IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV,
Bhopal) Scheme Based on AICTE Flexible
Curriculum

Department of Computer Science & Engineering

Master of Engineering (M.E.) [Data Science] III Semester

S.No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	**PSEC-MCS301**	PSEC	**Program Specific Elective Course-III** **	60	25	15	–	–	**100**	3	–	–	**3**
2.	**LLC-MCS301**	LLC	**Liberal Learning Course**	60	25	15	–	–	**100**	1	–	–	**1**
3.	**SBC-MCS301**	SBC	**Dissertation Phase-I**	–	–	–	120	80	**200**	–	–	20	**10**
		Total		**120**	**50**	**30**	**120**	**80**	**400**	**4**	**0**	**20**	**14**

Program Specific Elective Course-III	**Liberal Learning Course**
PSEC-MCS301(A) GPU Computing	LLC-MCS301(A) Business Analytics
PSEC-MCS301(B) Cloud Computing	LLC-MCS301(B) Artificial Intelligence for Robots
PSEC-MCS301(C) Machine Learning with Tensor flow	LLC-MCS301(C) Personality Development
PSEC-MCS301(D) Distributed Database	LLC-MCS301(D) Waste to Energy

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
1 Credit	1 Credit	1 Credit

** This can be completed by online MOOC Course.

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PSEC-MCS301	**GPU Computing**	**3L (3 hrs.)**	**3 credits**

Prerequisite: GPUs can accelerate machine learning. With the high-computational ability of a GPU, workloads such as image recognition can be improved.

Course Objective:

To learn parallel programming with Graphics Processing Units (GPUs).

Course Contents: (40 hrs.)

Module 1: (06 hrs.)

Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

Module 2: (06 hrs.)

Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Module 3: (10 hrs.)

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Module 4: (08 hrs.)

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-basedSynchronization - Overlapping data transfer and kernel execution, pitfalls.

Module 5: (10 hrs.)

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

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Course Outcome

1. Learn the basic data sharing techniques between a CUDA program and a OpenGL-based visualization program.
2. Understand the system architecture, especially memory hierarchy, of GPUs.
3. Implement efficient algorithms for common application kernels, such as matrix multiplication
4. Learn the basic visualization techniques, such as OpenGL-based rendering and ray-tracing, on GPUs.
5. Understand programming model and language specifications of GPU programming. .

List of Text / Reference Books:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)

2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

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PSEC-MCS301	**Cloud Computing**	**3L (3 hrs.)**	**3 credits**

Prerequisite: Basic Understanding of Different Types of Cloud

Course Objective:

An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.

Course Contents: (40 hrs.)

Module 1: (06 hrs.)

Introduction to Cloud Computing Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing

Module 2: (12 hrs.)

Cloud Computing Architecture Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model

Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

Module 3: (10 hrs.)

Security Issues in Cloud Computing Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security

Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

Module 4: (06 hrs.)

Security Management in the Cloud Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS

Module 5: (06 hrs.)

Audit and Compliance Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

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Course Outcome

1. Identify security aspects of each cloud model.
2. Develop a risk-management strategy for moving to the Cloud.
3. Implement a public cloud instance using a public cloud service provider.
4. Apply trust-based security model to different layer.
5. To ensure a company meets the guidelines from Government regulatory agencies and its own internal policies.

List of Text / Reference Books:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009.

2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765, O'Reilly Media, September 2009.

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PSEC-MCS301	**Machine Learning with Tensor Flow**	**3L (3 hrs.)**	**3 credits**

Prerequisite: Soft Computing and Artificial Intelligence.

Course Objective:

The objective of this course is to learn various concepts of machine learning and algorithms.

Course Contents: (40 hrs.)

Module 1: (10 hrs.)

Introduction to machine learning and Deep learning, scope and limitations, regression, probability, statistics and linear algebra, convex optimization, data visualization, hypothesis function and testing, data distributions, data preprocessing, data augmentation, normalizing data sets, machine learning models, supervised and unsupervised learning.

Module 2: (10 hrs.)

Overview of Tensor flow, Steps in Machine Learning Process, Loss Functions in Machine Learning, Gradient Descent, Gradient Descent Variations, Model Selection and Evaluation, Machine Learning Visualization,,

Module 3: (06 hrs.)

