

**Department of Higher Education  
Madhya Pradesh**

**Detailed Syllabus of  
M.Sc. (CS)  
One Year PG Programme  
Effective From July – 2025**

**Department of Higher Education, Govt of Madhya Pradesh**  
**M.Sc. (Computer Science)**  
**One Year PG Programme**  
**First-Year**

**Scheme B-1 (For Courses of Science & Arts Discipline having Major Practicum Components)**

Year/Semester		Course Level	Core Course / Dissertation	Credit	Practicum Courses	Credit	Internship/Apprenticeship/ Seminar OR VAC (CHEM / EESC)	Credit	Total Credit
First Year	Sem-I	500	CC-31 : Cloud Computing	6	PC-31 : Web Development using JAVA and Cloud Computing	4	Project/Internship -I	2	22
			CC-32: Theory of Computation OR Software Project Management	6	PC-32 : Data Science using Python	4			
		Research	Research Thesis / Projects/ Patents						22
	Sem-II	500	CC-41: Research Methodology	6	PC-41 : Analysis and Design of Algorithms	4	Project/Internship -II	2	22
			CC-42 : Compiler Design OR Soft Computing	6	PC-42 : Artificial Intelligence and Machine Learning	4			
		Course work + Research /Research	Research Thesis / Projects/ Patents						22

**Note:** Every Student is required to complete 22 credits in every semester either through Theory/Practicum course or Research/Thesis/Patent

**Department of Higher Education, Govt of Madhya Pradesh**  
**M.Sc. (Computer Science)**

**PART A: Introduction**

Program: One Year PG Degree		Class: M.Sc. (Computer Science)	Semester: I	Session: 2025-26
Subject: Computer Science				
1.	Course Code	CC-31		
2.	Course Title	Cloud Computing		
	Course Type(Core Course/Elective)	Core Course		
4.	Pre-Requisite(if any)	Basics of Computer Networks, Operating Systems, and Programming		
5.	Course Learning Outcomes(CLO)	<p>On completion of this course, learners will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand cloud computing concepts and its evolution.</li> <li>2. Analyze different cloud service models (IaaS, PaaS, SaaS) and deployment models.</li> <li>3. Gain hands-on experience with AWS/Microsoft Azure/ Google Cloud.</li> <li>4. Develop understanding of virtualization, cloud storage, security, resource management and edge computing.</li> <li>5. Plan multi cloud strategies in cloud-based applications</li> </ol>		
6.	Credit Value	<b>Theory</b> —6 Credits		
7.	Total Marks	Max. Marks: 60+40	Min. Passing : 24+16	

**PART B: Content of the Course**

No. of Lectures (in hours per week): 6Hrs. per week

Total No. of Lectures: 90Hrs.

Module	Topics	No. of Lectures
I	<p>Introduction to Cloud Computing, Evolution from Traditional, Computing to Cloud, Cloud Architecture and Components, Deployment Models: Public, Private, Hybrid, Community Cloud Multi-cloud &amp; Hybrid Cloud Strategies, Advantages &amp; Disadvantages of Cloud Computing.</p> <p><b>Activity:...Quiz on Introduction to Cloud computing(Questions based on frequently asked questions by employers)</b></p>	18
II	<p>Cloud Service Models and Virtualization :</p> <p>Service Models- IaaS, PaaS, SaaS Virtualization-Concepts, Types, Hypervisors, Types of hypervisors Overview of AWS, Microsoft Azure, Google Cloud, IBM Cloud Cloud Resource Management &amp; Scheduling, load balancing, autoscaling</p> <p>Case Study: Virtual Machine using Virtualbox /Azure, AWS EC2, Google Compute</p>	18

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	Engine, Microsoft Azure Virtual Machines <b>Activity:...Cloud computing use cases PaaS demonstration through popular youtube channels and question/answers</b>	
III	Cloud Storage, Security & Compliance : Cloud Storage: File, Block, Object Storage, Data Management & Providers (AWS S3/Google Cloud Storage/Azure Blob Storage) Cloud Security Challenges: Data Privacy, Threats, Identity & Access Management (IAM), Compliance & Legal Issues in Cloud, Disaster Recovery & Backup Strategies <b>Activity:...Quiz on Cloud computing use cases SaaS</b>	18
IV	Cloud Container Platforms, Serverless Computing, AI in Cloud Containers: Docker, Kubernetes Hands-on: AWS Lambda/Google Cloud Functions/Azure Functions Cloud-based AI/ML & Big Data Applications Internet of Things (IoT) and Cloud Computing <b>Activity:...Expert talks/ eContent demonstration on Cloud computing use cases DevOps and Software Development</b>	18
V	Emerging Trends & Future Directions : Edge Computing & Fog Computing, Blockchain & Quantum Computing in Cloud, Green Cloud Computing and Sustainability, Research Trends & Career Opportunities in Cloud Computing <b>Activity:...Group Discussion on Cloud computing use cases IoT</b>	18
<b>Keywords/ Tags:</b> Cloud Computing, Virtualization, SaaS, IaaS, PaaS, AWS, Google Cloud, Azure, Edge Computing, Serverless Computing, Security		

**PART C: Learning Resources**

**Textbooks, Reference Books, Other Resources**

**Suggested Readings:**

- “Cloud Computing & Big Data: From the Basics to Practical Use Cases” M Sudheep Elayidom | Sarith Divakar M | Lija Mohan | Tanmay Kumar Pandey | Shubham Agrawal, Cengage Publishers 1st Edition 2024
- “Mastering Cloud Computing: Foundations and Applications Programming”, Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill Education India, 2023 (2nd Edition)
- Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture," Pearson
- A. Bahga, V. Madisetti, "Cloud Computing: A Hands-On Approach," University Press
- Barrie Sosinsky, "Cloud Computing Bible," Wiley, 2010

**Suggestive digital platform web links:**

- **AWS Academy:** <https://aws.amazon.com/training/>
- **Google Cloud Training:** <https://cloud.google.com/training>
- **Microsoft Learn - Azure:** <https://learn.microsoft.com/en-us/training/>

**Suggestive equivalent online courses:**

- **Coursera:** Google Cloud Fundamentals
- **Udacity:** AWS Machine Learning Foundations

**PART D: Assessment and Evaluation**

<b>Internal Assessment :</b> Continuous Comprehensive Evaluation(CCE): --		End Term Examination(s) :--	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of	Marks		

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attendance in the class			
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

**PART A: Introduction**

Program: One Year PG Degree		Class: M.Sc. (Computer Science)	Semester: I	Session: 2025-26
Subject: Computer Science				
1.	Course Code	PC-31		
2.	Course Title	Web Development using JAVA and Cloud Computing		
3.	Course Type(Core Course/Practical Course)	Practical Course		
4.	Pre-Requisite(if any)			
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Develop JAVA programs using the concepts of inheritance, polymorphism, interfaces and packages.</li> <li>2. Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.</li> <li>3. Get exposure to advanced java concepts.</li> <li>4. Develop web based applications using MVC architecture.</li> <li>5. Implement cloud computing concepts using cloud platforms.</li> <li>6. Develop applications on cloud platforms</li> <li>7. Configure cloud security, IAM, and monitoring tools.</li> </ol>		
6.	Credit Value	<b>Theory</b> —4 Credits		
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40	

**PART B: Content of the Course**

No. of Labs (in hours per week):8Hrs.per week

Total No. of Labs: **120Hrs.**

	<b>Note</b> : Faculty is free to introduce innovative assignments as per student level. The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions. Theory of Cloud Computing shall be covered under course code CC-31.	
	<b>Theory to supplement Practical</b>	
Features of Java, Object-oriented programming overview, Introduction of Java Technologies, How to write simple Java programs, Data Types, Variables, Memory concepts, control statements, looping, Method Call Stack and Activation Record, Argument Promotion and Casting, Scope of declaration and Method Overloading, String Handling: The String constructors, String operators, Character Extraction, String comparison, String Buffer. Arrays: Declaring and Creating Arrays, Enhanced for Statement, Passing Arrays to Method, Multidimensional Arrays, Variable-Length Argument lists, Using Command-line Arguments Inheritance: Extending classes & related things, Packages and Interfaces: Defining a Package, Understanding CLASSPATH, Access Protection, Importing packages, creating own packages Exception Handling: Introduction, overview of doing it and keywords used, when to use it,		

