Fourth Year – First Semester
Artificial Intelligence (PCCS-412)
Professional Core (PCS); 4 Credits (3-1-0)

Objectives:

The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning. Students will implement a small AI system in a team environment. The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program.

Unit	Contents	No. of Lectures
Unit 1	Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.	**09**
Unit 2	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning. Statistical Reasoning: Classical logic versus non monotonic logic, Default logic, Circumscription, Fuzzy Logic, Typicality Levels of confidence, Baye's Theorem, Dempster-Shafer theory of evidence.	**12**
Unit 3	Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.	**10**
Unit 4	**Machine Learning:** Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning, Production Rules : Procedural versus declarative knowledge, Forward versus backward reasoning, Matching, Control Knowledge.	**09**
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Reference/Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Pearson Education
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
3. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education
4. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India

Professional Elective -II

Data Analytics with R (PECS-41x)
Professional Elective (PECS); 4 Credits (3-0-2)

Objectives:

The objective of the course is to present an overview of Big Data Analytics principles and approaches. Develop a basic understanding of the building blocks of Big Data as presented in terms of kinds of data and analytical languages

Unit	Contents	No. of Lectures
Unit 1	**Introduction to big data analytics:** Big data overview, Data pre-processing, concepts of supervised and unsupervised learning, Differences between Big data and statistics, Key disciplines for Big Data, Big Data problem, What is Big Data Analytics? What Big Data Analytics Isn't? Why this Sudden Hype Around Big Data Analytics? Classification of Analytics. Greatest Challenges that Prevent Businesses from Capitalizing on Big Data. Top Challenges Facing Big Data. Why Big Data Analytics is Important? Kind of Technologies are we Looking Toward to Help Meet the Challenges Posed by Big Data?	**09**
	Basics of R programming for Data Analytics: Why learn R? How to install R / R Studio? How to install R packages? Basic computations in R, Data Types and Objects in R, Control Structures (Functions) in R, Useful R Packages **,**	

Unit 2	Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, What is Big Data? Volume, velocity and variety. Why big data? A typical data warehouse environment. A typical Hadoop environment. What is new today? What is Changing in the Realms of Big Data?.	**12**
Unit 3	**Algorithms for Data Analytics:**Basic statistics: mean, median, standard deviation, variance, correlation, covariance, Linear regression: simple linear regression, introduction to multiple linear regression, Classification: logistic regression, decision trees, SVM, Clustering: K-means, K-medoids, Hierarchical clustering, X-means.	**10**
Unit 4	**Exploratory Data Analysis in R:** Basic Graphs, Treating Missing values, working with Continuous and Categorical Variables, Feature Engineering, Label Encoding / One Hot Encoding.Haddoop: Features of Hadoop, Key Advantages of Hadoop, Versions of Hadoop. Overview of Hadoop Ecosystems, Hadoop Distributions, Hadoop versus SQL	**09**
Unit 5	**NoSQL Database with R:**R with Relational Database management system, R with non-relational database management system, What We Miss With NoSQL. Use of NoSQL in Industry, NoSQL Vendors, SQL versus NoSQL, New SQL, Comparison of SQL, NoSQL, and New SQL Future of R. In-Memory Analytics, In—Database Processing, Symmetric Multiprocessor System (SMP), Massively parallel Processing, Difference Between Parallel and Distributed systems, Shared Nothing Architecture.	**5**
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Reference/Text Books:

1. Data Analytics Made Accessible, A. Maheshwari.

Machine Learning with Python (PECS-41x)
Professional Elective III (PECS); 4 Credits (3-0-2)

Unit	Contents	No. of Lectures
Unit 1	**Machine Learning:** Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning, **Production Rules** : Procedural versus declarative knowledge, Forward versus backward reasoning, Matching, Control Knowledge.	**09**
Unit 2	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning **Statistical Reasoning** : Classical logic versus non monotonic logic, Default logic, Circumscription, Fuzzy Logic, Typicality Levels of confidence, Baye's Theorem, Dempster-Shafer theory of evidence**Chapter 3:** Inheritance :Overriding methods ,Polymorphism, Making methods and classes final ,Abstract classes and methods , Interfaces	**12**
Unit 3	**Natural Language Processing**: Defining the problem, Overview of solution, Syntactic Analysis: Context-free grammars, Transformational grammars. Parsing: Top down, bottom up,& chart parsing Semantics: Thematic roles, Aktionsart, Coercion, Cospecification, Extended reasoning with KB,Discourse & Pragmatic Processing: Modelling	**10**
Unit 4	Introduction to Python, use IDLE to develop programs, Basic coding skills, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure, Illustrative Programs with machine learning modules	**09**
Unit 5	Define and use functions and modules, working with recursion, Basic skills for working with lists, work with a list of lists, work with tuples, work with dates and times, get started with dictionaries,An introduction to file I/O, use text files, use CSV files, use binary files,Handle a single exception, handle multiple exceptions-	**5**

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Reference/Text Books:

1. **Machine Learning: The New AI***By Ethem Alpaydin*

Internet of Things (IOT) (PECS-41x)
Professional Elective (PECS); 4 Credits (3-1-0)

Objectives:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web based services on IoT devices

Unit	Contents	No. of Lectures
Unit 1	Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle	**09**
Unit 2	Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER	**12**
Unit 3	Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages – JSON, XML, HTTPLib, URLLib, SMTPLib	**10**

Unit 4	Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.	**09**
Unit 5	Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API	**5**
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Reference/Text Books:

- Internet of Things – A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547