# Government College of Engineering, Aurangabad

**(An Autonomous Institute)**

Teaching and Evaluation Scheme from year 2023-2024

**B. Tech. Program in Information Technology with Semester– VII and VIII**

**SEMESTER-VII**

| Sr. No | Category | Course Code | Course Title | Hours per week | | | Credits | Continuous Evaluation in terms of Marks | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | ISE I | ISE II | ISE III | ESE | |
| 1 | PEC | ITPEC40** | Professional Elective VI | 3 | 0 | 0 | 3 | 15 | 15 | 10 | 60 | 100 |
| 2 | PEC | ITPEC40** | Lab Professional Elective VI | 0 | 0 | 2 | 1 | - | - | 25 | - | 25 |
| 3 | PEC | ITPEC40** | Professional Elective VII | 2 | 0 | 0 | 2 | 10 | 10 | - | 30 | 50 |
| 4 | ELC | ITELC4001 | Project-II | 0 | 0 | 8 | 4 | - | | 100 | 100 | 200 |
| **Total Credits with MDM** | | | | **5** | **0** | **10** | **10** | **25** | **25** | **135** | **190** | **375** |
| 5 | Honors | ITHNC7004 | Advanced Machine Learning | 3 | 1 | 0 | 4 | 15 | 15 | 10 | 60 | 100 |
| **Total Credits with MDM+Honors** | | | | **8** | **1** | **10** | **14** | **30** | **30** | **145** | **250** | **475** |
| 6 | Research | | Research Project-I | 0 | 0 | 18 | 9 | - | - | 50 | 50 | 100 |
| **Total Credits with MDM + Research** | | | | **8** | **1** | **28** | **23** | **25** | **25** | **195** | **300** | **575** |

**SEMESTER-VIII**

| Sr. No | Category | Course Code | Course Title | Hours per week | | | Credits | Continuous Evaluation in terms of Marks | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | ISEI | ISEII | ISE III | ESE | |
| 1 | ELC | ITELC4002 | Research Methodology | 2 | 0 | 0 | 2 | 15 | 15 | 10 | 60 | 100 |
| 2 | ELC | ITELC4003 | Internship/OJT | 0 | 0 | 24 | 12 | | | 100 | 100 | 200 |
| **Total Credits with MDM** | | | | **2** | **0** | **24** | **14** | **15** | **15** | **110** | **160** | **300** |
| 3 | Honors | ITHNC7005 | Advanced Deep Learning | 3 | 1 | 0 | 4 | 15 | 15 | 10 | 60 | 100 |
| 4 | Honors | ITHNC7006 | Project | 0 | 0 | 4 | 2 | - | - | 25 | 25 | 50 |
| **Total CreditswithMDM+Honors** | | | | **5** | **1** | **28** | **20** | **30** | **30** | **145** | **245** | **450** |
| 5 | Research | | Research Project-II | 0 | 0 | 18 | 9 | - | - | 50 | 50 | 100 |
| **Total Credits with MDM + Research** | | | | **5** | **1** | **46** | **29** | **15** | **15** | **160** | **295** | **550** |

**List of Professional Electives:**

| Professional Elective: VI | Professional Elective: VII |
|---|---|
| ITPEC4031: Speech and Natural Language Processing<br>ITPEC4032: Lab Speech and Natural Language Processing | ITPEC4039: Soft Computing |
| ITPEC4033: Distributed Systems<br>ITPEC4034: Lab Distributed Systems | ITPEC4040: Data Science |
| ITPEC4035: Advanced Computer Architecture<br>ITPEC4036: Lab Advanced Computer Architecture | ITPEC4041: Software Testing and Quality Assurance |
| ITPEC4037: High Performance Computing<br>ITPEC4038: Lab High Performance Computing | ITPEC4042: Generative Artificial Intelligence |

| ITPEC4031: Speech and Natural Language Processing | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 03 hrs/ week** | **ISE I** | **15 Marks** |
| **Tutorial: 0** | **ISE II** | **15 Marks** |
| **Credits:03** | **ISE III** | **10 Marks** |
| | **End Semester Examination** | **60 Marks** |

**Course Description:** This course introduces the fundamentals of **Speech and Natural Language Processing (SNLP)**, covering techniques for word-level and syntactic analysis, text classification, information retrieval, lexical resources, and machine translation. It provides students with essential knowledge to understand and develop basic language-based intelligent systems.

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Understand basic concepts and applications of NLP and speech processing. |
| **CO2** | Apply word-level analysis and part-of-speech tagging techniques. |
| **CO3** | Perform syntactic analysis using grammar and parsing methods. |
| **CO4** | Use Naive Bayes for text classification and sentiment analysis. |
| **CO5** | Explain information retrieval models, lexical resources, and machine translation approaches. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | Word Level Analysis**:** Regular Expressions and their role in text processing; Finite-State Automata for lexical analysis; Morphological analysis and morphological parsing; Inflectional and derivational morphology; Spelling error detection and correction techniques; Words and word classes; Part-of-Speech tagging approaches – rule-based and statistical methods. |
| **Unit 2** | Syntactic Analysis: Introduction to syntactic structure; Context-Free Grammar (CFG); Constituency and parse trees; Parsing strategies – Top-down parsing and Bottom-up parsing; CYK parsing algorithm and its applications; Limitations of grammar-based parsing. |
| **Unit 3** | Text Classification and Sentiment Analysis:<br>Naive Bayes classifiers for text processing; Bayes theorem and independence assumptions; Training the Naive Bayes classifier; Worked example of text classification; Sentiment analysis using Naive Bayes; Optimization techniques for sentiment analysis; Naive Bayes for other text classification tasks; Naive Bayes as a language model. |
| **Unit 4** | Information Retrieval:<br>Design features of Information Retrieval (IR) systems; Information Retrieval models – Classical models (Boolean, Vector Space, Probabilistic); Non-classical IR models; Alternative models of information retrieval – Cluster model, Fuzzy model, LSTM-based model; Major issues in information retrieval including indexing, ranking, relevance, and evaluation. |
| **Unit 5** | Lexical Resources:<br>Lexical resources for NLP; WordNet – structure and semantic relations; FrameNet; Stemmers and lemmatization techniques; Part-of-Speech taggers; Research corpora – annotated and unannotated corpora; Role of corpora in NLP research. Case study on recent trends in Speech and natural language processing |