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<p>Multithreading: What are threads, The java Thread model, Thread priorities, Thread life cycle, Thread Synchronization, Applets: Applet basics, Applet Architecture, Applet life cycle methods, Database connectivity: JDBC, The design of JDBC, Typical uses of JDBC</p> <p>Introduction to HTTP, web Server and application Servers, Installation of Application servers, Config files, Web.xml. Java Servlet, Servlet Development Process, Deployment Descriptors, Generic Servlet, Lifecycle of Servlet, Servlet Packages, Classes, Interfaces, and Methods, Handling Forms with Servlet, Various methods of Session Handling, various elements of deployment descriptors.</p> <p>JSP Basics: JSP lifecycle, Directives, scripting elements, standard actions, implicit objects. Connection of JSP and Servlet with different database viz. Oracle, MS-SQL Server, MySQL, java.sql Package, Querying database, adding records, deleting records, modifying records, types of Statement, Separating Business Logic and Presentation Logic, Building and using JavaBean, Session handling in JSP, Types of errors and exceptions handling.</p> <p>MVC Architecture Introduction to Remote Method Invocation, Introduction to Enterprise Java Bean, Types of EJB, Creating and working with Session Bean</p>		
<b>Total No. of Labs: 120Hrs.</b>	<b>List of Practical</b>	<b>No. of Labs</b>
I	I/O statements, Mathematical Computations, Swapping, Arrays, Control Statements, Looping, String handling, Functions, Method overloading	14
II	Class, CLASSPATH, Packages, Exception Handling, Multithreading, Thread: Life cycle, Synchronization, Applet : Life cycle method, database connectivity, JDBC	14
III	Installation of Application servers, Config files, Web.xml. Java Servlet, Deployment Descriptors Servlet: Generic Servlet, Lifecycle, Packages, Classes, Interfaces, and Methods Forms with Servlet, Session Handling methods, deployment descriptors.	14
IV	JSP : Lifecycle, Directives, Scripting elements, Implicit objects, JSP and Servlet : Connection with Oracle, MS-SQL Server, MySQL, java.sql Package, Session handling Querying database : Records (Adding, Deleting , Modifying) Errors and Exceptions handling	14
V	JavaBean : Enterprise Java Bean (EJB) Session bean : Creation and Working MVC : Remote Method Invocation	14
VI	<b>Introduction to Cloud Platforms</b> -Creating virtual machine using Virtual Box or VMWare - Setting up free-tier accounts on AWS/ Google Cloud/ Azure - Exploring cloud dashboards and services	20
VII	<b>Virtualization and Cloud Storage</b> - Creating and managing virtual machines (AWS EC2, Google Compute Engine) - Implementing cloud storage (AWS S3, Google Cloud Storage)	10
VIII	<b>Cloud Development Deployment and Management</b> - Develop web application through PAAS - Deploying web applications through Github/ Github Actions - Serverless computing with AWS Lambda / Google Cloud Functions - Load balancing and auto-scaling	10

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IX	<b>Security &amp; Monitoring in Cloud</b> - Identity and Access Management (IAM) - Cloud security groups, encryption, and compliance tools - Cloud monitoring and logging (AWS Cloud Watch/ Google Stackdriver)	10
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**Keywords/ Tags:**

**PART C: Learning Resources**

**Textbooks, Reference Books, Other Resources**

**Web Development using JAVA**

**Suggested Readings:**

- Java2:The Complete Reference by Herbert Schildt, Tata McGraw-Hill, 8th Edition, 2011
- Beginning Java EE 5: From Novice to Professional by K. Mukhar, Wrox Press
- An Integrated Approach to The Java Programming Language, Ken Arnold, James Gosling, David Holmes, 3rd Edition, Person Education, 2000
- Head First Java, Kathy, Sierra, Bert Bates, O'Reilly Publication, 2nd Edition, 2005

**Suggestive digital Platform web links:**

- <https://www.geeksforgeeks.org/web-development-using-java-technology-for-beginners/>
- <https://www.digitalocean.com/community/tutorials/java-web-application-tutorial-for-beginners>

**Suggestive equivalent online courses:**

- NPTEL Course Video Lectures on "Programming in java", By Prof. Debasis Samant, IIT Kharagpur
- Swayam Course Video Lectures on "Web Technology", By Prof. Dr. Ashutosh Kumar .Bhat

**Cloud Computing**

**Suggested Readings:**

- Cloud Computing & Big Data: From the Basics to Practical Use Cases
- M Sudheep Elayidom | Sarith Divakar M | Lija Mohan | Tanmay Kumar Pandey | Shubham Agrawal, Cengage Publishers 1st Edition 2024
- "Mastering Cloud Computing" - **Rajkumar Buyya**
- "Cloud Computing: Concepts & Architecture" - **Thomas Erl**

**Suggestive digital platform web links:**

- **AWS Academy:** <https://aws.amazon.com/training/>
- **Google Cloud Training:** <https://cloud.google.com/training>
- **Microsoft Learn - Azure:** <https://learn.microsoft.com/en-us/training/>

**Suggestive equivalent online courses:**

- **Coursera: Google Cloud Fundamentals**
- **Udacity: AWS Machine Learning Foundations**

**Suggested online Editors**

- <https://aws.amazon.com/cloud9/>
- <https://www.eclipse.org/cbe/>
- <https://github.com/features/codespaces>
- <https://www.gitpod.io/>

**PART D: Assessment and Evaluation**

<b>Internal Assessment : Continuous Comprehensive Evaluation (CCE): 40 Marks</b>		<b>End Term Examination(s) : 60 Marks</b> Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of	Marks		

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attendance in the class			
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			



**M.Sc. (Computer Science)**

**PARTA: Introduction**

Program: One Year PG Degree		Class: M.Sc. (Computer Science)	Semester: I	Session:2025-26
Subject: Computer Science				
1.	Course Code	CC-32		
2.	Course Title	Theory of Computation		
	Course Type(Core Course/Practical Course)	Core Course		
4.	Pre-Requisite(if any)	Discrete Mathematics		
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand computation theory through the use of abstract, formal models.</li> <li>2. Analyze and compare models of computation, including finite automata, context-free grammars, and turing machines.</li> <li>3. Learn tools for analyzing the computation models, their strengths and limitations</li> <li>4. Gain experience with creative mathematical problem solving and develop the ability to write correct, clear, and concise mathematical proofs.</li> </ol>		
6.	Credit Value	<b>Theory</b> —6Credits		
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40	

**PARTB: Content of the Course**

No. of Lectures (in hours per week):6Hrs.per week

TotalNo.ofLectures:90Hrs.

Module	Topics	No. of Lectures
I	Theory of Automata: String, Alphabet and Languages, Finite Automata, Finite State machine, Basic Definition. Description of a Finite Automaton, Deterministic Finite Acceptors Transition Graphs, Languages, Non-deterministic Finite Acceptors- Definition, Finite Automata with $\epsilon$ - moves, Equivalence of Deterministic and Nondeterministic Finite Acceptors, Conversion of NDFA to DFA, Removal of $\epsilon$ transition from $\epsilon$ – NDFA, Minimization of Finite Automata –Definition and Construction. Mealy and Moore models Definitions, Transformation of Mealy Machine into Moore Machine andvice-versa. <b>Activity:...Group Discussion on Importance of Automata</b>	18
II	Properties of Regular Sets: Pumping lemma for regular set, Closure properties of regular set. Formal Language: Basic Definition, Chomsky Classification of languages, Regular Expression and Connection between Regular Expressions and Regular Languages. <b>Activity:...Quiz on Languages and Expressions</b>	18

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III	Regular Grammars – Right and Left Linear Grammars, Equivalence between Regular Languages and Regular Grammars. Context-Free Grammars: Leftmost and Rightmost Derivations, Derivation Trees, Parsing and Ambiguity, Simplification of CFGs. Chomsky Normal Form, Greibach Normal Form, Cocke-Kasami-Younger Algorithm, Properties of Context-Free Languages. <b>Activity:...Important question/answer session on above mentioned algorithm</b>	18
IV	Pushdown Automata: Definition, Non-deterministic Pushdown Automata, Pushdown Automata for Context Free Languages Context-Free Grammars for Pushdown Automata. Deterministic Pushdown Automata and Deterministic Context-Free Languages. <b>Activity:...Group Discussion on Grammar Automata and Context Free Language.</b>	18
V	Turing Machine: Definition of Standard Turing Machine, Turing Machine as Language Acceptors and Transducers. Introduction to complexity theory, The Class P and NP. <b>Activity:...Group Discussion on the usage of Turing Machine.</b>	18

**Keywords/ Tags**

**PART C: Learning Resources**

**Textbooks, Reference Books, Other Resources**

**Text Book**

- J. E. Hopcroft, R. Motwani and J.D Ullman, Introduction to Theory, Languages and Computation; Third Edition, Pearson.

