Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) IV Semester (Artificial Intelligence & Data Science)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	MA41	BSC	Discrete Structure	70	20	10	-	-	100	3	1	-	4
2	AI42	PCC	Introduction to AI & ML	70	20	10	30	20	150	3	-	2	4
3	AI43	PCC	Data Base Management System	70	20	10	30	20	150	3	-	2	4
4	AI44	PCC	Operating System	70	20	10	30	20	150	3	-	2	4
5	AI45	PCC	Microprocessor & Microcontroller	70	20	10	-	-	100	3	1	-	4
6	AI46	ESC	Software Lab-II (R Programming)	-	-	-	30	20	50	-	-	4	2
			Total	**350**	**100**	**50**	**120**	**80**	**700**	**15**	2	**10**	**22**
7	AI47	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
8	AI48	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum 8 credits against additional MOOC courses in subject code AI47 for the award of Honours (Minor Specialization).									

Note: MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator.

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

BSC: Basice Science Course, PCC: Professional Core Course, ESC: Engineering Science Course, DLC: Distance Learning Course, MC: Mandatory Course

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(AICTE Model Curriculum Based Scheme and Syllabus)

Bachelor of Technology (B.Tech.) IV Semester, Branch (CS/IT/AI&DS)

COURSE CONTENT **w.e.f. July 2023**

Subject Code	Subject Name	Maximum marks Allotted			Total marks	Hours/Week			Total Credit
MA41	DISCRETE STRUCTURE	Theory			100	L	T	P	4
		End Sem	Mid-Sem Exam	Quiz/ Assignment		3	1	0	
		70	20	10					

Module 1: Set theory, relation and function (08 Hours)

Definition of sets, countable and uncountable sets, Venn Diagram, proofs of some general identities on sets relation: Definition, types of relation, composition general identities on sets relation: Definition, types of relation, composition ordering relation Function: Definition one to one, into and onto function, inverse function, composition of functions recursively defined functions, pigeonhole principle.

Module 2: Posets, Hasse diagram and lattices (08 Hours)

Introduction ordered set, Hasse diagram of partially, ordered set, isomorphic ordered set, well ordered set, properties of Lattices, bounded and complemented lattices. Propositional logic Proposition, first order logic, Basic logical operation, truth tables tautologies, contractions, Algebra of Proposition, logical implications, logical equivalence, Rules of inference, Predicates, the statement function.

Module 3: Theorem proving techniques (06 Hours)

Mathematical induction, Recurrence Relation and Generating Function: Introduction to recurrence relation and recursive algorithm, linear recurrence relations with constant coefficients, homogeneous solutions, particular solutions Total solution, generating functions, Solution by method of generating functions.

Module 4: Algebraic structure: Group, Ring, Field (10 Hours)

Definition properties types: Groups, Semi groups, Monoid groups, Abelian group, Properties of groups, Subgroup, Cyclic groups, Cosets, Normal subgroup, Homomorphism & Isomorphism of groups, Rings and Fields and finite fields: definition and examples.

Module 5: Graph theory (08 Hours)

Introduction and basic terminology of graphs, Planer graphs Multigraphs and weighted graphs Isomorphic graphs, Paths, Cycles and connectivity, shortest path in weighted graph Introduction to Eulerian paths and circuits, Hamiltonian paths and circuits, Graph coloring, chromatic number.

Books Reference:

1. Elements of Discrete Mathematics by C. L. Liu Tata McGraw-Hill Edition.
2. Discrete Mathematical structure with application in CS by Trembly, J.P. & Manohar; Mc Graw Hill.
3. Graph Theory with application to engineering and computer science by Deo, Narsingh; PHI.
4. Discrete Mathematics by Seymour Lipschutz and and mark Lipson Schaum's Outlines Tata McGraw-Hill Pub.

Course Outcomes:

At the end of the course the students will:

1. Solve basic problems based on set theory, relation and function.
2. Apply the concepts of Posets, Hasse diagram and Lattices to solve branch specific problems.
3. Establish the results employing theorem proving techniques.
4. Use the concept of Algebraic structures to solve branch specific problems.
5. Apply the concept of Graph theory to solve branch specific engineering related problems.

Dr. O. P. Chauhan
H.O.D,
Deptt. of App. Mathematics

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Bachelor of Technology (B.Tech.) IV Semester (Artificial Intelligence & Data Science)

COURSE CONTENTS w. e. f. July 2023

Subject Code	Subject Name & Title	Maximum Marks Allocated						Hours/ Weeks			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI 42	Introduction to AI & ML	70	20	10	30	20	150	3	-	2	4

Module I: Introduction to AI and State Space Search:
Meaning and definition of artificial intelligence, Study and comparison of breadth first search , depth first search Techniques, hill Climbing, Best first Search. A* algorithm, AO* algorithms etc., and various types of control strategies.