**Text Books & Reference Books**


1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2024
2. Lewis Tunstall, Leandro Von Werra, Thomas Wolf. Natural Language Processing with Transformers, O'Reilly, 2023
3. Sowmya Vajjala, Bodhisattwa Majumder, Anju Gupta, HarshitSurana. Practical Natural Language Processing, O'Reilly, 2021
4. James Allen. Natural language Understanding 2e, Pearson Education, 2007
5. Akshar Bharati, Vineet Chaitanya, Rajeev Sangal. Natural Language Processing: A Paninian Perspective, PHI, 2023
6. Tanveer Siddiqui., U.S. Tiwary. Natural Language Processing and Information Retrieval, OUP, 2008


**Web Resources**

**1.https://archive.nptel.ac.in/content/syllabus_pdf/106105158.pdf**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | 2 | | | | 1 | | 2 |
| CO2 | | | | | | | | 1 | 2 | 2 | 2 | 2 | 1 | | 1 |
| CO3 | | | | | | | | 1 | 1 | 1 | 2 | 2 | 1 | | 2 |
| CO4 | | | | | | | | 1 | 1 | 2 | 2 | 1 | 1 | | 1 |
| CO5 | | | | | | | | | 1 | | | | 1 | | |

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

**3– High 2 – Medium 1 - Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-15

**ISE II:** Class Test-II of Maximum Marks-15

**ISE III:** Teacher's Assessment of Maximum Marks-10

Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Power point presentation
2) Question & answer / Numerical solution
3) Surprise test
4) Any other activity suggested by course coordinator

**ESE**: End Semester Examination of Maximum Marks-60

**Assessment Pattern:**

| Assessment Pattern Level No. | Knowledge Level | ISE I | ISE II | ISE III | End Semester Examination |
|---|---|---|---|---|---|
| K1 | Remember | 5 | 5 | 2 | 10 |
| K2 | Understand | 7 | 7 | 3 | 20 |
| K3 | Apply | 3 | 3 | 5 | 20 |
| K4 | Analyze | - | - | | 10 |
| K5 | Evaluate | | | | |
| K6 | Create | | | | |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**:

| **Assessment Tool** | **K1** | **K2** | **K3** |
|---|---|---|---|
| | CO1 | CO2,CO3 | CO4,CO5 |
| **ISE I** (15 Marks) | 3 | 5 | 7 |
| **ISE II** ( 15 Marks) | 5 | 4 | 6 |
| **ISE III** (10 Marks) | 2 | 4 | 4 |
| **ESE Assessment** (60 Marks) | 10 | 30 | 20 |
| **Total Marks 100** | 20 | 43 | 37 |

| ITPEC4033: Distributed Systems | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 03 hrs/ week** | **ISE I** | **15 Marks** |
| **Tutorial: 0** | **ISE II** | **15 Marks** |
| **Credits:03** | **ISE III** | **10 Marks** |
| | **End Semester Examination** | **60 Marks** |

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Identify the issues in designing distributed operating system. |
| **CO2** | Identify the desirable features of good message passing system and issues in designing inter process communication system by message passing. |
| **CO3** | Design and develop distributed programs using RPC. |
| **CO4** | Identify the issues of distributed shared memory system. |
| **CO5** | Analyze different algorithms and techniques for file systems. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | **Distributed Computing System**: DCS models, Distributed systems architecture, Distributed Operating Systems: Definition, Design Issues, Introduction to Distributed Computing Environment, Key characteristics, resource sharing, openness concurrency, scalability, fault tolerance, transparency. |
| **Unit 2** | **Distributed Systems Models**: Client-Server model, Thin Client, Mobile Devices, Software agents. Fundamental models: Interaction, Failure and Security models. |
| **Unit 3** | **Message passing** : Desirable features of a Good Message Passing System, Issue in IPC by message passing Synchronization, Buffering, Multi datagram messages, encoding and decoding of message data, process addressing, failure handling, **Remote Procedure Call** :RPC Model, Transparency of RPC, Implementing RPC mechanism, RPC messages, Marshaling arguments and results, Server management, Parameter passing semantics, Call semantics, Communication protocols for RPC, Client Server binding, Exception handling, Security, RPC in heterogeneous environments, Optimization for better performance. |
| **Unit 4** | **Distributed Shared Memory:** General architecture of DSM system, Design and Implementation, issues of DSM, Granularity, Structure of shared memory space, Consistency models, Replacement strategy, Thrashing, Other approaches to DSM, Advantages of distributed shared memory.<br><br>**Distributed File System:** Desirable features of good Distributed file system, file models, File Accessing, Sharing, Caching methods, File replication, Fault tolerance, atomic transactions, Design principles. |
| **Unit 5** | **Synchronization**: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms. Resource Management: Features of Global Scheduling Algorithm, Task Assignment Approach, Load Sharing Approach. |

**Text Books & Reference Books**


1. Distributed Operation System, Concepts and Design, P.K. Sinha, 2nd Edition, IEEE Press, Prentice Hall India,1998.
2. Distributed Systems Concepts and Design, GeorgeCoulouris, Jean Dollimore, and Tim Kindberg, 3rd Edition., Addison Wesley, 2002
3. Distributed Operating System, A. S. Tanenbaum , 2nd Edition, Prentice Hall India ,2002.