**Reference Book**

- Mishra and Chandrasekaran, Theory of Computer Science (Automata, language and Computation), Third Ed. 2006, Prentice Hall of India.
- Peter Linz, An Introduction to Formal Languages and Automata, 6/e, 2013.
- Martin, J.C.: Introduction to Languages and the Theory of Computation, Fourth Edition, 2010, Mc Graw Hill

**Suggested Readings:**

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**Suggestive digital platform web links:**

- <https://nptel.ac.in/courses/106103070>

**Suggestive equivalent online courses:**

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**PART D : Assessment and Evaluation**

<b>Internal Assessment : Continuous Comprehensive Evaluation(CCE): 40 Marks</b>		<b>End Term Examination(s) :60 Marks</b> Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

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**PART A: Introduction**

Program: One Year PG Degree		Class: M.Sc. (Computer Science)	Semester: I	Session: 2025-26
Subject: Computer Science				
1.	Course Code	CC-32		
2.	Course Title	Software Project Management		
3.	Course Type(Core Course/Elective)	Core Course		
4.	Pre-Requisite(if any)	<ul style="list-style-type: none"> <li>Knowledge of Software Engineering</li> <li>Basic of software testing concepts</li> </ul>		
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>Learn the skills required for planning, monitoring &amp; evaluation of software projects.</li> <li>Examine Requirements Elicitation, Project Management, Verification &amp; Validation of software projects.</li> <li>Get knowledge to select and apply project management techniques for process modeling, planning, estimation, process metrics and risk management.</li> <li>Gain exposure to tools and techniques of software project management.</li> </ol>		
6.	Credit Value	<b>Theory</b> — 6 Credits		
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40	

**PART B: Content of the Course**

No. of Lectures (in hours per week):6 Hrs.per week

TotalNo.ofLectures:90Hrs.

Module	Topics	No. of Lectures
I	<b>Introduction to Project Management:</b> What is a Project? What is Project Management? Project phases and project life cycle, Organizational structure, Qualities of a Project Manager, Work Breakdown Structure. Project Management Components: Project Integration Management, Project Plan, Project Development and Execution, Change controls and CCB, Configuration management. <b>Activity:...Quiz on importance of project management.</b>	18
II	<b>Scope, Time and Cost Management:</b> Strategic planning, Scope planning, definition, Verification and control, Activity planning, Schedule development and control, GANTT Chart, Cost estimation and Control, COCOMO model. <b>Activity:...Case study Discussion on importance of Cost-Benefit Analysis</b>	18
III	<b>Quality Management and Quality Standards:</b> Quality planning and assurance, CMM levels, KPA's, PSP/TSP. <b>Human Resource</b>	18

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	<b>Management and Communication Management:</b> Organizational planning, Staff acquisition, Information distribution, Reporting. <b>Activity:...Group Discussion on importance of Software Quality</b>	
IV	<b>Risk and Procurement Management:</b> Risk identification, Quantification and control, Solicitation management and control, Contract administration. <b>Activity:...Demonstration through live case studies on risk management</b>	18
V	Stakeholder Management and Software Metrics: Identifying Stakeholders, Planning, Managing and Monitoring, Stakeholder Engagement, The scope of software metrics, Size-oriented metrics, Function-oriented, Software metrics data collection, Analyzing software data. <b>Activity:...Group Discussion on Software Testing</b>	18

**Keywords/ Tags:** Project Management, Scope, Time, Cost, Integration Management, Risk and Procurement Management.

### PART C: Learning Resources

#### Textbooks, Reference Books, Other Resources

**Suggested Readings:**

- The Software Development Project: Planning and Management by Phillip Bruce and Sam M Pederson
- Software Project Management: A Process-Driven Approach by Ashfaq Ahmed
- Software Engineering Project Management by Richard Thayer, Edward Yourdon WILEY.
- Introduction to Software Project Management by Adolfo Villafiorita CRC Press
- Software Engineering by Roger Pressman McGraw-Hill
- Software Metrics for Project Management and process improvement by Robert B. Grady Prentice hall

**Suggestive digital platform web links:**

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**Suggestive equivalent online courses:**

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### PART D : Assessment and Evaluation

<b>Internal Assessment :</b> Continuous Comprehensive Evaluation(CCE): <b>40 Marks</b>		<b>End Term Examination(s) :60 Marks</b> Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

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**PARTA: Introduction**

Program: One Year PG Degree		Class: M.Sc. (Computer Science)	Semester: I	Session:2025-26
Subject: Computer Science				
1.	Course Code	PC-32		
2.	Course Title	<b>Data Science using Python</b>		
3.	Course Type (Core Course/Practical Course)	Practical Course		
4.	Pre-Requisite(if any)	Basics of Python Programming and Statistics		
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand the fundamentals of Data Science and its applications.</li> <li>2. Perform data wrangling, data handling, cleaning, and preprocessing techniques using python.</li> <li>3. Develop machine learning models for prediction and classification tasks.</li> <li>4. Apply tools &amp; techniques to utilize real-world datasets for decision-making.</li> <li>5. Apply python based tools &amp; techniques for prediction, analysis, visualisation and classification using real-world datasets</li> </ol>		
6.	Credit Value	<b>Theory—4 Credits</b>		
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40	

Total No. of Labs: 8 Hrs per week Total: 120Hrs.

**PARTB: Content of the Course**

**Remark:** Practicum course requires strong theoretical foundation therefore teachers may conduct Theory during Lab sessions to supplement the Practicum Courses. The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions.

**Theory to supplement Practical**

Digital preservation and analysis of ancient text & disease patterns in Ayurveda using Data Science

**Introduction to Data Science & Python Basics**–, Overview of Data Science and its Applications

- Python Basics: Data Types, Operators, Control Structures
- Functions and Modules in Python
- Introduction to Jupyter Notebook and Google Colab
- NumPy for Numerical Computing
- Pandas for Data Manipulation
- Data Cleaning: Handling Missing Values, Outliers, and Duplicates
- Exploratory Data Analysis (EDA)

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**Data Visualization and Statistical Analysis**

- Matplotlib & Seaborn for Data Visualization
- Descriptive and Inferential Statistics
- Correlation and Hypothesis Testing
- Feature Engineering Techniques

**Machine Learning using Python**

- Introduction to Machine Learning and its Types
- Supervised Learning: Linear & Logistic Regression, Decision Trees
- Unsupervised Learning: Clustering (K-Means, DBSCAN)
- Performance Metrics (Precision, Recall, F1-Score, ROC Curve, Accuracy)

**Advanced Topics and Applications**

- Introduction to Deep Learning with TensorFlow/Keras
- Introduction to Image Processing and Natural Language Processing (with specific focus on processing local languages too)
- Real-world Case Studies in Data Science
- Ethical Considerations and Future Trends in Data Science

**Practical**

Total No. of Labs:120Hrs.	Suggestive List of Practical Faculty is free to introduce innovative assignments as per student level.	No. of Labs
I	Digital preservation and analysis of ancient text & disease patterns in Ayurveda using Data Science <b>Python Basics for Data Science</b> - Introduction to Python, Jupyter Notebook, and Google Colab - Python Libraries: NumPy, Pandas	24
II	<b>Data Handling and Cleaning</b> - Data Preprocessing (Missing Values, Outliers, Duplicates) - Data Transformation (Encoding, Normalization, Scaling)	24
III	<b>Data Visualization and Statistics</b> - Plotting and visualizing data using Matplotlib and Seaborn - Performing statistical analysis and correlation tests	24
IV	<b>Machine Learning Models</b> - Implementing Linear Regression and Logistic Regression - Decision Trees and Random Forests - Unsupervised Learning (K-Means Clustering)	24
V	<b>Advanced Applications in Data Science</b> - Working with real-world datasets (Kaggle) - Image Processing and Natural Language Processing with Python - Project in Data Science	24

**Keywords/ Tags:** Data Science, Python, NumPy, Pandas, Matplotlib, Seaborn, Machine Learning, NLP, Data Cleaning

**PART C: Learning Resources**

**Textbooks, Reference Books, Other Resources**

**Suggested Readings:**

- **Reema Thareja**"Data Science and Machine Learning Using Python", McGraw Hill Education India 2022

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- **Joel Grus**, "Data Science from Scratch," O'Reilly, 2019
- **Jake VanderPlas**, "Python Data Science Handbook," O'Reilly, 2019
- **Wes McKinney**, "Python for Data Analysis," O'Reilly

