Vikram University, Ujjain

Board of studies in Computer science (Faculty of Science)

SYLLABUS of PGDCSAinAI & MACHINE LEARNINGProgramme

Exclusively for University Teaching Department (ICS,VUU)

ONE YEAR PGDCSA in AI & MACHINE LEARNING PROGRAMME of UTD (ICS,VUU)

(Effective from Academic Session 2020-21)

[Modified as according to the provision of "Ordinance 14"]

COURSE STRUCTURE

PGDCSA (AI & MACHINE LEARNING) FIRST SEMESTER

SN	Course code	Title	End term sem Exam	Internal	Max Marks	Credits*	Distribution of Credits		
						C	L	T	P
1	PG-101	Basic Statistical Methods	60	40	100	6	4	2	
2	PG-102	Basic Machine Learning	60	40	100	6	4	2	
3	PG-103	Advances in Artificial Intelligence	60	40	100	6	4	2	
4	PG-104	Neural Networks	60	40	100	6	4	2	
5	PG-105	Machine Learning in IOT	60	40	100	6	4	2	
6	PG-106	Comprehensive Viva Voce	50	-	50	04 Virtual (VR)			
		Total			550	30+04	20	10	

C=Credit Per Week) / (L = Lectures Per Week)/ (T & PW =Tutorials &Practical Work per week)

***One Credit is equivalent to one hour (60 minutes) of teaching (lecture or tutorial)and two hours (120 minutes) for practical**

COURSE STRUCTURE

PGDCSA (AI & MACHINE LEARNING) SECOND SEMESTER

SN	Course code	Title	End term sem Exam	Internal	Max Marks	Credits*	Distribution of Credits		
						C	L	T	P
1	PG-201	Advanced Statistical Model and Analysis	60	40	100	6	4	2	
2	PG-202	Advance Machine Learning	60	40	100	6	4		2
3	PG-203	Big Data Analytics & Machine Learning	60	40	100	6	4	2	
4	PG-204	Natural Language Processing	60	40	100	6	4	2	
5	PG-205	Cloud Computing	60	40	100	6	4	2	
6	PG-206	Comprehensive Viva Voce	50	-	50	04 Virtual (VR)			
		Total			550	30+04	20	08	02

C=Credit Per Week) / (L = Lectures Per Week)/ (T & PW =Tutorials &Practical Work per week)

***One Credit is equivalent to one hour (60 minutes) of teaching (lecture or tutorial)and two hours (120 minutes) for practical**

PG- 101 : Basic Statistical Methods

Unit I: Statistical analysis, Measures of central tendency and dispersion, mean, median, mode, range, mean and standard deviations, computing correlation in variables, linear and non-linear regression.

Unit II: Probability and Probability distributionsProbability: classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes'Theorem and independence. Probability distributions: binomial, poison, geometric, negative binomial uniform exponential, normal and log normal distribution.

UNIT III

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quintiles, Markov inequality, correlation and regression, independence of random variables.

Unit IV

Sampling & DistributionsThe Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, ChiSquare, t and F distributions, problems.

UNIT V

Hypothesis Testing: Basic ideas of testing hypothesis, null and alternative hypotheses, the critical and acceptance regions, two types of error, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications. Software and Tools to be learnt: Statistical packages like SPSS and R.

Text:

1. R. Panneerselvam, "Research Methodologies," PHI.
2. C.R. Kothari: Research methodology, Methods and Techniques, New Age Publication.
3. S.M. Ross, A First Course in Probability, 8 th Edition, Prentice Hall.

PG-102 : Basic Machine Learning

Unit 1

Learning Problems - Perspectives and Issues - Concept Learning - Version Spaces and Candidate Eliminations - Inductive bias - Decision Tree learning - Representation - Algorithm- Heuristic Space Search.

Unit 2

Neural Network Representation - Problems - Perceptrons - Multilayer Networks and Back Propagation Algorithms - Advanced Topics - Genetic Algorithms - Hypothesis Space Search - Genetic Programming - Models of Evalution and Learning.

Unit 3

Bayes Theorem - Concept Learning - Maximum Likelihood - Minimum Description Length Principle - Bayes Optimal Classifier - Gibbs Algorithm - Naïve Bayes Classifier - BayesianBelief Network - EM Algorithm - Probability Learning - Sample Complexity - Finite and Infinite Hypothesis Spaces - Mistake Bound Model.