**Mapping of Course outcome with Program Outcomes and Program Specific Outcome**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | | | | | | | | 2 | | |
| CO2 | | 1 | | | 3 | | | | | | | | | 2 | |
| CO3 | | | 3 | | | 1 | | | | | | | | | 2 |
| CO4 | | | | | | | | | | 2 | 1 | 2 | | 1 | 2 |
| CO5 | | | | | | | | 1 | 2 | | | | | | 1 |

**3– High 2 – Medium 1 – Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-15

**ISE II:** Class Test-II of Maximum Marks-15

**ISE III:** Teacher's Assessment of Maximum Marks-10

Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Power point presentation
2) Question & answer / Numerical solution
3) Surprise test
4) Any other activity suggested by course coordinator

**ESE**: End Semester Examination of Maximum Marks-60

**Assessment Pattern:**

| Assessment Pattern Level No. | Knowledge Level | ISE I | ISE II | ISE III | End Semester Examination |
|---|---|---|---|---|---|
| K1 | Remember | 5 | 5 | 2 | 10 |
| K2 | Understand | 7 | 7 | 3 | 20 |
| K3 | Apply | 3 | 3 | 5 | 20 |
| K4 | Analyze | - | - | | 10 |
| K5 | Evaluate | | | | |
| K6 | Create | | | | |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**:

| Assessment Tool | K1 | K2 | K3 |
|---|---|---|---|
| | CO1 | CO2,CO3 | CO4,CO5 |
| **ISE I** (15 Marks) | 3 | 5 | 7 |
| **ISE II** (15 Marks) | 5 | 4 | 6 |
| **ISE III** (10 Marks) | 2 | 4 | 4 |
| **ESE Assessment** (60 Marks) | 10 | 30 | 20 |
| **Total Marks 100** | 20 | 43 | 37 |

| **ITPEC4035: Advanced Computer Architecture** | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 03 hrs/ week** | **ISE I** | **15 Marks** |
| **Tutorial: 0** | **ISE II** | **15 Marks** |
| **Credits:03** | **ISE III** | **10 Marks** |
| | **End Semester Examination** | **60 Marks** |

**Course Description:**

- To make students know about the Parallelism concepts in Programming
- To give the students an elaborate idea about the different memory systems and buses.
- To introduce the advanced processor architectures to the students.
- To make the students know about the importance of multiprocessor and multicomputer.
- To study about data flow computer architectures

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Demonstrate concepts of parallelism in hardware/software. |
| **CO2** | Discuss memory organization and mapping techniques. |
| **CO3** | Describe architectural features of advanced processors. |
| **CO4** | Interpret performance of different pipelined processors. |
| **CO5** | Development of software to solve computationally intensive problems. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | PARALLEL COMPUTER MODELS<br>Evolution of Computer architecture, system attributes to performance, Multi processors and multi computers, Multi-vector and SIMD computers, PRAM and VLSI models-Parallelism in Programming, conditions for Parallelism-Program Partitioning and Scheduling-program flow Mechanisms-Speed up performance laws-Amdahl‘s law, Gustafson‘s law-Memory bounded speedup Model. |
| **Unit 2** | MEMORY SYSTEMS AND BUSES<br>Memory hierarchy-cache and shared memory Concepts-Cache memory organization-cache addressing models, Aliasing problem in cache, cache memory mapping Techniques-Shared Memory Organization-Interleaved memory organization, Lower order interleaving, Higher order interleaving. Backplane bus systems-Bus addressing, arbitration and transaction. |
| **Unit 3** | ADVANCED PROCESSORS<br>Instruction set architectures-CISC and RISC scalar processors-Super scalar processors-VLIW architecture- Multivector and SIMD computers-Vector processing principles-Cray Y-MP 816 system-Inter processor communication |
| **Unit 4** | MULTI PROCESSOR AND MULTI COMPUTERS<br>Multiprocessor system interconnects- Cross bar switch, Multiport memory-Hot spot problem, Message passing mechanisms-Pipelined processors-Linear pipeline, on linear pipeline- Instruction pipeline design-Arithmetic pipeline design. |
| **Unit 5** | DATA FLOW COMPUTERS AND VLSI COMPUTATIONS<br>Data flow computer architectures-Static, Dynamic-VLSI Computing Structures-Systolic array architecture, mapping algorithms into systolic arrays, Reconfigurable processor array-VLSI matrix arithmetic processors-VLSI arithmetic models, partitioned matrix algorithms, matrix arithmetic pipelines. |

**Text Books & Reference Books**

**TEXT BOOKS:**

1. Kai Hwang,‖Advanced Computer architecture Parallelism ,scalablity ,Programmablity,Mc GrawHill,N.Y, 2003
2. Kai Hwang and F.A.Briggs, Computer architecture and parallel processor‖‘ Mc Graw Hill, N.Y, 1999
3. David A. Paerson and John L. Hennessey, ―Computer organization and design,Elsevier, Fifth edition, 2014.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://www.shiksha.com/online-courses/cloud-computing-basics-by-nptel-course-nptel25
3. https://www.linkedin.com/pulse/successfully-completed-nptel-course-cloud-computing-key-ramkumar-j3g3c

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | | | | | | | | 2 | | |
| CO2 | | 1 | | | 3 | | | | | | | | | 2 | |
| CO3 | | | 3 | | | 1 | | | | | | | | | 2 |
| CO4 | | | | | | | | | | 2 | 1 | 2 | | 1 | 2 |
| CO5 | | | | | | | | 1 | 2 | | | | | | 1 |

**3– High 2 – Medium 1 - Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-15
**ISE II:** Class Test-II of Maximum Marks-15
**ISE III:** Teacher's Assessment of Maximum Marks-10
Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Power point presentation
2) Question & answer / Numerical solution
3) Surprise test
4) Any other activity suggested by course coordinator