Deep Learning, Introduction to Tensors, Mathematical Foundations of Deep Learning, Building Data Pipelines for Tensor flow

Module 4: (10 hrs.)

Text Processing with Tensor flow, Classify Images, Regression, Classify Structured Data, Text Classification, Under fitting and Over fitting, Save and Restore Models, Transfer learning with pretrained, Transfer learning with TF hub, Image classification and visualization, Estimator API, Logistic Regression, Boosted Trees

Module 5: (04 hrs.)

Introduction to word embeddings, Recurrent Neural Networks , Time Series Forecasting with RNNs, Text Generation with RNNs.

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Course Outcome

1. Understand basic concepts of machine learning and deep learning.
2. Gain knowledge about Tensor flow.
3. Understand mathematical foundation and data pipeline of tensor flow.
4. Apply text processing with tensor flow.
5. Understand word embeddings and concept of RNN.

List of Text / Reference Books:

1. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer-Verlag New York Inc., 2nd Edition, 2011.
2. Tom M. Mitchell, “Machine Learning”, McGraw Hill Education, First edition, 2017.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016.
4. Aurelien Geon, “Hands-On Machine Learning with Scikit-Learn and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems”, Shroff/O'Reilly; First edition (2017).
5. Francois Chollet, "Deep Learning with Python", Manning Publications, 1 edition (10 January 2018).
6. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Shroff/O'Reilly; First edition (2016).
7. Russell, S. and Norvig, N. “Artificial Intelligence: A Modern Approach”, Prentice Hall Series in Artificial Intelligence. 2003.

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PSEC-MCS301	Distributed Database	3L (3 hrs.)	3 credits

Prerequisite: Operating Systems, Networks

Course Objective:

The objective of course is to provide insight to distributed database, normalization techniques and integrity rules. It also includes parallel database system along with object oriented models.

Course Contents: (40 hrs.)

Module 1: (08 hrs.)

Introduction: Distributed Data processing, Distributed database system (DDBMS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS.

Module 2: (08 hrs.)

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic integrity control

Module 3: (08 hrs.)

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing. Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction. Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms.

Module 4: (08 hrs.)

Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.

Module 5: (08 hrs.)

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing.

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Course Outcome

1. Understand the design principles in distributed systems and the architectures for distributed systems.
2. Apply various distributed algorithms related to clock synchronization, concurrency control, deadlock detection, load balancing, voting etc.
3. Analyze fault tolerance and recovery in distributed systems and algorithms for the same.
4. Analyze the design and functioning of existing distributed systems and file systems.
5. Implement different distributed algorithms over current distributed platforms.

List of Text / Reference Books:

1. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valdur 2. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill.

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LLC-MCS301	**Business Analytics**	**1L (1 hrs.)**	**1 credits**

Prerequisite: Business Analysis

Course Objective:

The main objective of this course is to give the student a comprehensive understanding of Business analytics methods

Course Contents: (16 hrs.)

Module 1: (6 hrs)
Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

Module 2: (4 hrs.)
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Module 3: (02 hrs.)
Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Module 4: (03 hrs.)
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Module 5: (03 hrs.)
Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

COURSE OUTCOMES

1. Extract, manipulate, and mine data sets from various sources to meet organizational needs.
2. Apply business analytics and business intelligence tools as a business process to support evidence-based decision-making.
3. Design statistical models using data mining techniques to meet the needs of a specific business process.
4. Develop software applications to manipulate data sets, correlate information, and produce reports.
5. Create and present data visualizations to communicate information to business stakeholders using multiple forms of communication.

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LLC-MCS301	Artificial Intelligence for Robots	1L (1 hrs.)	1 credits

Prerequisite: Artificial Intelligence

Course Objective:

- To understand the concept of Artificial Intelligence (AI)
- To learn various peculiar search strategies for AI
- To acquaint with the fundamentals of mobile robotics
- To develop a mind to solve real world problems unconventionally with optimality

Course Contents: (16 hrs.)