**Suggestive digital platform web links:**

- **Kaggle Data:** <https://www.kaggle.com/>
- **Scikit-Learn Documentation:** <https://scikit-learn.org/>
- **Google Colab:** <https://colab.research.google.com/>
- <https://www.viirj.org/specialissues/2025/SP2502/1.pdf>

**Suggestive equivalent online courses:**

- **Coursera:** IBM Data Science Professional Certificate
- **Udacity:** Data Analyst Nanodegree
- **edX:** Harvard's Data Science Course

**Suggested online Editors**

<https://colab.research.google.com/>

<https://www.kaggle.com/code>

<https://deepnote.com/>

<https://datalore.jetbrains.com/>

**PARTD: Assessment and Evaluation**

<b>Internal Assessment : Continuous Comprehensive Evaluation(CCE): 40 Marks</b>		<b>End Term Examination(s) :60 Marks</b> Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/ Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			



**Department of Higher Education, Govt of Madhya Pradesh**  
**M.Sc. (Computer Science)**

**PART A: Introduction**

Program: One Year PG Degree		Class: M.Sc.	Semester: II	Session: 2025-26
Subject: Computer Science				
1.	Course Code	CC-41		
2.	Course Title	Research Methodology		
3.	Course Type(Core Course/Practical Course)	Core Course		
4.	Pre-Requisite(if any)			
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand the fundamental concepts of research, research questions, hypotheses, and variables, conduct a comprehensive literature review to identify relevant studies, synthesize existing knowledge, and identify research gaps.</li> <li>2. Identify research problems, formulate research questions, and design appropriate methodologies to address these problems.</li> <li>3. Identify and select appropriate research designs, such as experimental, observational, survey, qualitative, or mixed-methods, based on the research objectives.</li> <li>4. Apply appropriate data analysis methods, including statistical techniques or qualitative analysis, to draw meaningful conclusions from research data.</li> <li>5. Develop a well-structured research proposal, outlining research questions, methodology, expected outcomes, and a rationale for the study.</li> <li>6. Communicate research findings effectively through written reports, presentations, and academic papers following the principles of research ethics and integrity.</li> </ol>		
6.	Credit Value	<b>Theory</b> —6Credits		
7.	Total Marks	Max.Marks:60+40		Min.PassingMarks:24+16

**PART B: Content of the Course**

No. of Lectures (in hours per week): 6 Hrs. per week

Total No. of Lectures: 90Hrs.

Module	Topics	No. of Lectures
I	Research, its meaning, objectives and motivation, Research types, its significance, Research Ethics and Integrity, Plagiarism, its types & tools, Research Methods versus Methodology, Criteria of Good Research, Vedas, Upnishads and Darshana as a means of representing knowledge and presenting in the form of research paper <b>Activity: ...Debate on Indian knowledge system and its importance in research</b>	18
II	Research Process, literature review, research strategies and methods, Formulation of research problem, techniques for selecting a research problem <b>Activity: Invited lectures on selection of research topics. Lectures available over Internet may also be used</b>	18



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III	Research Design, features of good design, Different Research Designs/Methods: Pure and Applied Research, Exploratory or Formulative Research, Descriptive Research, Diagnostic Research, Evaluation Studies, Action Research, Experimental Research, Analytical Study or Statistical Method, Historical Research, Surveys, Case Study, Field Studies <b>Activity:...Group Discussion on research techniques</b>	18
IV	Hypothesis, Nature & Characteristics of Hypothesis, Sampling, Basis & its characteristics, Merits and demerits, Sampling method, choice & tradeoffs, Method of data Collections-Observation, Interview, Questionnaires and Schedules, Collection of Secondary Data, Statistics in Research, Correlation and Regression, Partial Correlation and Association in Case of Attributes, Quantitative and Qualitative Data Analysis Tools <b>Activity:...Group Discussion on research tools</b>	18
V	Interpretation, its techniques, Report Writing, Layout of the Research Report, Types of Reports (Research Proposal/Synopsis, Research Paper, and Thesis), Oral Presentation. Publication ethics: definition, introduction and importance, best practices/standards setting initiatives and guidelines: COPE, WAME, etc., Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, Violation of publication ethics, authorship and contributor ship, Predatory publishers and journal, Open access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc. E-Resources for research: Google Scholar, Shodh Ganaga, ShodhGangotri <b>Activity:...Asking one to two bright students to present on research paper writing and its quality.</b>	18

**Keywords/ Tags:**

**PART C: Learning Resources**

**Textbooks, Reference Books, Other Resources**

**Suggested Readings:**

1. Researching Information Systems and Computing by Briony Joates, SAGE SOUTH ASIA Ed
2. Research Methodology: A Step-by-Step Guide for Beginners, Kumar, Pearson Education.
3. Research Methodology Methods and Techniques, Kothari, C. R., Wiley Eastern Ltd.
4. The Research Methods Knowledge Base, by William M. K. Trochim, James P. Donnelly
5. Introducing Research Methodology : A Beginner "s Guide to Doing a Research Project, Uwe Flick
6. A Guide to Research and Publication Ethics by Partha Pratim Ray, New Delhi Publishers
7. RESEARCH & PUBLICATION ETHICS by Wakil Kumar Yadav, NOTION PRESS
8. Practical Research Methods, Dawson, C., UBSPD Pvt. Ltd.

**Suggestive digital platform web links:**

- <https://iksindia.org/research-projects.php>

**Suggestive equivalent online courses:**

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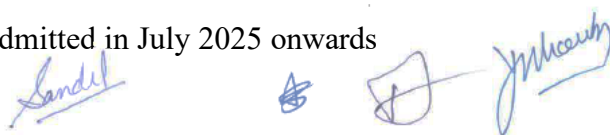
**PART D : Assessment and Evaluation**

<b>Internal Assessment : Continuous Comprehensive Evaluation(CCE): 40 Marks</b>		<b>End Term Examination(s) :60 Marks</b> Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

*Sandil* *B* *J. K. Singh*

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<b>PARTA: Introduction</b>			
Program: One Year PG Degree		Class: M.Sc.	Semester: II
Session:2025-26			
Subject: Computer Science			
1.	Course Code	PC-41	
2.	Course Title	Analysis and Design of Algorithms	
3.	Course Type(Core Course/Practical Course)	Practical Course	
4.	Pre-Requisite(if any)	Study techniques to design efficient algorithms and analyse their time complexity for effective problem-solving.	
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Compare and analyze different data structures and sorting algorithms.</li> <li>2. Understand, Analyse &amp; Implement different algorithm design paradigms such as greedy, dynamic programming, backtracking, branch and bound for effective problem-solving.</li> <li>3. Understand, Analyse &amp; Implement major graph algorithms.</li> <li>4. Understand time &amp; space complexity of algorithms.</li> </ol>	
6.	Credit Value	Theory—4 Credits	
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40
<b>PARTB: Content of the Course</b>			
No. of Labs (in hours per week): 8 Hrs. per week			
Total No. of Labs : 120Hrs.			
<b>Remark :</b> Practicum course required strong theoretical foundation therefore teachers may conduct Theory during Lab sessions to supplement the Practicum Courses. The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions.			
<b>Theory to supplement Practical</b>			
Introduction: Algorithmic thinking through Indian Knowledge System, Algorithms, 18analyzing algorithms, Complexity of algorithms, Growth of functions, Asymptotic Notations, Recurrence Relations and their Solution Methods.			
Dynamic Programming: 0/1 Knapsack, Longest Common Subsequence (LCS), Matrix Chain Multiplication. Edit distance, All pair shortest paths – Warshal’s and Floyd’s algorithms, Optimal binary search tree, Bellman-Ford algorithms.			
Graph: Graph Traversal-Breadth First Search, Depth First Search Greedy Methods: Fractional Knapsack, Activity Selection Problem. Minimum Spanning trees – Prim’s and Kruskal’s algorithms. Single source shortest paths – Dijkstra’s algorithms.			
Sorting and Order Statistics – Divide-Conquer approach with Quick sort, Merge sort, Comparison of sorting algorithms, sorting in linear time (Counting, Radix, Bucket sort), Heap Sort. Advanced Data Structures: Red-Black Tree-Properties, Insertion, B-Trees-Creation, Insertion, and Deletion. Introduction to Binomial Heaps – Merge, Union Operation, Fibonacci Heaps – Insertion, Finding Minimum Key, Union.			
Backtracking: Graph Coloring, n-Queen Problem, Sum of Subset, Branch and Bound: Travelling Salesman			