**ESE**: End Semester Examination of Maximum Marks-60

**Assessment Pattern:**

| **Assessment Pattern Level No.** | **Knowledge Level** | **ISE I** | **ISE II** | **ISE III** | **End Semester Examination** |
|---|---|---|---|---|---|
| K1 | Remember | 5 | 5 | 2 | 10 |
| K2 | Understand | 7 | 7 | 3 | 20 |
| K3 | Apply | 3 | 3 | 5 | 20 |
| K4 | Analyze | - | - | | 10 |
| K5 | Evaluate | | | | |
| K6 | Create | | | | |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**:

| **Assessment Tool** | **K1** | **K2** | **K3** |
|---|---|---|---|
| | CO1 | CO2,CO3 | CO4,CO5 |
| **ISE I** (15 Marks) | 3 | 5 | 7 |
| **ISE II** ( 15 Marks) | 5 | 4 | 6 |
| **ISE III** (10 Marks) | 2 | 4 | 4 |
| **ESE Assessment** (60 Marks) | 10 | 30 | 20 |
| **Total Marks 100** | 20 | 43 | 37 |

| ITPEC4037: High Performance Computing | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 03 hrs/ week** | **ISE I** | **15 Marks** |
| **Tutorial: 0** | **ISE II** | **15 Marks** |
| **Credits:03** | **ISE III** | **10 Marks** |
| | **End Semester Examination** | **60 Marks** |

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO**1 | Design, formulate, solve and implement high performance versions of standard single threaded algorithms |
| **CO2** | Demonstrate the architectural features in the GPU and MIC hardware accelerators. |
| **CO3** | Design programs to extract maximum performance in a multicore, shared memory execution environment processor. |
| **CO**4 | Develop and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm. |
| **CO5** | Analyze symmetric and distributed architectures. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | Introduction to high Performance Computing: Introduction to heterogeneous parallel computing, GPU architecture, thread hierarchy, GPU memory hierarchy. computer organization concepts |
| **Unit 2** | Processors & virtual memory: pipelined processors: pipelining, structural, data and control hazards, impact on programming, Use of memory by programs, address translation, basics of GPU programming |
| **Unit 3** | Operating systems & cache memory: organization, impaction programming, virtual caches, many integrated cores, introduction to many integrated cores. MIC, Xeon Phi architecture, threads hierarchy, memory hierarchy, memory bandwidth and performance considerations. |
| **Unit 4** | Shared memory parallel Programming: Symmetric and distributed architectures, OpenMP Introduction, thread creation, parallel regions. work sharing, Synchronization. program profiling &File systems: disk management, name management, Protection |
| **Unit 5** | Parallel architecture: message passing interface, MPI Introduction, collective communication, data grouping for communication. basics of parallel architecture, parallel programming with message passing using MPI |

**Text Books & Reference Books**

1 Programming Massively Parallel Processors a Hands-on Approach, 3e, Wen-Mei W Hwu, David B Kirk and Morgan Kaufmann-2019
2. Intel Xeon Phi Coprocessor Architecture and Tools, Rezaur Rahman, Apress Open, 1 st edition-2013
3. Using OpenMP, Barbara Chapman, Gabriele Jost, Rudd Vander Pas, MIT Press, 2008
4. J.L.HennessyandD.A.Patterson,ComputerArchitecture:A Quantitative Approach, Morgan Kaufmann.
5. A.Silberschatz,P.B.Galvin,G.Gagne,OperatingSystemConcepts,JohnWiley.
6. R.E.BryantandD.R.O'Hallaron,ComputerSystems:A Programmer's Perspective, Prentice Hall.

| **ITPEC4032: Lab Speech and Natural Language Processing** | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Practical:2Hrs/Week** | **ISEIII (Term Work)** | **25 Marks** |
| **Credits:01** | | |

**Course Description**

This course introduces the fundamentals of Natural Language Processing, focusing on word-level and syntactic analysis, text classification and sentiment analysis, information retrieval models, and the use of lexical resources and corpora for real-world language processing applications.

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Apply word-level and morphological analysis techniques, including regular expressions, finite-state automata, and Part-of-Speech tagging. |
| **CO2** | Analyze syntactic structures of natural language using context-free grammars and parsing techniques. |
| **CO3** | Implement text classification and sentiment analysis models using probabilistic approaches such as Naive Bayes. |
| **CO4** | Design and evaluate Information Retrieval systems and utilize lexical resources and corpora for NLP applications. |

**Suggested list of Practical's**

| Sr. No. | Title of the Experiments | Skill / Knowledge Level | CO | Marks for ISE |
|---|---|---|---|---|
| 1 | Implement text preprocessing tasks using **regular expressions** for tokenization and pattern matching. | S1 | CO1 | 02 |
| 2 | Design a **Finite-State Automaton (FSA)** for lexical analysis of words and symbols | S1 | CO1 | 02 |
| 3 | Develop a **morphological analyzer** to identify root words, prefixes, and suffixes. | S1 | CO1 | 02 |
| 4 | Implement **Part-of-Speech tagging** using rule-based and statistical approaches. | S2 | CO2 | 02 |
| 5 | Construct **Context-Free Grammar (CFG)** and generate parse trees for simple sentences. | S2 | CO2 | 02 |
| 6 | Implement the **CYK parsing algorithm** to validate sentence structure. | S2 | CO2 | 03 |
| 7 | Perform **text classification** using the Naive Bayes classifier. | S3 | CO3 | 03 |
| 8 | Implement **sentiment analysis** on textual data using Naive Bayes. | S3 | CO3 | 03 |
| 9 | Design a basic **Information Retrieval system** using TF-IDF and Vector Space Model. | S4 | CO4 | 03 |
| 10 | Explore **lexical resources** such as WordNet, stemming, lemmatization, and NLP corpora. | S4 | CO4 | 03 |

**Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes**

| Course outcomes | Program Outcomes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO 11** | **PO 12** |
| CO1 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 1 |
| CO2 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 1 |
| CO3 | 3 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 1 |
| CO4 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 |

**3 – High2 – Medium1 - Low**

**Assessment Table:**

| Assessment Tool | S1 | S2 | S3 | S4 |
|---|---|---|---|---|
| | **CO1** | **CO2** | **CO3** | **CO4** |
| **ISEI(Term Work)** | 06 | 07 | 06 | 06 |

**Assessment:**

ISE III: It shall be based on one of the/combination of few of: Attendance, punctuality, sincerity

throughout semester, performance of during sessions, timely completion of allotted work, Oral examination, work knowledge etc.

