSMA/CA, IEEE 802.11 MAC Layer, Advanced, Routing Protocols for AD-HOCWireless Networks, Routing Protocols for AD HOC Wireless Networks	6	T1, T3, R1, R2
4	Energy Management in Wireless Networks, Network Lifetime Enhancement	3	T1, T2
5	Security: Introduction, Overview, Security techniques, Cryptography: Concepts & Techniques, Symmetric Key Algorithm, Asymmetric Key Algorithm, Digital Signature and RSA, Internet Security Protocols, User Authentication, Electronic Mail Security, Firewall	10	T3, R1, R2

Text Books:

T1.Ad HocWireless Networks, Pearson Education,C.Siva Ram Murthy, B.S. Manoj
T2. Cryptography and Network Security, Tata McGraw-Hill, Atul Kahate
T3. Protocols and Architectures for Wireless Sensor Networks, Paperback, Holger Karl, Andreas Willig

Reference Books:

R1.Data Communications and Networking, 5E, Tata McGraw-Hill, Behrouz A. Forouzan
R2. Computer Networks, Prentice-Hall International editions,Andrew S. Tanenbaum

Course Title: Deep Learning Fundamentals	**Code: PGCSE 202**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 2nd	**Contact Hours: 3L/week**
Credit: 3	
Continuous Assessment: 20+20 Marks	**Final Exam: 60 Marks**

PREREQUISITES:

Course Title	Code
1. Mathematics	PGCSE101
2. Machine Learning	PGCSE104A

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Bloom's Level
CO1	Apply fundamental mathematical and statistical concepts to understand and analyze deep learning models.	Apply, Understand, Analyze	L3 L2 L4
CO2	Demonstrate proficiency in basic neural network architectures, activation functions, and training processes.	Demonstrate	L3
CO3	Implement optimization techniques and regularization methods to enhance model performance.	Implement	L3
CO4	Design and Apply deep learning models, including CNNs and RNNs, for structured and sequential data processing.	Design, Apply	L6 L3
CO5	Develop autoencoder-based solutions for feature learning, anomaly detection, and data reconstruction.	Develop	L6
CO6	Analyze and Explore state-of-the-art deep learning networks and their applications in real-world scenarios.	Analyze, Explore	L4 L5

SYLLABUS:

Unit	Content	Hrs/ Unit	Text/Reference book serial no.
1.	Perceptron and Multilayer Perceptron (MLP),Activation functions (Sigmoid, Tanh, ReLU, Softmax),Forward and backward propagation,Gradient Descent and Optimization techniques (SGD, Adam, RMSprop),Loss functions (MSE, Cross-Entropy),Overfitting and Regularization (L1/L2, Dropout)	6	
2.	Linear Algebra (vectors, matrices, eigenvalues, and SVD), Probability & Statistics (Bayes' theorem, probability distributions, expectation, and variance), Multivariate Calculus (partial derivatives, gradients, and the chain rule), Optimization Techniques (gradient descent, momentum-based methods, and second-order optimization), and Computational Graphs & Automatic Differentiation (forward and backward propagation, autograd in deep learning frameworks).	6	
3	Convolutional Networks: The Convolution Operation, Pooling, Variants of the Basic Convolution Function, Structured Outputs, Structured outputs and datatypes.	6	
4	Sequence Modelling, Recurrent Neural Networks (RNN): Unfolding Computational Graphs, RNNs, Bidirectional RNNs, LSTM. (6)	6	
5	Autoencoders: Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders.	6	
6	Some Popular Deep networks and Applications: Generative Adversarial Networks, VGG net, ResNet, Inception Net. Applications of deep learning.	6	

Text Books:

1. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, The MIT Press, 2017.
2. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, 2018.