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Problem, Introduction to P, NP, NP-complete, NP-Hard.		
<b>Practical</b>		
Total No. of Labs: 120Hrs.	Suggestive List of Practical Faculty is free to introduce innovative assignments as per student level	No. of Labs
I	Implement the following sorting algorithm for a given set of elements and determine the time required to sort the elements. The elements can be read from a file or can be generated using the random number generator. • Quick sort, Merge sort, Counting, Radix, Bucket sort, Heap Sort	20
II	Write programs to implement the following data structures: • Red-Black Tree, B-Trees	20
III	Write programs to print all the nodes reachable from a given starting node in a graph using the following traversal methods: • Breadth First Search (BFS), Depth First Search (DFS)	20
IV	Write programs to find the optimal solution for the following problems using the Greedy Method: • Fractional Knapsack, Activity Selection Problem. • Minimum Spanning trees – Prim's and Kruskal's algorithms. • Single source shortest paths - Dijkstra's algorithms	20
V	Write programs to find the optimal solution for the following problems using the Dynamic Programming approach: • 0/1 Knapsack • Longest Common Subsequence (LCS) • Matrix Chain Multiplication • Edit distance • All pair shortest paths – Warshal's and Floyd's algorithms • Optimal binary search tree • Bellman-Ford algorithms • Graph Coloring • n-Queen Problem • Sum of Subset	20
VI	Write a program to find the optimal solution for the following problems using the Branch and Bound method: • Travelling Salesman Problem	20
<b>Keywords/ Tags:</b> Algorithms, Sorting, Order Statistics, Data Structures, Graph, Greedy Methods, Knapsack, Longest Common Subsequence (LCS), Backtracking, Graph Coloring		
<b>PART C: Learning Resources</b>		
<b>Textbooks, Reference Books, Other Resources</b>		
<b>Suggested Readings:</b> <ul style="list-style-type: none"> <li>• Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest (2022), Introduction to Algorithms, Fourth edition, Prentice Hall of India.</li> <li>• Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran (2008), "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd.</li> <li>• Gilles Brassard Paul Bratley (1996), "Fundamentals of Algorithms", Prentice Hall.</li> <li>• Anany Levitin (2009), "An Introduction to Design and Analysis of Algorithms", Pearson.</li> </ul>		
<b>Suggestive digital platform web links:</b> <ul style="list-style-type: none"> <li>• NPTEL Course Video Lectures on "Design and Analysis of Algorithms" - By Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan IIT Bombay</li> </ul>		

- NPTEL Course Video Lectures on "Design and Analysis of Algorithms" - Prof. Madhavan Mukund, Chennai Mathematical Institute.

**Suggested online Editors**

- <https://visualgo.net/en>
- <https://replit.com/>
- <https://www.programiz.com/python-programming/online-compiler/>
- <https://leetcode.com/playground/>

**PART D : Assessment and Evaluation**

**Internal Assessment :** Continuous Comprehensive Evaluation(CCE): --

End Term Examination(s) : --

Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions:

**PARTA: Introduction**

Program: One Year PG Degree		Class: M.Sc.	Semester: II	Session:2025-26
Subject: Computer Science				
1.	Course Code	PC-42		
2.	Course Title	Artificial Intelligence and Machine Learning		
3.	Course Type (Core Course/Practical Course)	Practical Course		
4.	Pre-Requisite(if any)	Knowledge of Object Oriented Programming Concepts		
5.	Course Learning Outcomes(CLO)	<p>On completion of this course, learners will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand core AI, ML concepts and problem-solving techniques, including search algorithms and real-world applications.</li> <li>2. Gain insight into knowledge representation, reasoning, and natural language processing for developing expert systems.</li> <li>3. Understand the fundamentals of machine learning, supervised &amp; unsupervised learning techniques, and performance evaluation metrics.</li> <li>4. Develop ability to build and train deep learning models through practical implementation of neural networks, including convolutional neural networks.</li> <li>5. Apply the concepts of advanced neural network architectures like RNNs and LSTMs, along with reinforcement learning principles and in areas like computer vision and NLP.</li> </ol>		
6.	Credit Value	<b>Theory</b> —4 Credits		
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40	

**PARTB: Content of the Course**

No. of Labs (in hours per week):8Hrs.per week

**Total No. of Labs:120Hrs.**

**Remark:** Practicum course requires strong theoretical foundation therefore teachers may conduct Theory during Lab sessions to supplement the Practicum Courses. The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions.

**Theory to Supplement Practical**

Indian Knowledge system and AI, Introduction to Artificial Intelligence (AI): Definition, History, and Goals of AI. Problem-Solving in AI: State space search, Production systems, Search strategies: Uninformed search - Breadth-First Search (BFS), Depth-First Search (DFS). Heuristic Search: Hill climbing, Best-first search, A\* and AO\* search, Constraint Satisfaction, Means-end Analysis. Applications of AI.

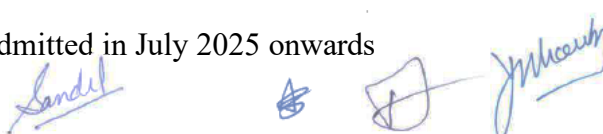
Fundamental Concepts in AI: Knowledge Representation: Propositional logic and predicate logic, Semantic networks and frames. Reasoning - Forward chaining, backward chaining, and resolution and its relation to Indian Knowledge System. Sankrit and AI models. Expert Systems and Rule-Based Systems: Bayes' Theorem, introduction to fuzzy logic, Case study: MYCIN.

Natural Language Processing (NLP): Uses of NLP, Syntactic and Semantic Processing, ATN and RTN.

Introduction to Machine Learning (ML): use of ML, convex optimization, data visualization, hypothesis function and testing, data distributions, data preprocessing, data augmentation, normalizing data sets. Types of ML - supervised, unsupervised, and reinforcement learning. Supervised Learning: Linear regression, Logistic

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regression, Decision trees. Performance Evaluation Metrics: accuracy, precision, recall, and F1-score, Confusion matrices. Unsupervised Learning: Clustering Algorithms – k-means and hierarchical clustering, metrics to evaluate clusters such as silhouette score.		
Introduction to Neural Networks: Structure of neural networks. Activation functions like sigmoid, ReLU, etc., weights and bias, loss function, gradient descent, multilayer network, backpropagation, weight initialization, training, testing, unstable gradient problem, auto encoders, batch normalization, dropout, L1 and L2 regularization, momentum, tuning hyper parameters. Convolutional neural network, flattening, subsampling, padding, stride, convolution layer, pooling layer, loss layer, dense layer 1x1 convolution, inception network, input channels, transfer learning, one shot learning, dimension reductions, implementation of CNN like tensor flow, keras etc.		
Recurrent neural network, Long short-term memory, gated recurrent unit, translation, beam search and width, Bleu score, attention model, Reinforcement Learning, RL-framework, MDP, Bellman equations, Value Iteration and Policy Iteration, Actor-critic model, Q-learning, SARSA. Application of machine learning in computer vision, speech processing, natural language processing etc.		
<b>Practical</b>		
S. No.	Suggestive List of Practical Faculty is free to introduce innovative assignments as per student level	No. of Labs
1	Indian Knowledge System and Artificial Intelligence Algorithms on BFS and DFS and implement it in C++ or Java.	12
2	Algorithm for A* search and trace it with an example.	12
3	Setup a python environment for Machine Learning with Anaconda.	12
4	Python Basic Programming including Python Data Structures such as List, Tuple, Strings, Dictionary, Lambda Functions, Python Classes and Objects and Python Libraries such as Numpy, Pandas, Matplotlib etc.	12
5	Brief Study of Machine Learning Frameworks such as Open CV, Scikit Learn, Keras, Tensorflow etc.	12
6	The probability that it is Friday and that a student is absent is 3%. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.	12
7	Extract the data from database using python	12
8	Implement linear regression using python	12
9	Write a program to demonstrate the working of the decision tree based ID3 algorithm by considering a dataset.	12
10	Implement K-Means Clustering using Python. Vary the number of k values as follows and compare the results: i. 1 ii. 3 iii. 5 iv. 7 v. 11	12
<b>Keywords/ Tags:</b> Artificial intelligence, heuristic search, predicate logic, reasoning, supervised, unsupervised and reinforcement learning, neural network, convolutional neural network, recurrent neural network		
<b>PART C: Learning Resources</b>		
<b>Textbooks, Reference Books, Other Resources</b>		
<b>Suggested Readings:</b>		
<ul style="list-style-type: none"> <li>Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill</li> </ul>		





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- Dan W. Patterson “Introduction to Artificial Intelligence and Expert Systems”, Prentice India.
- Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer-Verlag New York Inc., 2nd Edition, 2011.
- Tom M. Mitchell, “Machine Learning”, McGraw Hill Education, First edition, 2017.
- Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016
- Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", Oreily, Third Edition, 2022.
- Andreas Muller and Sarah Guido, "Introduction on to Machine Learning with Python: A Guide for Data Scientists", Oreily, 2016.