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | 3 | | | | | | | | | | | 3 | |
| CO2 | 2 | | | | | | 3 | | | | | | | 2 | |
| CO3 | | | 3 | | | | | | | | | 2 | | 3 | |
| CO4 | | | 3 | | 2 | | | | | | 2 | 2 | | 3 | 2 |
| CO5 | | | | | | | | | 2 | 2 | | 2 | | | 2 |

**3– High 2 – Medium 1 - Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-15
**ISE II:** Class Test-II of Maximum Marks-15
**ISE III:** Teacher's Assessment of Maximum Marks-10
Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Power point presentation
2) Question & answer / Numerical solution
3) Surprise test
4) Any other activity suggested by course coordinator

**ESE**: End Semester Examination of Maximum Marks-60

**Assessment Pattern:**

| **Assessment Pattern Level No.** | **Knowledge Level** | **ISE I** | **ISE II** | **ISE III** | **End Semester Examination** |
|---|---|---|---|---|---|
| K1 | Remember | 5 | 5 | 2 | 10 |
| K2 | Understand | 7 | 7 | 3 | 20 |
| K3 | Apply | 3 | 3 | 5 | 20 |
| K4 | Analyze | - | - | | 10 |
| K5 | Evaluate | | | | |
| K6 | Create | | | | |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**:

| **Assessment Tool** | **K1** | **K2** | **K3** |
|---|---|---|---|
| | CO1 | CO2,CO3 | CO4,CO5 |
| **ISE I** (15 Marks) | 3 | 5 | 7 |
| **ISE II** ( 15 Marks) | 5 | 4 | 6 |
| **ISE III** (10 Marks) | 2 | 4 | 4 |
| **ESE Assessment** (60 Marks) | 10 | 30 | 20 |
| **Total Marks 100** | 20 | 43 | 37 |

| ITPEC4034: Lab Distributed Systems | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Practical: 2Hrs/Week** | **ISE III(Term Work)** | **25 Marks** |
| **Credits:01** | **End Semester Evaluation** | **--** |

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Design and implement client–server architectures using socket programming, including thin client and mobile client models. |
| **CO2** | Apply inter-process communication techniques such as message passing, multi-datagram communication, and remote procedure calls for distributed applications. |
| **CO3** | Analyze and implement RPC mechanisms including parameter marshaling/unmarshaling, client–server binding, and exception handling. |
| **CO4** | Implement and evaluate distributed system coordination mechanisms including logical clocks, event ordering, and consistency models in distributed shared memory. |
| **CO5** | Develop and analyze distributed algorithms for synchronization and resource management, including mutual exclusion, deadlock detection, and leader election. |

**List of the Experiments:**

The student shall perform minimum ten experiments of the following.

| Sr. No. | Title of the Experiments | Skill / Knowledge Level | CO | Marks for ISE |
|---|---|---|---|---|
| **Level: Basic** | | | | |
| 1 | Implementation of Client–Server Model Using Sockets | S1 | CO1 | 02 |
| 2 | Simulation of Thin Client and Mobile Client Models | S2 | CO1 CO2 | 02 |
| 3 | Implementation of Inter-Process Communication Using Message Passing | S2 | CO1 CO2 | 02 |
| **Level: Medium** | | | | |
| 4 | Implementation of Multi-Datagram Message Communication | S2, S3 | CO2 CO3 | 02 |
| 5 | Implementation of Remote Procedure Call (RPC) Mechanism | S2, S3 | CO4 | 02 |
| 6 | Marshaling and Unmarshaling of RPC Parameters | S2, S3 | CO4 CO5 | 02 |
| 7 | Client–Server Binding and Exception Handling in RPC | S2, S4 | CO4 CO5 | 02 |
| 8 | Implementation of Consistency Models in DSM | S2, S3, S4 | CO3 CO4 | 02 |
| **Level: Complex** | | | | |
| 9 | Implementation of Logical Clock and Event Ordering | S2 | CO4 | 03 |
| 10 | Implementation of Distributed Mutual Exclusion Algorithm | S4,S5 | CO5 | 03 |
| 11 | Implementation of Deadlock Detection Algorithm | S4,S5 | CO2 CO5 | 03 |
| 12 | Implementation of Leader Election Algorithms | S4,S5 | CO5 | 03 |

**Assessment:**
**ISE III (Term Work):** In-Semester Evaluation of 25 marks each will be based on practical assignments completed and timely submission

**Assessment Table:**

| Assessment Tool | **S1** | **S2** | **S3** |
|---|---|---|---|
| | CO1 CO2 | CO3 CO4 | CO5 |
| **ISE III**(Term Work) | 06 | 06 | 13 |
| **End Semester Evaluation** (Practical Examination & Viva Voce) | -- | -- | -- |

**Assessment Pattern:**

| Assessment Pattern Level No. | Knowledge Level | ISE III | End Semester Examination |
|---|---|---|---|
| S1 | Imitation | 05 | - |
| S2 | Manipulation | 10 | - |
| S3 | Precision | 10 | - |
| S4 | Articulation | 00 | - |
| S5 | Naturalization | 00 | - |
| | **Total Marks** | 25 | - |

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes:**

| Course outcome | Program Outcomes | | | | | | | | | | | | PSO's | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | | | 2 | | 3 | | | | | | | | 1 | 2 | |
| CO2 | 3 | | 2 | 1 | | | | 2 | | | | | 3 | | 3 |
| CO3 | | 3 | | | | | | | 1 | | | | 3 | 1 | 3 |
| CO4 | | | | | | | | | | | 3 | 2 | 3 | 1 | 1 |
| CO5 | | | | 2 | | 3 | | | | 1 | | | 1 | 1 | |