Representation of Knowledge: Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving,inferencing, monotonic and no monotonic reasoning.

Module II: Knowledge Inference & Reasoning:
Probabilistic reasoning, Baye's theorem, semantic networks scripts schemas, frames, conceptual dependency, fuzzy logic, forward and backward reasoning.

Game Playing:Game playing techniques like minimax procedure, alpha-beta cut-offs etc, planning, Study of the block world problem in robotics

Module III: Introduction to Machine Learning:
Basic Concepts, Understand and Formalize the Learning Problem, Model and Parameters, Training, Validation and Test Data. Metrics for Evaluation of Model

Performance: Accuracy, Precision, Recall, Confusion Matrix, Bias Variance tradeoffs, Overfitting and Under fitting. Types of Learning.

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Module IV: Supervised Learning:
Classification, Linear Regression, Linear Regression of One Variable using Gradient Descent Algorithm, Linear Regressions of Multiple Variables using Gradient Descent Algorithm. Logistic Regression. Decision Trees, Ensemble Learning – Boosting – Bagging, Naive Bayes Classifier, k-Nearest Neighbors Classifier, Support Vector Machine.

Module V: Unsupervised Learning:
Hierarchical Clustering, k-Means Clustering, Mixture Models, Density-Based Spatial Clustering of Applications with Noise (DBSCAN), Ordering Points to Identify the Clustering Structure (OPTICS) Introduction to Neural Network: Perceptron, Basic Neural Network Structure, Forward Propagation, Cost Functions, Error Backpropagation Algorithm, Training by Gradient Descent.

Reference Books:

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill.
2. Nelsson N.J., Principles of Artificial Intelligence, Springer Verlag, Berlin.
3. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education.
4. Dan W. Patterson, "Introduction to AI and ES", Pearson Education..
5. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", CRC Press.
6. Chapman and Hall, " Machine Learning and Pattern Recognition Series", CRC Press.
7. Tom M Mitchell, "Machine Learning", McGraw Hill Education.
8. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data",
Cambridge University Press.
9. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", Wiley.
10. EthemAlpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)" , MIT Press.
11. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press.

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List of experiments for AI and ML(AI 42) Lab

1. Write a program to implement BFS and DFS search strategies.
2. Write a program to implement A* algorithm and AO* algorithm.
3. Write a program to implement Min Max procedure.
4. Write a program to implement Linear regression .use appropriate dataset for training and testing. Compare the performance of your program of Linear regression with that of sklearn's implementation.
5. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Write a program to implement Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong prediction . Compare the performance of your implementation.with that of sklearn's implementation.
7. Write a program to implement the naïve Bayesian classifier for a sampling training data set stored as a CSV file. Compute the accuracy, precision and recall of the classifier, considering few test data sets.
8. Write a program to implement K- means clustering algorithm. Use appropriate data set for training and testing. Compare the performance of your Implementation with that of sklearn's implementation.
9. Write a program to compare the result of DBSCAN and OPTICS clustering algorithms : Use appropriate Dataset to demonstrate the clusters identified by these algorithms. You can use Python ML library classes of DBSCAN and OPTICS.
10. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

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COURSE CONTENTS w. e. f. July 2023

Subject Code	Subject Name & Title	Maximum Marks Allocated						Hours/ Weeks			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI 43	Data Base Management System	70	20	10	30	20	150	3	-	2	4

Module I: Introduction:

General introduction to database systems, DBMS Concepts and architecture, Data models- Hierarchical, Network and Relational, Three-schema architecture of a database, Data independence- Physical and Logical data independence. Challenges in building a DBMS, Various components of a DBMS.

Module II: Entity Relationship Model:

Conceptual data modeling - motivation, Entities, Entity types, Various types of attributes, Relationships, Relationship types, E/R diagram notations, Keys: Super key, Candidate key, Primary Key, Alternate key and Foreign key. Extended ER features: Specialization, Generalization, Aggregation, Examples.

Module III: Relational Data Model:

Concept of relations, Schema-instance distinction, Keys, referential integrity and foreign keys; Relational Algebra: Selection, Projection, Cross product, Various types of joins, Division, Example queries; Converting the database specification in E/R notation to the relational schema; SQL: Introduction, Data definition in SQL, Table, key and foreign key definitions, Update behaviors, Querying in SQL, Basic select-from- where block and its semantics, Nested queries, Aggregation functions group by and having clauses.

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Module IV: Functional Dependencies and Normal forms:
Importance of a good schema design, Problems encountered with bad schema designs, Motivation for normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, Minimal covers; Definitions of 1NF, 2NF, 3NF and BCNF, Decompositions and desirable properties of them; Multi-valued dependencies and 4NF, Join dependencies and definition of 5NF.

