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 (Computer Science & Engineering)

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	CS42	PCC	Database Management Systems	70	20	10	30	20	150	3	-	2	4
3	CS43	PCC	AI & Machine Learning	70	20	10	30	20	150	3	-	2	4
4	CS44	PCC	Design and Analysis of Algorithms	70	20	10	30	20	150	3	-	2	4
5	CS45	PCC	Computer Organization and Architecture	70	20	10	-	-	100	3	1	-	4
6	CS46	ESC	Software Lab-II (Java)	-	-	-	30	20	50	-	-	4	2
			Total	**350**	**100**	**50**	**120**	**80**	**700**	**15**	**2**	**10**	**22**
7	CS47	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
8	CS48	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 CS47 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

Jabalpur Engineering College, Jabalpur (M.P.)

(Declared Autonomous by Govt. of Madhya Pradesh and Affiliated to RGPV, Bhopal)

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

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w.e.f. July 2023

Subject code	Subject Name	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS42	Database Management Systems	70	20	10	30	20	150	3	0	2	4

Course Contents:

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.

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.

Suggested Books:

1. Avi Silberschatz, 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.

Database Management Systems (CS42)

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Explain the fundamental concepts of Database Management Systems, Data models, Normalization, Transaction Management & Recovery.

CO2: Apply normalization concepts when designing the database.

CO3: Design the database's ER and Relational Model for the given problem.

CO4: Formulate SQI- commands (DDL, DML and DCL) for the given problem statement.

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		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS43	**AI & Machine Learning**	70	20	10	30	20	150	3	-	2	4

Course Content:

Module I: Introduction:

Definition of Artificial Intelligence and Machine Learning; History of AI; Various Types of Learning: Supervised learning, Unsupervised Learning, Semi-Supervised Learning, Reinforcement Learning and Deep Learning. Machine Learning Problem: Understand and Formalize the Learning Problem, Model, Parameters and Hyper-parameters. Dataset: Training, Validation and Test Dataset.

Module II: Data Collection, Preprocessing, and Feature Engineering

Data acquisition methods. Data preprocessing techniques (cleaning, normalization, handling missing values) Feature selection and engineering for ML models in practical settings. Handling unbalanced datasets and data augmentation techniques.

Module III: 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, Naive Bayes Classifier, k-Nearest Neighbors Classifier, Support Vector Machine. Decision Trees, Ensemble Learning, Random Forest– Boosting – Bagging

Module IV: Unsupervised Learning:

Introduction to clustering; Distance Metrics; Hierarchical Clustering, k-Means Clustering, KNN (k-nearest neighbors), DBSCAN, Independent Component Analysis, Principal Component Analysis,

Module V: Performance Evaluation and Practical Issues in Machine Learning:

Evaluating Model Performance: Mean Absolute Error, Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and R^2 (R-Squared). Accuracy, Confusion Matrix, Precision and Recall, F1-score, and AU-ROC. Bias Variance Tradeoffs, Overfitting, Underfitting. cross-validation methods such as leave-one-out (LOO) cross-validation, k-folds cross validation.

Suggested Books:

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", CRC Press.
2. Chapman and Hall, " Machine Learning and Pattern Recognition Series", CRC Press.
3. Tom M Mitchell, "Machine Learning", McGraw Hill Education.
4. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press.
5. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", Wiley.
6. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)" , MIT Press.

AI & Machine Learning (CS43)

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

CO1: Understand the distribution and diversity of Data and Extract features helpful in building predictive models.

CO2: Gain knowledge of Supervised and unsupervised Learning techniques.

CO3: Analyze Statistical learning techniques and Logistic Regression

CO4: Select appropriate Support Vector Machines and Perceptron Algorithm

CO5: Compare the performance of different learning models.

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		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS44	**Design and Analysis of Algorithms**	70	20	10	30	20	150	3	0	2	4

Course Contents:

Module I: Algorithm Analysis: Time, Space Tradeoff, Asymptotic Notations, Conditional asymptotic notation, removing condition from the conditional asymptotic notation, properties of big -Oh notation, Recurrence equations, Solving recurrence equations.