**3 – High 2 – Medium 1 - Low**

| ITPEC4036: Lab Advanced Computer Architecture | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Practical: 2Hrs/Week** | **ISE III(Term Work)** | **25 Marks** |
| **Credits:01** | **End Semester Evaluation** | **--** |

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Apply fundamental concepts of parallel computer models and performance laws (Amdahl's and Gustafson's) to analyze system speedup and efficiency. |
| **CO2** | Analyze memory hierarchy components, including cache mapping techniques and interleaved memory organization, to evaluate memory performance. |
| **CO3** | Compare and interpret architectural features of advanced processors such as RISC, CISC, superscalar, VLIW, SIMD, and multivector architectures. |
| **CO4** | Design and evaluate pipelined and multiprocessor systems by analyzing instruction pipelines, interconnection networks, and message passing mechanisms. |
| **CO5** | Develop and simulate parallel and dataflow-based solutions for computationally intensive problems using SIMD, systolic arrays, and data flow architectures. |

**List of the Experiments:**

The student shall perform minimum ten experiments of the following.

| **Sr. No.** | **Title of the Experiments** | **Skill / Knowledge Level** | **CO** | **Marks for ISE** |
|---|---|---|---|---|
| | **Level: Basic** | | | |
| 1 | Study and compare SISD, SIMD, MISD, and MIMD architectures using diagrams and examples. | S1 | CO1 | 02 |
| 2 | Write a program or perform numerical analysis to calculate speedup and efficiency using Amdahl's Law | S2 | CO1 CO2 | 02 |
| 3 | Analyze scalability of parallel systems using Gustafson's Law with suitable problem sizes. | S2 | CO1 CO2 | 02 |
| | **Level: Medium** | | | |
| 4 | **Program Partitioning for Parallel Execution** Implement a program showing task or data partitioning and analyze parallelism conditions. | S2, S3 | CO2 CO3 | 02 |
| 5 | **Cache Performance Analysis** Simulate cache hit/miss ratios for different cache sizes and block sizes. | S2, S3 | CO4 | 02 |
| 6 | **Interleaved Memory Organization** Study lower-order and higher-order interleaving and analyze memory access performance. | S2, S3 | CO4 CO5 | 02 |
| 7 | Design a pipeline for a given instruction set and evaluate hazards and throughput. | S2, S4 | CO4 CO5 | 02 |
| 8 | Analyze instruction count, CPI, and execution time for RISC vs CISC instruction sequences. | S2, S3, S4 | CO3 CO4 | 02 |
| | **Level: Complex** | | | |
| 9 | **Simulation of Superscalar or VLIW Processor** Design and analyze instruction-level parallelism in superscalar or VLIW architectures | S2 | CO4 | 03 |
| 10 | **Parallel Program using SIMD or Multivector Concept** Implement vector operations (e.g., matrix or array processing) using SIMD-style parallelism. | S4,S5 | CO5 | 03 |
| 11 | **Message Passing in Multiprocessor Systems** Implement and analyze inter-process communication using message passing mechanisms. | S4,S5 | CO2 CO5 | 03 |
| 12 | **Data Flow Architecture Simulation** Design and simulate a simple static or dynamic data flow execution model for arithmetic operations. | S5 | CO5 | 03 |

**Assessment:**
**ISE III (Term Work):** In-Semester Evaluation of 25 marks each will be based on practical assignments completed and timely submission

**Assessment Table:**

| Assessment Tool | **S1** | **S2** | **S3** |
|---|---|---|---|
| | CO1 CO2 | CO3 CO4 | CO5 |
| **ISE III**(Term Work) | 06 | 07 | 12 |
| **End Semester Evaluation** (Practical Examination & Viva Voce) | -- | -- | -- |

**Assessment Pattern:**

| **Assessment Pattern Level No.** | **Knowledge Level** | **ISE I** | **End Semester Examination** |
|---|---|---|---|
| S1 | Imitation | 05 | - |
| S2 | Manipulation | 10 | - |
| S3 | Precision | 10 | - |
| S4 | Articulation | 00 | - |
| S5 | Naturalization | 00 | - |
| | **Total Marks** | 25 | - |

| **ITPEC4038: Lab High Performance computing** | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Practical: 2Hrs/Week** | **ISE I (Term Work)** | **25 Marks** |
| **Credits:01** | **End Semester Evaluation** | |

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Understand the architecture of modern HPC systems and parallel computing models. |
| **CO2** | Implement parallel algorithms using shared memory programming (OpenMP). |
| **CO3** | Design and develop distributed memory applications using Message Passing Interface (MPI). |
| **CO4** | Implement GPU-accelerated computing using CUDA or OpenCL. |
| **CO5** | Analyze and optimize the performance of parallel applications using profiling tools. |

**List of the Experiments:**

The student shall perform minimum ten experiments of the following

| **Sr. No.** | **Title of the Experiments** | **Skill / Knowledge Level** | **CO** | **Marks for ISE** |
|---|---|---|---|---|
| **Level: Basic (all)** | | | | |
| 1 | Analyze CPU/GPU specifications and setup the HPC environment (GCC, OpenMP, MPI, CUDA). | S1 | CO1 | 02 |
| 2 | Implement a parallel version of Bubble Sort / Selection Sort using OpenMP. | S2 | CO1 CO2 | 02 |
| 3 | Design and implement a parallel program to add two large vectors using OpenMP. | | | |
| **Level: Medium** | | | | |
| 4 | Design and implement Parallel Breadth First Search (BFS) and Depth First Search (DFS) using OpenMP. | S2, S3 | CO2 CO3 | 02 |
| 5 | mplement Matrix-Matrix Multiplication using the Message Passing Interface (MPI). | S2, S3 | CO4 | 03 |
| 6 | Implement a Basic CUDA program for Vector Addition or Matrix Multiplication on GPU. | S2, S4 | CO2 CO3 CO4 CO5 | 03 |
| **Level: Complex** | | | | |
| 7 | Implement a program to calculate the value of π using the Monte Carlo method with MPI. | S2 | CO4 | 02 |
| 8 | **Case Study:** Implementation of a parallel Image Processing filter (e.g., Gaussian Blur) using CUDA. | S4,S5 | CO2 CO3 CO4 CO5 | 03 |
| 9 | **Case Study:** Optimization of a Large-scale Linear Equation Solver using Hybrid (MPI + OpenMP). | S4,S5 | CO2 CO3 CO4 CO5 | 02 |
| 10 | Real-time performance analysis of a parallel application using tools like Gprof or NVVP. | | | |