**Suggestive digital platform web links:**

- <https://www.viirj.org/specialissues/2025/SP2502/29.pdf>

**Suggestive equivalent online courses:**

- <https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-cs42/>
- <https://nptel.ac.in/courses/106105152>
- Coursera Course Video Lectures on "Machine Learning" - By Prof. Andrew Ng, Stanford University.

**Suggested online Editors**

- <https://colab.research.google.com/>
- <https://www.kaggle.com/code>
- <https://deepnote.com/>
- <https://notebooks.azure.com/>

**PARTD: Assessment and Evaluation**

<b>Internal Assessment : Continuous Comprehensive Evaluation(CCE): 40 Marks</b>		<b>End Term Examination(s) :60 Marks</b> Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

**PARTA: Introduction**

Program: One Year PG Degree		Class: M.Sc.	Semester: II	Session:2025-26
Subject: Computer Science				
1.	Course Code	CC-42		
2.	Course Title	Compiler Design		
	Course Type(Core Course/Elective)	Discipline Specific Elective		
4.	Pre-Requisite(if any)	To equip students with the knowledge and skills to design, implement, and optimize compilers by understanding their structure, phases, and		



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		tools.
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand the design and functioning of Lexical Analyzers.</li> <li>2. Develop syntax analyzers using top-down parsing and tools like YACC and LEX.</li> <li>3. Implement efficient bottom-up parsers, including SLR, Canonical LR, and LALR.</li> <li>4. Conduct semantic analysis and create intermediate representations.</li> <li>5. Apply optimization techniques and manage effective code generation</li> </ol>
6.	Credit Value	Theory—6
7.	Total Marks	Max.Marks:60+40      Min.PassingMarks:24+16

**PARTB: Content of the Course**

No. of Lectures (in hours per week):6Hrs.per week

TotalNo.ofLectures:90 Hrs.

Module	Topics	No. of Lectures
I	Use of sanskrit in language development, panini grammer & compiler, Compiler Structure: Compilers and Translators, Various Phases of Compiler, Lexical Analysis: The role of Lexical Analyzer, A simple approach to the design of Lexical Analyzer, Implementation of Lexical Analyzer. <b>Activity:...Quiz on compilers, assemblers and translators</b>	18
II	LMD (Leftmost Derivation), RMD (Rightmost Derivation), Derivation and Parse Tree, Ambiguity, Capabilities of CFG. Basic Parsing Techniques: Top-Down parsers with backtracking, Non- Recursive Predictive Descent Parser, YACC (Yet Another Compiler Compiler), LEX utility tool. <b>Activity:...Group Discussion on Parsing Techniques</b>	18
III	Bottom-up Parsers, Shift-Reduce Parsing, Operator Precedence Parsers, LR Parsers: SLR (Simple LR), Canonical LR (Left-to-right, LALR (Look-Ahead LR). <b>Activity:...Group Discussion on LR,SLR and Parsing Techniques</b>	18
IV	Semantic Analysis, Memory overflow underflow, Type matching, mismatching, global local variable. Intermediate Code Generation: Different Intermediate forms: three address code, Quadruples & Triples. Syntax Directed translation mechanism. Control flow, syntax tree, postfix translation. <b>Activity:...Group Discussion on Semantic Analysis</b>	18
V	Optimization and Code Generation: Local optimization, Loop optimization, Basic blocks and flow graphs, DAG, Data flow analyzer, Symbol Table management, Error handler. <b>Activity:...Live demonstration of codeOptimization Techniques through code snippets</b>	18

**Keywords/ Tags:** Compilers, Translators, LMD, RMD, CFG, LEX, Operator Precedence, Semantic Analysis, Memory overflow underflow, Control flow, Optimization and Code Generation, DAG, Error handler.

**PART C: Learning Resources**

**Textbooks, Reference Books, Other Resources**

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**Suggested Readings:**

- Principles of Compiler Design - Alfred V. Aho, Jeffrey D. Ullman, Narosa Publishing House.
- Compiler Construction: Principles and Practice - Kenneth C. Loudon, 1st Edition, Cengage Learning.
- Compiler Design in C - A. C. Holub, Prentice-Hall Inc., 1993.
- Compiler Design - Raghavan, TMH Publications.

**Suggestive digital platform web links:**

- [https://onlinecourses.nptel.ac.in/noc25\\_cs13/preview](https://onlinecourses.nptel.ac.in/noc25_cs13/preview)
- <https://nptel.ac.in/courses/106106237>
- [https://www.google.com/search?q=IKS+and+compiler&rlz=1C1RXQR\\_enIN993IN993&oq=IKS+and+compiler&gs\\_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigAdIBCDM2MDFqMWO3qAIIIsAIB8QWglAAQIV7dC\\_EFoJQAEJVe3Qs&sourceid=chrome&ie=UTF-8](https://www.google.com/search?q=IKS+and+compiler&rlz=1C1RXQR_enIN993IN993&oq=IKS+and+compiler&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigAdIBCDM2MDFqMWO3qAIIIsAIB8QWglAAQIV7dC_EFoJQAEJVe3Qs&sourceid=chrome&ie=UTF-8)
- <https://www.ciks.anaadi.org/post/did-panini-dream-of-designing-compilers-exploring-panini-s-asthadhyayi-in-india-s-long-grammarians>

**PART D : Assessment and Evaluation**

<b>Internal Assessment : Continuous Comprehensive Evaluation(CCE): 40 Marks</b>		<b>End Term Examination(s) :60 Marks</b> Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

**PART A: Introduction**

PART A: Introduction				
Program: One Year PG Degree		Class: M.Sc.	Semester: II	Session:2025-26
Subject: Computer Science				
1.	Course Code	CC-42		
2.	Course Title	Soft Computing		
	Course Type(Core Course/Elective)	Core Course		
4.	Pre-Requisite(if any)	<ul style="list-style-type: none"><li>• A strong mathematical background</li><li>• Proficiency with algorithms</li><li>• Problem solving skills and critical thinking</li></ul>		
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <div><div>1.</div><div>Understand soft computing techniques based on human experience.</div></div> <div><div>2.</div><div>Develop the skills to design, analyze, and perform experiments on real-life problems using different learning Algorithms</div></div> <div><div>3.</div><div>Conceptualize fuzzy logic and its applications in real-life problems.</div></div> <div><div>4.</div><div>Develop mathematical foundation to carry out optimization using genetic algorithm.</div></div>		
6.	Credit Value	Theory—6 Credits		
7.	Total Marks	Max.Marks:60+40		Min.PassingMarks:24+16

**PART B: Content of the Course**

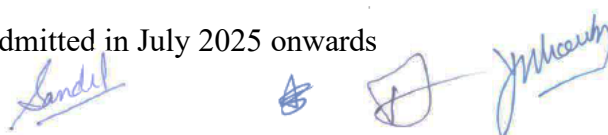
No. of Lectures (in hours per week):6Hrs.per week

TotalNo.ofLectures:90Hrs.