Module II: Divide and Conquer: Design and analysis of algorithms: binary search, Heap sort, Merge sort, quick sort, Multiplication of large Integers, Strassen's matrix Multiplication

Module III: Greedy Algorithms: Knapsack Problem, Job Scheduling algorithms, Huffman Code , Spanning tree.

Module IV: Dynamic Programming: General Method ,Multistage Graphs ,All-Pair of shortest paths ,Optimal Binary Search Trees ,0/1 Knapsack,Travelling Salesperson Problem

Backtracking: General method, 8 queen problem, sum of subsets, graph coloring, Hamiltonian Problem, knapsack problem, graph traversals.

Module V: Branch and Bound: General Methods (FIFO & LC), 0/1 knapsack, Introduction to NP Hard and NP Completeness

Suggested Books:

1. Horowitz & Sahani; Analysis & Design of Algorithm
2. Anany Levitin, "Introduction to Design and Analysis of Algorithm" pearson Education, 2003
3. Coreman Thomas, leiserson CE, Rivest RL Introduction to Algorithms, PHI
4. Dasgupta Algorithms , TMH
5. Ullman, Analysis & Design of Algorithms.
6. Michaer Goodrich, Roberto Tamassia, Algorithm Design, Wiley India.

Design and Analysis of Algorithms (CS44)

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Analyze the different algorithm design techniques for a given problem.
CO2: Design algorithms for various computing problems.
CO3: Argue the correctness of algorithms using inductive proofs and invariants.
CO4: Synthesize set operations
CO5: Explain how to cope with the limitations of algorithms.

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		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS45	**Computer Organization and Architecture**	70	20	10	-	-	100	3	1	0	4

Course Contents:

Module I:

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Module II:

Basic Computer organization and Design: Stored program organization, computer registers and common bus system, Instruction codes, computer instructions, timing and control, instruction cycle: Fetch and Decode, Register reference instructions; Memory reference instructions. input, output and Interrupt: configuration, instructions, program interrupt, Interrupt cycle, Microprogrammed control organization, address sequencing, microinstruction format and microprogram sequencer, Case study - instruction sets of some common CPUs.

Module III:

Central Processing Unit: Control unit design: hardwired and microprogrammed design approaches, Case study - Introduction to x86 architecture.

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Module IV:

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged And non-privileged instructions, software interrupts and exceptions. Programs and Processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB.

Module V:

Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Suggested books:

1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education Suggested reference books:
3. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill

Computer Organization and Architecture (CS45)
Course Outcomes: After completion of the course, Students will be able to:

CO1:To create the architecture of modern computers, and also understand how the computer performs arithmetic operations on positive and negative numbers.

CO2: Evaluation of different register transfers and instruction types.

CO3: Develop a detailed understanding of architecture and functionality of the central processing unit.

CO4:Exemplify in a better way the memory organization is communicating with the processing unit.

CO5:Understanding of I/O devices communicating with Processing Unit and also knowing the characteristics of multi processors.

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		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS46	**Software Lab-II (Java)**	-	-	-	30	20	50	-	-	4	2

1) Fundamentals of Object-Oriented Programming, Java Evolution, Java History
2) Java Features: Overview of Java Language, Constants, Variables and Data Types, Operators and Expressions, Decision making, branching and looping.
3) Classes, Objects and Methods, Access Specifiers, Inheritance, Arrays, String and Collections, Interfaces, Packages, Managing Errors and Exceptions
4) Multithreading, Applet Programming, Java AWT, Event Handling
5) Java I/O Handling, Java Database Connectivity.

Suggested Books:

1. Java How to Program, Sixth Edition, H.M.Deitel and P.J.Deitel, Pearson Education/PHI
2. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, Seventh Edition, Pearson Education.
3. Beginning in Java 2, Iver Horton, Wrox Publications.
4. The Complete Reference Java J2SE 5th Edition, Herbert Schildt, TMH Publishing Company Ltd, NewDelhi.
5. Big Java 2nd Edition, Cay Horstmann, John Wiley and Sons.

Software Lab-II (Java)(CS46)

Course outcome:After completion of the course, Students will be able to:

CO1. Use the syntax and semantics of Java programming language and basic concepts of OOP.
CO2. Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.
CO3. Explain and apply the concepts of Multithreading and Exception handling to develop efficient and error-free codes.
CO4. Illustrate applet programming and Java database connectivity.

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