**Assessment:**

**ISE I (Term Work):** In-Semester Evaluation of 25 marks each will be based on practical assignments completed and timely submission

**End Semester Evaluation**: The ESE will be based on oral / practical performance of the students

**Assessment Table:**

| Assessment Tool | **S1** | **S2** | **S3** |
|---|---|---|---|
| | CO1<br>CO2 | CO3<br>CO4 | CO5 |
| **ISE I** (Term Work) | 00 | 15 | 10 |
| **End Semester Evaluation** (Practical Examination & Viva Voce) | 05 | 10 | 10 |

**Assessment Pattern:**

| **Assessment Pattern Level No.** | **Knowledge Level** | **ISE I** | **End Semester Examination** |
|---|---|---|---|
| S1 | Imitation | 05 | 05 |
| S2 | Manipulation | 10 | 10 |
| S3 | Precision | 10 | 10 |
| S4 | Articulation | 00 | 00 |
| S5 | Naturalization | 00 | 00 |
| | **Total Marks** | 25 | 25 |

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes:**

| **Course outcome** | **Program Outcomes** | | | | | | | | | | | | **PSO's** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
| **CO1** | | 3 | 3 | | | | | | | | | | | 3 | |
| **CO2** | | | | | | | 3 | 2 | | | | | 3 | | 2 |
| **CO3** | | 3 | 2 | 3 | | | | | | | | | | 2 | 2 |
| **CO4** | | | | | | | | | | 2 | 2 | 3 | | 2 | 3 |
| **CO5** | | | | | | | | 2 | 2 | | 3 | 3 | 2 | 2 | 3 |

**3 – High 2 – Medium 1 - Low**

| ITPEC4039: Soft Computing | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 02hrs/ week** | **ISE I** | **10 Marks** |
| **Tutorial: 0** | **ISE II** | **10 Marks** |
| **Credits:02** | **ISE III** | |
| | **End Semester Examination** | **30 Marks** |

**Course Description:**

This course introduces the fundamental concepts and techniques of Soft Computing, which provide intelligent and flexible solutions to complex real-world problems where traditional (hard computing) methods are ineffective. The course covers core components such as fuzzy logic, neural networks, and evolutionary and nature-inspired meta-heuristic algorithms. Emphasis is placed on understanding fuzzy reasoning, genetic algorithms, and hybrid systems such as Neuro-Fuzzy Inference Systems (ANFIS).

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Interpret soft computing schemes using knowledge of discrete mathematics, data structures and computerarchitectures. |
| **CO2** | Compare and analyse soft computing schemes. |
| **CO3** | Create and evaluate for better schemes using soft computing. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | **Introduction to Soft Computing:**<br>Concept of computing systems, Difference between Hard and Soft Computing, Soft Computing Constituents, From Conventional AI to Computational Intelligence, Neural Networks, Fuzzy Set Theory, Evolutionary Computing, Neuro-Fuzzy and Soft Computing Characteristics<br>**Fuzzy Logic:** Crisp Logic, Fuzzy Logic, Fuzzy Rule base and Approximate Reasoning, Defuzzification Methods, Applications |
| **Unit 2** | **Nature Inspired Meta-heuristic Algorithms:**<br>Ant colony algorithm, Particle search optimization, Artificial Bee colony search, Bat Algorithm Genetic Algorithm: Introduction, Biological Background, Traditional Optimization and Search Techniques, Genetic Algorithm and Search Space, Generic Algorithm vs. Traditional Algorithms, Basic Terminologies in Genetic Algorithm, Simple GA, General Genetic Algorithm, Operators in Generic Algorithm, Stopping Condition, Constrains |
| **Unit 3** | **Hybrid Systems & Applications of Soft Computing:**<br>Introduction to Hybrid Systems, Adaptive Neuro Fuzzy Inference System(ANFIS)<br>Applications of Soft Computing: Optimization of Travelling Salesman Problem using GA, |

**Text Books & Reference Books**

**TEXT BOOKS:**


1. JyhShing Roger Jang, Chuen: Tsai Sun, EijiMizutani, "Neuro: Fuzzy and Soft Computing", Prentice Hall of India, 6th Edition, 2003.
2. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Wiley, 2nd Edition, 2011.
3. S. Rajasekaran, G. A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI,1st Edition, 2003.
4. George J. Klir, Bo Yuan, "Fuzzy Sets and Fuzzy Logic : Theory and Applications", Prentice Hall, 1995.
5. K. Mohan, S. Ranka, K Mehrotra, "Elements of Artificial Neural Networks", MIT Press, 1stEdition 1996.
6. Xin-She Yang, "Nature Inspired Metaheuristic Algorithms", Luniver Press, 2ndEdition, 2010.