Reference Books:

1. Deep Learning, From Basics to Practice, Vol 1 and Vol 2, A. Glassner, Published by The Imaginary Institute, Seattle, WA, 2018
2. F. Chollet, Deep Learning with Python, Manning Publications Co., 2018.
3. N. Buduma, Fundamentals of deep learning: Designing Next-Generation Machine Intelligence Algorithms, O'REILLY, 2017

Course Title: Data Analytics	**Code: PGCSE203**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 2	**Contact Hours: 3L/week**
Credit: 3	
Continuous Assessment: 20+20 Marks	**Final Exam: 60 Marks**

PREREQUISITES:

Course Title	Code
Mathematics, statistics and problem solving	BSC-CS302 ES-CS201

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Bloom's Level
PGCSE203.CO1	Understand the concepts of data preprocessing and data mining techniques	Demonstrate	L4
PGCSE203.CO2	Learn the statistical nature of data using measures of central tendency, measures of dispersion, probability distributions.	Discuss	L1
PGCSE203.CO3	To be familiar with a set of well-known machine learning predictive models	Discuss	L1
PGCSE203.CO4	Acquire the fundamental concepts of big data analytics and frameworks in Hadoop, Spark ecosystem.	Explain	L2
PGCSE203.CO5	Apply various data visualization techniques for in-depth data analysis	Implement	L3

SYLLABUS:

Unit	Content	Hrs/ Unit	Text/Reference book serial no.
1	**Introduction to Data Analytics**- Overview of Data analytics and its importance, Life Cycle, Data collection methods and sources, Applications of data science in various domains	2	1
2	**Data Preprocessing**- Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization, Handling missing data and outliers, Data sampling techniques, Association Rule Mining, Apriori Algorithm	5	1
3	**Different types of data analytics**- Descriptive Analytics: Measures of central tendency and dispersion, Probability distributions, Exploratory data analysis, Correlation and covariance, Inferential analytics, Hypothesis Testing, Confidence Intervals, Predictive analysis, Regression Analysis, Time Series Analysis, Classification Techniques, Classification and regression models, Model evaluation and selection, Feature selection, clustering techniques	6	3
4	**Predictive Analytics-** Classification vs. Regression, Linear and Logistic Regression, Gradient Descent, Classification models: Support Vector Machines, Kernels, Decision Trees, ML and MAP Estimates, K-Nearest Neighbor, Naive Bayes, Bayesian Networks, Artificial Neural Networks. Clustering Models: Partitioning based methods, Hierarchical methods, Density based methods, Gaussian Mixture Models, Learning with Partially Observable Data (EM). Dimensionality Reduction and Principal Component Analysis.	6	3
5	**Big Data Analytics-**Introduction to Big Data Platform, four dimensions of Big Data: volume, velocity, variety, veracity, Data Storage and Processing, Big data ecosystem-Hadoop ecosystem: HDFS, MapReduce, YARN, Apache Spark: RDDs, DataFrames, and MLlib, NoSQL databases: MongoDB, Cassandra, HBase.	6	2
6	**Data Visualization and Interpretation**- Graphical representation of data, Visualization tools and libraries (e.g., Matplotlib, Seaborn, Plotly, Tableau), Dashboard design and interactive visualization. Decision-making frameworks and models,Risk analysis and decision trees	6	3
7	***Optimization Techniques-*** *Bias-Variance trade-off, Cross-validation, Regularization, Precision, Recall and F-measure.*	4	4

Textbooks/References:

1. G James, D. Witten, T Hastie, and R. Tibshirani, An Introduction to Statistical Learning: with Applications in R, 1st ed. Springer, 2013

2. Raj Kamal, Preeti Saxena, “Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning”, McGraw Hill, 2018.

3. Ethem Alpaydin, Introduction to Machine Learning, 4th edition, MIT Press 2020.

4. C.M. Bishop, Pattern Recognition Machine Learning, Springer, 2006

Course Title: Internet of Things	**Code: PGCSE 204A**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 2nd	**Contact Hours: 3L/week**
Credit: 3	
Continuous Assessment: 20+20 Marks	**Final Exam: 60 Marks**

PREREQUISITES:

Course Title	Code
Fundamentals of Computer Networks – Basics of networking protocols, TCP/IP model, and wireless communication.	
Basic Electronics & Embedded Systems – Knowledge of microcontrollers (Arduino, Raspberry Pi), sensors, and actuators.	
Cloud Computing & Data Management – Awareness of cloud storage, data processing, and cloud services.	