Unit 4

K- Nearest Neighbour Learning - Locally weighted Regression - Radial Bases Functions - Case Based Learning

Unit 5

Learning Sets of Rules - Sequential Covering Algorithm - Learning Rule Set – First Order Rules - Sets of First Order Rules - Induction on Inverted Deduction - Inverting Resolution - Analytical Learning - Perfect Domain Theories - Explanation Base Learning - FOCL Algorithm - Reinforcement Learning - Task - Q-Learning - Temporal Difference Learning

TEXT BOOKS:

1.Machine Learning - Tom M. Mitchell, - MGH

REFERENCE BOOKS

1. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis

PG- 103: Advances in Artificial Intelligence

UNIT 1

Introduction: What is AI? Foundations of AI, History of AI, Agents and environments, The nature of the Environment, Problem solving Agents, Problem Formulation, Search Strategies

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UNIT 2

Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Prepositional logic, First-order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining

UNIT 3

Learning: Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, why learning works, Learning in Neural and Belief networks

UNIT 4

Practical Natural Language Processing: Practical applications, Efficient parsing, Scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis

UNIT 5

Robotics: Introduction, Tasks, parts, effectors, Sensors, Architectures, Configuration spaces, Navigation and motion planning, Introduction to AI based programming Tools

Reference Books:

1. Artificial Neural Networks B. Yagna Narayana, PHI
2. Artificial Intelligence , 2nd Edition, E.Rich and K.Knight (TMH).
3. Artificial Intelligence and Expert Systems - Patterson PHI.
4. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.
5. Stuart Russell, Peter Norvig: “Artificial Intelligence: A Modern Approach”,2nd Edition, Pearson Education, 2007

PG-104 :Neural Networks

UNIT 1

INTRODUCTION: History Of Networks, Structure And Functions Of Biological And Artificial Neuron, Neural Network Architectures, Characteristics Of ANN, Basic Learning Laws and Methods

UNIT 2

SUPERVISED LEARNING: Single Layer Neural Network and architecture, McCulloch-Pitts Neuron Model, Learning Rules, Perceptron Model, Perceptron Convergence Theorem, Delta learning rule, ADALINE, Multi-Layer Neural Network and architecture, MADALINE, Back Propagation learning, Back Propagation Algorithm.

UNIT 3

UNSUPERVISED LEARNING-1: Outstar Learning, Kohenen Self Organization Networks, Hamming Network And MAXNET, Learning Vector Quantization, Mexican hat.

UNIT 4

UNSUPERVISED LEARNING-2: CounterPropagation Network -Full Counter Propagation network, Forward Only Counter Propagation Network, Adaptive Resonance Theory (ART) - Architecture, Algorithms.

UNIT 5

ASSOCIATIVE MEMORY NETWORKS : Introduction, Auto Associative Memory ,Hetero Associative Memory, Bidirectional Associative Memory(BAM) -Theory And
Architecture, BAM Training Algorithm, Hopfield Network: Introduction, Architecture Of Hopfield Network.

Reference Books:

1. B.Yegnanarayana" Artificial neural networks" PHI ,NewDelhi.
2. .S.N.Sivanandam ,S.N.Deepa, "Introduction to Neural Networks using MATLAB 6.0", TATA MCGraw- Hill publications William Stallings,"Cryptography and Network Security",Third Edition, Pearson Ed
3. J .M. Zurada ,"Introduction to Artificial neural systems" -Jaico publishing.

PG - 105: Machine Learning in IOT

UNIT 1

Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logicaldesign of IoT, Functional blocks of IoT, Communication models &APIs

UNIT 2

IoT & M2M Machine Machine, Difference between IoT and M2M, Softwaredefine Network

UNIT 3

Network & Communication aspects Wireless medium access issues, MAC protocol survey, Surveyrouting protocols, Sensor deployment & Node discovery, Dataaggregation & dissemination.

UNIT 4

Challenges in IoT Design challenges, Development challenges, Security challenges,Other challenges. **Domain specific applications of IoT**Home automation, Industry applications, Surveillance applications,Other IoT applications

UNIT 5

Developing IoTs Introduction to Python, Introduction to different IoT tools,Developing applications through IoT tools, Developing sensor basedapplication through embedded system platform, Implementing IoTconcepts with python

Reference Books:

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things”: A Hands-On Approach
2.Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

PG - 201: Advance Statistical Model and Analysis

UNIT-I
An overview of basic probability theory and theory of estimation; Bayesian statistics; maximum a posteriori (MAP) estimation; conjugate priors;

UNIT-II
Exponential family; posterior asymptotics; linear statistical models; multiple linear regression: inference technique for the general linear model, generalised linear models: inference procedures, special case of generalised linear models leading to logistic regression and log linear models;

UNIT-III
Introduction to non-linear modelling; sampling methods: basic sampling algorithms, rejection sampling, adaptive rejection sampling, sampling.

UNIT-IV
The EM algorithmMarkhov chain, Monte Carlo, Gibbs sampling, slice sampling.

References:
1. Dobson, A. J. and Barnett, A. G., An Introduction to Generalised Linear Models, 3rd ed., Chapman and Hall/CRC (2008).

2. Krzanowski, W. J., An Introduction to Statistical Modeling, Wiley (2010).

3. Hastie, T., Tibshirani, R., and Friedman, J., The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer (2002).

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

PG - 202 : Advance Machine Learning

Unit1

Kernel Methods: reproducing kernel Hilbert space concepts, kernel algorithms, multiple kernels, graph kernels.

Unit2

Multitasking, deep learning architectures; spectral clustering ; model based clustering, independent component analysis; sequential data.

Unit3

Hidden Markhov models; factor analysis; graphical models; reinforcement learning.

Unit 4

Gaussian processes; motiff discovery; graphbased semisupervised learning; natural language processing algorithms.