Module	Topics	No. of Lectures
I	Soft Computing: Introduction of Soft Computing, Soft Computing Verses Hard Computing, Various Types of Soft Computing Techniques, Application of Soft Computing, Artificial Intelligence: Introduction, Various types of Production System, Characteristics of production system, breadth first search, depth first search techniques, other search techniques like Hill Climbing, Best first search, A* Algorithm, AO* Algorithms and various types of control strategies, knowledge represent issues, propositional and predicted logic, monotonic and non monotonic reasoning, forward reasoning, backward reasoning, weak and strong slot and filler structures, NLP <b>Activity:...Quiz on applications of soft computing</b>	18
II	Neural Network: Definition, Advantages, Applications and Introduction to ANN: Introduction to ANN, History of Neural Network, Structure and working of Biological Neural Network, Neural net architecture, Models of neuron-Mc Culloch& Pitts model, Perceptron, Applications of neural	18

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	<p>networks, Comparison of BNN and ANN</p> <p>Learning Algorithms: Learning and Memory, Learning Algorithms, Numbers of hidden nodes, Error Correction and Gradient Descent Rules, Perceptron Learning Algorithms, Supervised SPPU</p> <p>Learning Back propagation, Multilayered Network Architectures, Back propagation Learning Algorithm, Feed forward and feedback neural networks, example and applications.</p> <p><b>Activity:...Invited Lectures/Internet references on Applications of neural networks</b></p>	
III	<p>Associative learning: Introduction, Associative Learning, Hopfield network, Error Performance in Hopfield networks, simulated annealing, Boltzmann machine and Boltzmann learning, State transition diagram and false minima problem, stochastic update, simulated annealing.</p> <p>Competitive learning Neural network: Components of CL network, Pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.</p> <p>Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Pattern Classification</p> <p>Convolution Neural Network: Building blocks of CNNs, Architectures, convolution /pooling layers, Padding, Strided convolutions, Convolutions over volumes, SoftMax regression, Deep Learning frameworks, Training and testing on different distributions, Bias and Variance with mismatched data distributions, Transfer learning, multi-task learning, end-to-end deep learning, Application of ANN:</p> <p>Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech.</p> <p><b>Activity:...Group Discussion on Associative learnings and SOM</b></p>	18
IV	<p>Fuzzy Set Overview of Conventional Set, Theory Introduction to Fuzzy Sets, Properties of Fuzzy Sets, Operations on Fuzzy Sets, Crisp Relation, Fuzzy Relation, Tolerance and equivalence relation, Fuzzy Tolerance and equivalence relation, Fuzzy Max-Min and Max-Product Composition, Membership Functions, Fuzzification, Defuzzification to crisp sets, <math>\lambda</math>-Cuts for fuzzy Relations, Fuzzy (Rule-Based) system, Graphical technique of inference, Membership value assignment-Intuition, Inference.</p> <p><b>Activity:...Group Discussion on importance on fuzzy sets</b></p>	18
V	<p>Genetic Algorithms</p> <p>Introduction to Genetic Algorithms History of Genetic Algorithms, What is Genetic Algorithms? Strengths and weaknesses of Genetic Algorithms, Traditional Optimization and Search Techniques, Basic terminologies in Genetic Algorithm, Operators in Genetic Algorithm, Simple Genetic Algorithm, Applications of Genetic Algorithms Optimization Problems, Combinational Optimization, Machine Learning, Image Processing.</p> <p><b>Activity:...Group Discussion on Applications of Genetic Algorithms</b></p>	18
<p><b>Keywords/ Tags:</b> Artificial Intelligence, Fuzzy Set, CNN, Genetic Algorithms</p>		



**PART C: Learning Resources**

**Textbooks, Reference Books, Other Resources**

**Suggested Readings:**

- Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
- Laurene Fausett: Fundamentals of Neural Networks: Architectures, Algorithms & Apps, Pearson, 2004.
- An introduction to neural networks, Gurney, Kevin, CRC press.
- Neural Networks By Satish Kumar, Tata McGraw Hill
- Introduction to Soft Computing by Deepa & Shivanandan, Wiley Publication
- Fuzzy Logic With Engineering Applications by Timothy Ross, Wiley Publication

**Suggestive digital platform web links:**

- e-Books: 1. <https://www.pdfdrive.com/neural-networks-a-comprehensive-foundationpdf18774300.html>
- <https://www.pdfdrive.com/elements-of-artificial-neural-networks-e17103719.html>
- <https://www.pdfdrive.com/neural-networks-methodology-and-applicationse38107895.html> MOOC Courses:

**Suggestive equivalent online courses:**

- <https://nptel.ac.in/courses/117105084>
- <https://www.coursera.org/projects/predicting-weather-artificial-neural-networks>

**PART D : Assessment and Evaluation**

**Internal Assessment :** Continuous Comprehensive Evaluation(CCE): **40 Marks**

**End Term Examination(s) :60 Marks**  
Time : 03:00 Hours

Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions:

*Sandil* *B* *J. K. Singh*

**Department of Higher Education, Govt of Madhya Pradesh**  
**M.Sc. (Computer Science)**

**PART A: Introduction**

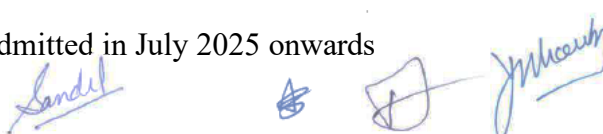
Program: One Year PG Degree		Class: M.Sc.	Semester: II	Session: 2025-26
Subject: Computer Science				
1.	Course Code	CC-43		
2.	Course Title	Project Work/ Internship		
	Course Type(Core Course/Elective)	Core Course		
4.	Pre-Requisite(if any)	The students should have knowledge about the project design and development technologies		
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Develop the ability to apply theoretical and practical tools / techniques to solve real life problems by developing software.</li> <li>2. Describe the various stages of the Systems Development Life Cycle (SDLC) carried out in their project.</li> <li>3. Master the fundamental programming concepts to build functional software components</li> <li>4. Apply validation during the development process</li> <li>5. Develop testing and debugging skills</li> </ol>		
6.	Credit Value	Theory—Credits		
7.	Total Marks	Max.Marks:100		Min.PassingMarks:40

**PART B: Content of the Course**

<b>Type of project</b>	The students are expected to work on a real-life project preferably in some industry/ Research and Development Laboratories/Educational Institution/Software Company. However, it is not mandatory for a student to work on a real-life project. The student can formulate a project problem with the help of her/his Supervisor and if approved the student can commence working on it.
<b>Project Proposal</b>	<p>The project proposal should be prepared in consultation with Supervisor. Approval of the project proposal is mandatory to continue and submit the project work. The project proposal should clearly state the project objectives and the environment of the proposed project to be undertaken.</p> <p>The project proposal should contain complete details in the following form:</p> <ol style="list-style-type: none"> <li>1. Title of the Project</li> <li>2. Introduction and Objectives of the Project, Scope of the Project</li> <li>3. Project Category(RDBMS/ OOPS/ Networking/ Multimedia/ Artificial Intelligence/ Expert Systems/ Cloud/ Security/ Data Analytics etc.)</li> <li>4. Analysis (DFDs /ER Diagrams/ Class Diagrams/ State Diagrams etc., Module Specification, Time Line etc. as per the project requirements).</li> <li>5. A complete structure which includes: <ul style="list-style-type: none"> <li>• Number of modules and their description to provide an estimation of the student's effort on the project.</li> <li>• Data Structures as per the project requirements for all the modules</li> <li>• Process Logic of each module</li> </ul> </li> </ol>

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	<ul style="list-style-type: none"> <li>• Reports to be generated</li> </ul> <ol style="list-style-type: none"> <li>6. Tools /Platform Hardware and Software Requirement specifications</li> <li>7. Project Team members(If any)</li> <li>8. Organization/Company details with profile of supervisor (If project is carried out outside the department)</li> </ol>
<b>Project Work Guideline</b>	<ul style="list-style-type: none"> <li>• The project work should include software development.</li> <li>• Preferably not more than one student is permitted to work on a project. However, in case a large project at most two students may work on the same project. If two students have been allowed to work on a project the project synopsis and project reports by them must include only different modules undertaken / worked upon individually. Each student must submit a separate project proposal and a separate project reports related to her/his modules. Completely identical project synopses and/or project reports are not allowed. Only introductory and possibly concluding remarks may be similar or common. Each student has to undergo all the phases</li> <li>• A candidate is required to present the progress of the Project work during the semester as per the schedule provided by the Study Institute.</li> <li>• The project can be evaluated on the basis of following             <ol style="list-style-type: none"> <li>i. Project Analysis &amp; Planning</li> <li>ii. Project Design &amp; Development</li> <li>iii. Project Testing &amp; Validation</li> <li>iv. Project Documentation</li> <li>v. Project Presentation &amp; Viva</li> </ol> </li> </ul>
<b>Project Report Format</b>	<p>Report should be prepared on good quality white executive bond paper A4 size paper.</p> <p>Page Specification: Left margin-3.0cms, Right margin- 2.0 cm, Top margin 2.54 cm, bottom margin 2.54 cm, Line Spacing – Single, Font Size – 12 for normal Text, Font Size – 14 for Headings and 16 for Chapter Heading. Page Numbers - All text pages as well as Program source code listing should be numbered at the bottom of the pages.</p> <p>The project report should contain the following:</p> <ol style="list-style-type: none"> <li>1. FrontPage</li> <li>2. The Approved Performa and Synopsis.</li> <li>3. Certificate from the Supervisor with her/his signature and date.</li> <li>4. Certificate from company/industry in their letterhead (if project is carried out outside the department)</li> <li>5. Certificate of originality/Self Certificate</li> <li>6. The Project Report documentation should include the following topics (as per the project requirements).             <ul style="list-style-type: none"> <li>▪ Acknowledgement</li> <li>▪ Table of Contents/Index with page numbering</li> <li>▪ Introduction/Objectives of the project</li> <li>▪ System Analysis                 <ul style="list-style-type: none"> <li>○ Identification of Need</li> <li>○ Project Planning and Project Scheduling (PERT Chart and Gantt Chart both)</li> <li>○ Software requirement specifications (SRS)</li> </ul> </li> </ul> </li> </ol>