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1:	Describe the characteristics, functional blocks, and architecture of IoT systems.	Explain, Describe	L2
CO2:	Differentiate various IoT hardware components (Arduino, Raspberry Pi, ESP32) and communication protocols (Wi-Fi, Bluetooth, ZigBee, LoRa, NB-IoT).	Compare, Differentiate	L4
CO3:	Utilize IoT communication models and protocols (MQTT, CoAP, HTTP, AMQP) for device-to-device and cloud-based communication.	Apply, Utilize	L3
CO4:	Examine data acquisition, processing, and analytics techniques while assessing security mechanisms like encryption, authentication, and blockchain.	Analyze, Examine	L4
CO5:	Develop IoT solutions for smart homes, healthcare, industrial automation, and environmental monitoring, integrating hardware, software, and cloud services.	Implement, Develop	L3

SYLLABUS

Module	Topics	Lectures
1	**Introduction to IoT :** Definition and Characteristics of IoT • IoT Functional Blocks and Architecture • Sensors, Actuators, and Smart Objects • IoT vs. Cyber-Physical Systems	(6 hours)
2	**Elements of IoT:** • Hardware Components: Arduino, Raspberry Pi, Communication Modules, Sensors • Networking Basics: IoT Networking Concepts • M2M and IoT Technology Fundamentals • Role of Cloud in IoT: XaaS (Everything as a Service) • Security Aspects in IoT	(9 hours)

3	**IoT Communication Technologies :** • IoT Communication Models • Wired and Wireless Communication in IoT (Wi-Fi, Bluetooth, ZigBee, LoRa, NB-IoT) • IoT Protocols (MQTT, CoAP, HTTP, AMQP, 6LoWPAN) • Edge, Fog, and Cloud Computing in IoT	(8 hours)
4	**IoT Data Management and Security:** **IoT Data Collection & Processing** • Data acquisition from IoT devices • Data storage and management in IoT systems • Real-time and batch processing of IoT data **IoT Analytics and Visualization** • Data analytics techniques for IoT • Machine Learning and AI in IoT applications • Visualization tools (Grafana, Power BI, Matplotlib) **IoT Security & Privacy** • Security threats and vulnerabilities in IoT • Encryption and authentication mechanisms • Blockchain for secure IoT transactions • Compliance and regulatory aspects (GDPR, HIPAA)	(10 hours)
5	**IoT Applications and Case Studies:** • Smart Home Automation: IoT-based Lighting and Energy Management • Industrial IoT (IIoT): Factory Automation and Predictive Maintenance • Healthcare IoT: Wearable Devices and Remote Patient Monitoring • Smart Cities and Environmental Monitoring: Air Quality Monitoring, Waste Management • Agriculture and Smart Irrigation Systems	(10 hours)

Text & References Books:

a.**ArshdeepBahga and Vijay Madisetti, Internet of Things A Hand-onApproach, Universities press, 2015**

Course Title: PATTERN RECOGNITION	**Code: PGCSE205B**
Type of Course: Theory	**Course Designation: Elective**
Semester: 2	**Contact Hours: 3L/week**
Credit: 3	
Continuous Assessment: 20+20	**Final Exam: 60**

PREREQUISITES:

Course Title	Code
Artificial Intelligence	

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Bloom's Level
PGCSE205B.CO1	**Understand the Fundamentals of Pattern Recognition**	Understand	L2
PGCSE205B.CO2	**Apply Data Preprocessing Techniques**	Apply	L3
PGCSE205B.CO3	**Implement and Evaluate Classification Models**	Apply	L3
PGCSE205B.CO4	**Understand and Apply Advanced Pattern Recognition Methods**	Understand	L2
PGCSE205B.CO5	**Recognize and Solve Real-World Problems Using Pattern Recognition**	Evaluate	L5
PGCSE205B.CO6	**Explore Current Research Trends and Techniques in Pattern Recognition**	Create	L6