Module1: (04 Hrs)
Introduction: Introduction to artificial intelligence and intelligent agents, categorization of AI Problem solving: Production systems and rules for some AI problems: water jug problem, missionaries-cannibals problem etc. Solving problems by searching : state space formulation, depth first and breadth first search, iterative deepening.

Module2: (02 Hrs)
Intelligent search methods: A* and its memory restricted variants Heuristic search: Hill climbing, best-first search, problem reduction, constraint satisfaction. Game Playing: Minimax, alpha-beta pruning.

Module 3: (02 Hrs)
Knowledge and reasoning: Propositional and first order logic, semantic networks, building a knowledge base, inference in first order logic, logical reasoning systems.

Module 4: **(04 Hrs)**
Planning: Components of a planning system, Goal stack planning, Non-linear planning strategies, Probabilistic reasoning systems, Baysian networks. Learning: Overview of different forms of learning, Inductive learning, Learning decision trees,

Module 5: (04 Hrs)
Computational learning theory, Artificial neural networks. Evolutionary computation: Genetic algorithms, swarm intelligence, particle swarm optimization. Applications: Robotics, Natural language processing.

Course Outcome:

1. Design smart system using different informed search / uninformed search or heuristic approaches
2. Solve problem using problem decomposition and planning
3. Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem.
4. Apply the suitable algorithms to solve AI problems
5. Describe robotics in practice

Reference Books:

1. Deepak Khemani, "A First Course in Artificial Intelligence", Tata McGraw Hill, 2013.
2. S. Russel and P.Norvig,"AI: A modern approach", 3rd Edition, Pearson Education, 2009.

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LLC-MCS301	**Operations Research**	**1L (1 hrs.)**	**1 credits**

Prerequisite: Knowledge of probability distributions and statistics, and preferably basic calculus

Course Contents: (16 hrs.)

Module 1: (06 hrs.)

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Module 2: (3 hrs.)

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module 3: (2 hrs.)

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module 4: (02 hrs.)

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 5: (03 hrs.)

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Course Outcomes:

At the end of the course, the student should be able to

1. Formulate a linear programming problem for given problem and solve this problem by using Simplex techniques.
2. Evaluate sensitivity analysis to the given input data in order to know sensitive of the output.
3. Apply the concept of non-linear programming for solving the problems involving non-linear constraints and objectives.
4. Solve deterministic and Probabilistic inventory control models for known and unknown demand of the items.
5. Apply the dynamic programming to solve problems of discrete and continuous variables.

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List of Text / Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008

2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009

5. Pannerselvam, Operations Research: Prentice Hall of India 2010

6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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LLC-MCS301	**Waste to energy**	**1L (1 hrs.)**	**1 credits**

Prerequisite: Principles associated with effective energy management

Course Objective:

The objective of this course is to understand the principles associated with effective energy management and to apply these principles in recovering energy from wastes, systematically evaluate the main operational challenges in operating thermal and biochemical energy from waste facilities.

Course Contents: (16 hrs.)

Module 1: (02 hrs.)

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module 2: (04 hrs.)

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 3: (03 hrs.)

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module 4: (03 hrs.)

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module 5: (04 hrs.)

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

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Course Outcome:

1. Describe basic concepts of waste to energy resources and their conversion devices.
2. Understand the concept of pyrolysis and the production of different products by using pyrolysis.
3. Explore different types of biomass gasification techniques and understand Biochemical conversion of biomass for energy application.
4. Explore different types of biomass combustion techniques and their working operations.
5. Describe the basic concepts of biogas and explore Biogas plant technology and their applications.

List of Text / Reference Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

5. http://nptel.ac.in/courses/103107125/

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SBC – MCS301	Dissertation phase -I	20 P	10 Credits

Prerequisite: Knowledge of Core Subject of CSE-Data Science and Basic knowledge of Research Domains

Course Objective:

This course is designed to encourage design projects where students take what they have learned throughout the course of their ME program and apply it examine a specific idea. The students pursuing this course have to submit a thesis at the end of the last semester.

Course Outcomes (CO):

1. Investigate and identity the real world problems.
2. Design, develop and implement a domain specific design/research problem.
3. Develop acumen for higher education and research.
4. Enhance technical report writing skills.
5. Understand importance of research articles and learning preparation of research papers