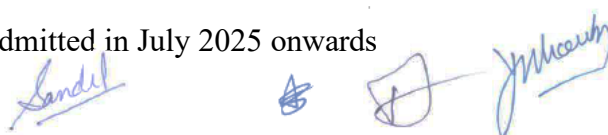




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**M.Sc. (Computer Science)**

	<ul style="list-style-type: none"> <li>○ Software Engineering Paradigm applied</li> <li>○ Data models (like DFDs), Control Flow diagrams, State Diagrams/Sequence diagrams, Entity Relationship Model, Class Diagrams/CRC Models/Collaboration Diagrams/Use-case Diagrams/Activity Diagrams and other models depending upon your project requirements</li> <li>▪ Feasibility Study</li> <li>▪ Software and Hardware Requirement Specifications</li> <li>▪ System Design <ul style="list-style-type: none"> <li>○ Modularization details</li> <li>○ Data integrity and constraints</li> <li>○ Database design, Procedural Design/Object Oriented Design</li> <li>○ User Interface Design</li> <li>○ Test Cases (Unit Test Cases and System Test Cases)</li> </ul> </li> <li>▪ Coding</li> <li>▪ Testing(TestingtechniquesandTestingstrategiesusedalongwiththetest dataandtheerrors listed for each test case).</li> <li>▪ Sample Reports</li> <li>▪ Screen Shots of Project</li> <li>▪ Conclusion</li> <li>▪ Future scope and further enhancement of the Project</li> <li>▪ Bibliography/References</li> <li>▪ Appendices(if required)</li> </ul> <p>Two copies of the original project report in bound form are to be submitted. Each student is required to prepare individual copy of Project Report in softcopy. College is required to save the soft copy of project report of every student batch wise.</p>
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<b>PART C : Assessment and Evaluation</b>			
<b>Internal Assessment : Continuous Comprehensive Evaluation(CCE): 50 Marks</b>		<b>End Term Examination(s): 50 Marks</b>	
Internal Progress presentation	Marks	Report	
Appropriate weightage of attendance in the class	Marks	Presentation of the work	
Total	50 Marks	Total	50 Marks
Any Remarks/ Suggestions:			






**Department of Higher Education, Govt of Madhya Pradesh**  
**M.Sc. (Computer Science)**

**PART A: Introduction**

Program: One Year PG Degree		Class: M.Sc.	Semester: II	Session: 2025-26
Subject: Computer Science				
1.	Course Code	CC-43		
2.	Course Title	Research Thesis/Projects/Patents		
	Course Type(Core Course/Elective)	Core Course		
4.	Pre-Requisite(if any)	The students should have knowledge about Research Methodologies		
5.	Course Learning Outcomes(CLO)	<b>On completion of this course, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Acquire knowledge of bibliometric tools and literature review methodologies.</li> <li>2. Illustrate research problem formulation.</li> <li>3. Analyse research related information and research ethics.</li> <li>4. Identify research gaps and propose solutions using acquired knowledge</li> <li>5. Formulate research problems and analyze those using relevant practices.</li> <li>6. Present research outcomes and submit structured technical documentation effectively.</li> </ol>		
6.	Credit Value	Theory—Credits		
7.	Total Marks	Max.Marks:100		Min.PassingMarks:40

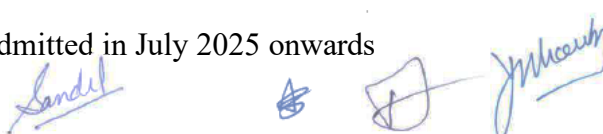
**PART B: Content of the Course**

<b>Type of project</b>	The students are expected to work on a real-life project preferably in some industry/ Research and Development Laboratories/Educational Institution. However, it is not mandatory for a student to work on a real-life project. The student can formulate a project problem with the help of her/his Supervisor and if approved the student can commence working on it.
<b>Project Proposal</b>	<p>The project proposal should be prepared in consultation with Supervisor. Approval of the project proposal is mandatory to continue and submit the project work. The project proposal should clearly state the project objectives and the environment of the proposed project to be undertaken.</p> <p>The project proposal should contain complete details in the following form:</p> <ol style="list-style-type: none"> <li>1. Introduction: A brief background about the subject chosen for study.</li> <li>2. Rationale: Specify why a particular topic has been chosen for the project work.</li> <li>3. Objectives: It should mention clearly and precisely the things which you hope will be able to know/achieve at the end of the study.</li> <li>4. Research Methodology:</li> <li>5. Research Design <ol style="list-style-type: none"> <li>i. Nature and source of data/information to be collected.</li> <li>ii. Sample and sampling technique. Rationale of chosen organisation and the sample.</li> <li>iii. Tools and Techniques to be used for data collection – details of the tools/questionnaire to be used and its relevance with the objectives of the project.</li> <li>iv. Method/s to be used for data collection.</li> <li>v. Data handling and analysis- organisation and analysis of data. Statistical tools to be used for analysis. Relevance of statistical tools with the objectives of the project.</li> </ol> </li> </ol>



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	6. Limitation of the proposed project
<b>Project Work Guideline</b>	<ul style="list-style-type: none"> <li>The project work should include Research Thesis/Projects/Patents.</li> <li>Preferably not more than one student is permitted to work on a project.</li> <li>A candidate is required to present the progress of the Project work during the semester as per the schedule provided by the Study Institute.</li> <li>The project can be evaluated on the basis of following               <ol style="list-style-type: none"> <li>Project Analysis &amp; Planning</li> <li>Literature Review</li> <li>Methodology</li> <li>Project Outcomes</li> <li>Project Presentation &amp; Viva</li> </ol> </li> </ul>
<b>Project Report Format</b>	<p>Report should be prepared on good quality white executive bond paper A4 size paper.</p> <p>Page Specification: Left margin-3.0cms, Right margin- 2.0 cm, Top margin 2.54 cm, bottom margin 2.54 cm, Line Spacing – Single, Font Size – 12 for normal Text, Font Size – 14 for Headings and 16 for Chapter Heading. Page Numbers - All text pages as well as Program source code listing should be numbered at the bottom of the pages.</p> <p>The project report should contain the following:</p> <ol style="list-style-type: none"> <li>Front Page</li> <li>The Approved Performance and Synopsis.</li> <li>Certificate from the Supervisor with her/his signature and date.</li> <li>Certificate from company/industry in their letterhead (if project is carried out outside the department)</li> <li>Certificate of Originality/Self Certificate</li> <li>The Report documentation should include the following topics (as per the project requirements).           <ul style="list-style-type: none"> <li>Acknowledgement</li> <li>Table of Contents/Index with page numbering</li> <li>Introduction to the project</li> <li>Literature Review</li> <li>Research Methodology</li> <li>Results and Discussions</li> <li>Summary and Conclusion</li> <li>Recommendations</li> <li>Limitations and future scope</li> <li>References/ Bibliography</li> <li>Sample Reports</li> <li>Annexures/Appendices (if any)</li> </ul> </li> </ol> <p>Two copies of the original project report in bound form are to be submitted. Each student is required to prepare individual copy of Project Report in Soft Copy. College is required to save the soft copy of project report of every student batch wise.</p>
<b>Plagiarism</b>	The Project Report submitted by the student should be free from plagiarism and his/her original work. In case if the project report is found to be plagiarised, action will be taken as per the policy of the University



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**PART C : Learning Resources**

**Suggestive digital platform web links:**

- <https://patents.google.com/>.
- <https://iprsearch.ipindia.gov.in/publicsearch>
- <https://shodhganga.inflibnet.ac.in/>

**PART D : Assessment and Evaluation**

<b>Internal Assessment : Continuous Comprehensive Evaluation(CCE): 50 Marks</b>		<b>End Term Examination(s): 50 Marks</b>	
Internal Progress presentation	Marks	Report	
Appropriate weightage of attendance in the class	Marks	Presentation of the work	
Total	50 Marks	Total	50 Marks
Any Remarks/ Suggestions:			