Module V: Transaction Processing and Recovery Concepts:
Concepts of transaction processing, ACID properties, Testing for Serializability of schedules, conflict & view serializable schedule, recoverability; Concurrency Control: Locking based protocols for CC; Deadlock handling; Recovery from transaction failures: Log based recovery, Checkpoints.

Reference Books:

1. AviSilberschatz, Henry F. Korth, S. Sudarsan, Database System Concepts.
2. Elmasi, R. and Navathe, S.B., "Fundamentals of Database Systems", Pearson Education.
3. Date, C. J., "Introduction to Database Systems", Pearson Education.
4. Ramakrishnan, R. and Gekhre, J., "Database Management Systems", McGraw-Hill.
5. Vipin C Desai, "An Introduction to Database Systems", Galgotia.

List of Experiment (AI 43 Lab)

1. Implementation of DDl. Commands of SQL with suitable examples-Create table , Alter table, Drop table
2. Implementation of DML commands of SQL , with suitable examples- Insert, update, Delete.
3. Implementation of different types of function with suitable example- Number function , Aggregate function, character function, Conversion function, Date function.
4. Implementation of different types of operations in Sql- Arithmetic operation , Logical operators, Comparison operator, Special operator , Set operation
5. Implementation of different types of join- inner join , Outer join, Natural join etc
6. Study and implementation of- Group By & Having clause, Order By clause , Indexing
7. Study and implementation of – Sub queries , Views.
8. Study and implementation of different types of constraints.
9. Study and implementation of Database Backup & Recovery commands . Study & Implementation of RollBack, Commit, Save point.
10. Creating Database / Table Space. Managing Users , Create User , Delete User , Managing roles: Grant , Revoke.
11. Study and implementation of PL / SQL.
12. Study and implementation of SQL Triggers.

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		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI 44	Operating System	70	20	10	30	20	150	3	-	2	4

MODULE-I Introduction to Operating System:

Architecture, Goals & Structures of Operating System, Basic functions, Interaction of O. S. & hardware architecture, System calls, Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S., Basics of Network Operating System, Server Operating System and Real Time Operating System.

MODULE-II Process Management:

Process Concept, Process states, Process control, Threads, Uni-processor Scheduling: Types of scheduling: Preemptive, Non preemptive, Scheduling algorithms: FCFS, SJF, RR, Priority, Thread Scheduling, Real Time Scheduling. System calls like ps, fork, join, exec family, wait. I/O Devices, Organization of I/O functions, Operating System Design issues.

MODULE-III Concurrency control:

Concurrency: Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, pipes, Message Passing, signals, Monitors, Classical Problems of Synchronization: Readers-Writers, Producer Consumer, and Dining Philosopher problem. Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, System calls like signal, kill.

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MODULE-IV Memory Management:

Memory Management requirements, Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, and Paging. Segmentation, Demand paging, Virtual Memory: Concepts, management of VM, Page Replacement Policies (FIFO, LRU, Optimal, Other Strategies), Thrashing., I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache.

MODULE-V Inter Process Communication and Multi-Processors:

Basic Concepts of Concurrency, Cooperating process, Advantage of Cooperating process, Bounded- Buffer ,Shared-Memory Solution, Inter-process Communication (IPC), Basic Concepts of Inter- Communication and Synchronization, Multi-Processor Based and Virtualization Concepts, Virtual machines; supporting multiple operating systems simultaneously on a single hardware platform; running one, operating system on top of another. Reducing the software Engineering effort of developing operating systems for new hardware architectures.True or pure virtualization.Para virtualization; optimizing performance of virtualization system; hypervisor call interface and process.

Reference Books:

1. Silberschatz, A., Galvin, P.B. and Gagne, G., "Operating System Concepts", John Wiley (2004) 7th ed.
2. W. Stallings, "Operating Systems Internals and Design Principles", Prentice Hall (2009) 6th ed.
3. Andrew S. Tanenbaum, "Operating Systems: Design and Implementation", Pearson (2006)
4. Andrew S. Tanenbaum, Modern Operating Systems, Pearson 4th edition (2014)
5. Dhamdhere, D.M., "Operating Systems: A Concept Based Approach", McGraw Hill (2008) 2nd ed.

List of Experiment (AI 44 Lab)

1. FCFS CPU scheduling algorithm.
2. SJF CPU scheduling algorithm.
3. Priority CPU scheduling algorithm.
4. Round Robin CPU scheduling algorithm.
5. Classical inter process communication problem (Producer Consumer).
6. Classical inter process communication problem (Reader Writer).
7. Classical inter process communication problem (Dining Philosophers)
8. FIFO page replacement algorithm..
9. LRU page replacement algorithm..
10. LFU page replacement algorithm..
11. Optimal page replacement algorithm.