References:

1. Bishop, C. M., Pattern Recognition and Machine Learning, Springer (2006).

2. Hastie, T., Tibshirani, R., and Friedman, J., The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer (2002).

3. Cristianini, N. and Shawe-Taylor, J., An Introduction to Support Vector Machines and other kernel-based methods, Cambridge Univ. Press (2000).

4. Scholkopf, B. and Smola, A. J., Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond, The MIT Press (2001).

5. Sutton R. S. and Barto, A. G., Reinforcement Learning: An Introduction, The MIT Press (2017).

PG -203 : Big Data Analytics And Machine Learning

UNIT 1

Introduction to Big Data. What is Big Data? Why Big Data is Important. Meet Hadoop Data,Data Storage and Analysis, Comparison with other systems, Grid Computing. A brief history of Hadoop. Apache hadoop and the Hadoop Ecosystem. Linux refresher, VMWare Installation of Hadoop.

UNIT 2

The design of HDFS. HDFS concepts. Command line interface to HDFS.Hadoop File systems. Interfaces. Java Interface to Hadoop. Anatomy of a file read. Anatomy of a file writes. Replica placement and Coherency Model. Parallel copying with distcp, keeping an HDFS cluster balanced.

UNIT 3 Introduction. Analyzing data with unix tools. Analyzing data with hadoop. Java MapReduce classes (new API). Data flow, combiner functions, Running a distributed MapReduce Job. Configuration API. Setting up the development environment. Managing configuration. Writing a unit test with MRUnit. Running a job in local job runner. Running on a cluster, Launching a job. The MapReduce WebUl.

UNIT 4 Classic Mapreduce. Job submission. Job Initialization. Task Assignment. Task execution.Progress and status updates. Job Completion. Shuffle and sort on Map and reducer sideConfiguration tuning. Map Reduce Types. Input formats. Output cormats. Sorting. Map side and Reduce side joins.

UNIT 5

The Hive Shell. Hive services. Hive clients. The meta store. Comparison with traditional databases. Hive QI. Hbasics. Concepts. Implementation. Java and Map reduce clients. Loading data, web queries.

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Reference:

1. Tom White, Hadoop,"The Definitive Guide", 3rd Edition, O'Reilly Publications, 2012.

2. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch ,"Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", 1st Edition, TMH,2012.

PG -204 Natural Language Processing

UNIT 1

Introduction to Natural language The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax.

UNIT 2

Grammars and Parsing Grammars and Parsing- Top- Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

UNIT 3

Grammars for Natural Language Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers.

UNIT 4

Semantic & Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts &embedded sentences, Defining semantics structure model theory. **Language Modeling**Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Crosslingual Language Modeling.

.**UNIT5**

Machine Translation Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status.Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem,Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges.**Multilingual Information Retrieval.**

Reference Books:

1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008.
3. Manning, Christopher and Henrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

PG -205 E2:**CloudComputing**

UNIT

CloudComputing:Definition,CloudArchitecture,CloudStorage,AdvantagesandDisadvantagesofCloudComputing,CompaniesintheCloudToday,CloudServices,CloudTypes:TheNISTModel,TheCloudCubeModel,DeploymentModels,ServiceModelsCloudComputing,ServiceModels:InfrastructureasaService(IaaS),PlatformasaService(PaaS),SoftwareasaService(SaaS).

UNIT 2

Web-BasedApplication–ProsandCons ofCloudServiceDevelopment–TypesofCloudServiceDevelopment–SoftwareasaService–PlatformasaService–WebServices–On-DemandComputing–DiscoveringCloudServicesDevelopmentServicesandTools–AmazonEc2–GoogleAppEngine–IBMClouds

UNIT 3

CentralizingEmailCommunications–CollaboratingonSchedules–CollaboratingonTo-DoLists–CollaboratingContactLists–CloudComputingfortheCommunity–CollaboratingonGroupProjectsandEvents–CloudComputingfortheCorporation

UNIT 4

CollaboratingonCalendars,SchedulesandTaskManagement–ExploringOnlineSchedulingApplications–ExploringOnlinePlanningandTaskManagement–CollaboratingonEventManagement–CollaboratingonContactManagement–CollaboratingonProjectManagement–CollaboratingonWordProcessing-CollaboratingonDatabases–StoringandSharingFiles

UNIT 5

Cloudcomputingsecurityarchitecture:ArchitecturalConsiderationsGeneralIssues,TrustedCloudcomputing,SecureExecutionEnvironmentsandCommunications,Microarchitectures;IdentityManagementandAccesscontrolIdentitymanagement,Accesscontrol,AutonomicSecurityCloudcomputingsecuritychallenges:Virtualizationsecuritymanagementvirtualthreats,VMSecurityRecommendations,VM-SpecificSecuritytechniques,SecureExecutionEnvironmentsandCommunicationsincloud.

Reference Books:

1.BarrieSosinsky,“CloudComputingBible”,WileyIndiapub
2.DinakarSitaram,“MovingtoTheCloud”,Elsevier,2014.
3.Danc.Marinercus,“CloudComputingTheoryAndPractice”,Elsevier,2013.