SYLLABUS

Module	Content	Hrs/Unit
1	**Introduction to Pattern Recognition** Introduction to Pattern Recognition: Definition, importance, and applications; Pattern Recognition System: Components of a PR system (feature extraction, classification, etc.); Types of Pattern Recognition: Supervised, unsupervised, and semi-supervised learning; Steps in Pattern Recognition: Preprocessing, feature extraction, classification, and post-processing	5
2	**Data Preprocessing and Feature Extraction** Data Preprocessing: Noise reduction, normalization, and data transformation; Feature Extraction: Feature selection and dimensionality reduction techniques (PCA, LDA); Statistical Methods: Mean, variance, skewness, kurtosis, and covariance; Signal Processing Techniques: Fourier transform, wavelets, etc.	7
3	**Classification Techniques** Supervised Learning Algorithms: Nearest Neighbor Classifier, Decision Trees and Random Forest, Support Vector Machines (SVM), Artificial Neural Networks (ANN), k-Nearest Neighbor (k-NN), Naive Bayes Classifier; Unsupervised Learning Algorithms: k-means clustering, Hierarchical clustering, Self-organizing maps (SOM), Principal Component Analysis (PCA)	8
4	**Evaluation Metrics for Classification** Performance Evaluation: Accuracy, precision, recall, F1 score; Confusion Matrix: Sensitivity, specificity, and other metrics; ROC Curve and AUC: Receiver Operating Characteristics, Area Under the Curve; Cross-Validation Techniques: k-fold cross-validation, leave-one-out cross-validation.	3
5	**Advanced Pattern Recognition Techniques** Deep Learning for Pattern Recognition: Introduction to CNN, RNN; Bayesian Networks: Probabilistic graphical models for pattern recognition; Hidden Markov Models (HMM):	7

	Applications in speech and time-series recognition; Ensemble Learning: Boosting, Bagging, and Stacking	
6	**Applications of Pattern Recognition** Image Recognition: Object detection, facial recognition, optical character recognition (OCR); Speech and Audio Recognition: Speech-to-text, audio signal classification; Biometric Systems: Fingerprint, iris, and voice recognition; Text Classification: Sentiment analysis, document classification; Medical Pattern Recognition: Disease diagnosis, medical image analysis.	6

Textbook

1. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, John Wiley,
2. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press,

References

1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer
2. P. A Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ
3. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Ed. Academic Press, New York

Course Title: Data Analytics Lab	**Code: PGCSE292**
Type of Course: Lab	**Course Designation: Compulsory**
Semester: 2	**Contact Hours: 3 Hours/week**
Credit: 3	
Continuous Assessment: 60 Marks	**Final Exam: 40 Marks**

PREREQUISITES:

Course Title	Code
1. Mathematics, statistics and problem solving	BSC-CS302 ES-CS201

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Bloom's Level
PGCSE203.CO1	Understand the concepts of data preprocessing and data mining techniques	Explain and Demonstrate	L2 & L4
PGCSE203.CO2	Interactive commands in Python, data operations, simple programs for writing into files and reading from files	Implement	L3
PGCSE203.CO3	Writing programs for standard algorithms of sorting and searching in Python.	Discuss Implement	L1 L3
PGCSE203.CO4	Write programs to perform exploratory data analysis: variance, standard derivation, summarization, distribution, and statistical inference.	Explain Implement	L2 L3
PGCSE203.CO5	Mini project to implement the Data Analytics in real environment	Implement	L3

SYLLABUS:

Unit	Content	Hrs/Unit	Text/Reference book serial no.
1	Interactive commands in Python, data operations, simple programs for writing into files and reading from files. Data file manipulations programs. Familiarization with IDE in Python.	2	
2	Writing programs for standard algorithms of sorting and searching in Python. 4. Plotting the data using X-Y graph, Bar- chart, and using other plotting techniques.	6	
3	Write programs to perform exploratory data analysis: variance, standard derivation, summarization, distribution, and statistical inference.	6	
4	Plotting the various distributions for given data sets.	6	
6	Classifying and presentation of data using different clustering and classification machine learning algorithms.	6	
7	Write programs on graphs of social networks for community detection.	3 Mini Project	
8	Write programs for analysis of graphs to find centrality and page-rank.	3 Mini Project	

Textbooks/References:

Data Science & Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services, Wiley, 2015.