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		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI45	Microprocessor & Microcontroller	70	20	10	-	-	100	3	1	-	4

Module I: Vonnewmann model-

CPU, Memory, I/O, System Bus, Memory address register, Memory data register, program Counter, Accumulator, Instruction register, Micro operations, Register Transfer Language, Instruction Fetch, decode and execution, Instruction formats. Control Unit Organization: Hardwired control Unit, Micro programmed Control Unit, Control Memory, Address Sequencing, Micro instruction formats, Micro program sequencer, Microprogramming. Memory organization: RAM, ROM, Memory maps, Cache memory, Cache mapping, Associative memory, Virtual memory. Memory management hardware.

Module II: Introduction to 8085

Fundamentals of Architecture of 8085, pin configurations, machine cycles and bus timings, Instruction classification and data formats, addressing modes, Data transfer operations, Arithmetic operations, Logic operations, Branch operations. Interrupts; 8085 interrupt process, multiple interrupt and priorities, vectored interrupts, Writing Assembly Language programs.

Module III: Interfacing

Memory interfacing, Interfacing I/O devices, Memory mapped I/O, Interfacing of 8085 with RAM and ROM, 8279 programmable Keyboard/Display interface, 8255A programmable Peripheral interface, Interfacing keyboard and seven-segment display and other applications using 8255A, 8254 , 8259A, Direct Memory Access (DMA), 8257 DMA Controller. Basic concept of serial I/O, Standards in serial I/O; RS 232C standard, 8085-serial I/O lines, 8251

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USART, interfacing scanned multiplexed displays and Liquid Crystal Displays, Interfacing a matrix keyboard. All Application based learning.

Module IV: Intel 8086 microprocessor:
Introduction to 16-bit microprocessor, 8086 architecture, pin functions.Basics of Register organization, Instruction Format; Addressing modes of 8086, Minimum and Maximum mode configuration, memory interfacing with 8086 in minimum and maximum mode. Interrupts, Instruction set of 8086; Data Transfer Instruction, Arithmetic Instructions, Branching and Looping Instructions, Flag Manipulation and machine control Instructions, Logical, Shift and Rotate Instructions, String Instructions, Assembler Directives and Operators; Assembly language Programming of microprocessor 8086.Advanced generations of processors.

Module V: Microcontroller:
Introduction to micro controller 8051, its architecture, Signal descriptions, Register set, Operational features; Program status word (PSW), memory and I/O addressing by 8051, I/O configuration, Counters and Timers, Interrupts and stack of 8051, Addressing modes and instruction set of 8051.

Reference Books:
1. Microprocessor architecture, Programming and Applications with the 8085 by Ramesh S.Gaonkar
2. Morris Mano, "Computer System Architecture" (PHI).
3. William Stalling, "Computer Organization and Architecture" (PHI).
4. BB Brey, "The Intel Microprocessors, Architecture, Programming and Interfacing" (PHI)
5. KM Bhurchandi and AK Ray, "Advanced Microprocessors and Peripherals" (Me-Graw Hill

Course Outcomes: After completion of course the students will be able to:

CO1:	Understand the fundamental concepts of computer system architecture
CO2:	Learn the operation and programming of 8085 microprocessor.
CO3:	Illustrate how the different peripherals are interfaced with microprocessor
CO4:	Analyze the architecture and working of 8086 microprocessor.
CO5:	Analyze of the working of 8051 microcontroller.

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		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI 46	Software Lab –II R Programming	-	-	-	30	20	50	-	-	4	2

History and overview of R install and configuration of R programming , Basic language elements and data structures, R+ knit r+ Markdown+ Git Hub, Data input/ output , Data storage formats Sub-setting objects , Vectorization , control structures, Functions, Scoping Rules Loop functions Graphics and visualization Grammar of Data manipulation (dplyr and related tools). Debugging / profiling Statistical simulation.

List of Experiments (AI 46 Lab)

Study of data analysis using MS- Excel (Prerequisite)

1. Study of basics Syntaxes in R.
2. Implementation of vector date objects opweration.
3. Implementation of matrix, array and factors and perform in R.
4. Implementation and use of data frames in R.
5. Create sample (Dummy) Data in R and perform data manipulation with R.
6. Study and implementation at various control structures in R.
7. Data manipulation with dplyr package.
8. Data manipulation with with data table package.
9. Study and implementation of Data Visualization with gplot 2.
10. Study and implementation of data transpose operations in R.

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Reference Books :

1. . R Cookbook paperback- 2011 by Teetor O Relly Publication.
2. Beginning R : the Statistical Programming Language by Dr. Mark Gardener, Willey Publication.
3. R Programming for Dummies by JorisMeysAndrie de Vries , Wiley Publications
4. Hands-on Programming with R by Grolemunds, O Reilly Publications.
5. R for Everyonr : Advanced Analytics and Graphics , ie. By Lander, Pearson Ltd.
6. R for Data Science Learning Dan Toomey December 2014 Packt Publishing Limited.

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