Web Resources

1. http://nptel.ac.in/courses/117105084/
2. https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-641j-introduction-to-neural-networks-spring-2005/
3. https://onlinecourses.nptel.ac.in/noc20_cs17/preview

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | | | | | | | | 2 | | |
| CO2 | | 1 | | | 3 | | | | 2 | 1 | 2 | | | 2 | |
| CO3 | | | 3 | | | 1 | | | | | | | | | 2 |
| CO4 | | | | | | | | | | | | | | 1 | 2 |

**3– High 2 – Medium 1 - Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-10

**ISE II:** Class Test-II of Maximum Marks-10

**ESE**: End Semester Examination of Maximum Marks-30

**Assessment Pattern:**

| Assessment Pattern Level No. | Knowledge Level | ISE I | ISE II | End Semester Examination |
|---|---|---|---|---|
| K1 | Remember | 3 | | 5 |
| K2 | Understand | 3 | 2 | 10 |
| K3 | Apply | 4 | 4 | 5 |
| K4 | Analyze | - | 4 | 10 |
| K5 | Evaluate | | | |
| K6 | Create | | | |
| **Total Marks 100** | | 10 | 10 | 30 |

**Assessment table**:

| **Assessment Tool** | **K1** | **K2** | **K3** |
|---|---|---|---|
| | CO1 | CO2 | CO4 |
| **ISE I** (10 Marks) | 3 | 3 | 4 |
| **ISE II** ( 10 Marks) | 2 | 4 | 4 |
| | | | |
| **ESE Assessment** (30 Marks) | 10 | 10 | 10 |
| **Total Marks 50** | 15 | 17 | 18 |

| ITPEC4040: Data Science | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 02 hrs/ week** | **ISE I** | **10 Marks** |
| **Tutorial: 0** | **ISE II** | **10 Marks** |
| **Credits:02** | | |
| | **End Semester Examination** | **30 Marks** |

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Identify, collect, and manage data from **multiple sources** using APIs and other methods, and perform **data cleaning, exploration, and storage** effectively.. |
| **CO2** | Apply **statistical concepts** such as central tendency, distributions, variance, sampling, and the **Central Limit Theorem** to analyze datasets. |
| **CO3** | Implement and compare **basic machine learning algorithms** such as Linear Regression, Support Vector Machines (SVM), and Naive Bayes for data analysis tasks. |

This course introduces students to the fundamental principles of machine learning for data science. It focuses on the implementation and comparative evaluation of basic machine learning algorithms, including **Linear Regression**, **Support Vector Machines (SVM)**, and **Naive Bayes**. Students will learn how these algorithms work, the assumptions behind each method, and their suitability for different types of data and problem domains. The course emphasizes hands-on data analysis, model training, performance evaluation, and interpretation of results, enabling learners to select and apply appropriate machine learning techniques to real-world datasets.

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | **Introduction to core concepts and technologies**: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications<br>**Data collection and management**: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources. |
| **Unit 2** | **Data analysis**: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes. |
| **Unit 3** | **Data visualisation**: Introduction, Types of data visualisation, Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings, **Recent trends** in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science. |

**Text Books & Reference Books**


1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | | | | | | | | 2 | | |
| CO2 | | 1 | | | 3 | | | | | | | | | 2 | |
| CO3 | | | 3 | | | 1 | | | | | | | | | 2 |

**3– High 2 – Medium 1 - Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-10

**ISE II:** Class Test-II of Maximum Marks-10

Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Power point presentation
2) Question & answer / Numerical solution
3) Surprise test
4) Any other activity suggested by course coordinator

**ESE**: End Semester Examination of Maximum Marks-30

| ITPEC4041: Software Testing and Quality Assurance | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 02hrs/ week** | **ISE I** | **10 Marks** |
| **Tutorial: 0** | **ISE II** | **10 Marks** |
| **Credits:02** | **ISE III** | |
| | **End Semester Examination** | **30 Marks** |

**Course Description:**

This course provides a comprehensive understanding of software testing principles and quality assurance practices essential for developing reliable and high-quality software systems. The course covers software verification techniques, including reviews of requirements, design documents, source code, and user documentation, along with test case generation from SRS and use cases.The course also emphasizes software measurement and metrics, focusing on internal and external product attributes to assess software quality.

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Understand various software testing methods and strategies. |
| **CO2** | Identify defects and manage those defects for improvement in software quality. |
| **CO3** | Design test cases and execute them for software quality control and assurance. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | Software Verification:<br>Verification Methods, SRS document verification, SDD document verification, Source code reviews, User documentation verification, Software project audit Creating test cases from SRS and Use cases: Use Case Diagram and Use Cases, Generation of test cases from use cases, Guidelines for generating validity checks. |
| **Unit 2** | Regression Testing:<br>Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization techniques Testing Web applications: web testing, functional testing, UI testing, usability testing, configurations and compatibility testing, performance testing. |
| **Unit 3** | Measurement in software engineering:<br>Scope of software metrics, classifying software measures, Applying the framework, Software measurement validation, Measuring internal product attributes: size, aspects of software size, length, reuse, functionality. Measuring internal product attributes:<br>Structure, Types of structural measures, Control-flow structure, Modularity and information flow attributes, Measuring external product attributes |

**Text Books & Reference Books**

**TEXT BOOKS:**


1. Yogesh Singh, "Software Testing", Cambridge University Press, 1st edition, 2013.
2. Ilene Burnstein, "Practical Software Testing", Springer professional computing, 1st edition, ISBN 0-387-95131-8
3. N. E. Fenton, S. L. Pfleeger, "Software Metrics-A Rigorous and Practical Approach", PWS publisher, 2nd edition, ISBN: 0-534-95425-1
4. Aditya P. Mathur, "Foundations of Software Testing", Pearson Education, 2ndedition, 2008.
5. RenuRajani, Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill, 1st edition, 2004.
6. Srinivasan Desikan and Gopalaswamy Ramesh, " Software Testing – Principles and Practices", Pearson education, 2006.
7. M. G. Limaye, "Software Testing Principles, Techniques and tools", McGraw Hills, 1st edition, 2009.


Web Resources

1. http://nptel.ac.in/courses/106105150 Software Testing, Dr. Rajib Mal, Department of CSE, IIT Kharagpur.
2. http://nptel.ac.in/courses/106101061/18 Software Testing, Prof. R. K. Joshi, Department of CSE, IIT Bombay.
3. http://www.softwaretestingmentor.com/istqb-videos/ Software Testing, Manish Varma.

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | | | | | | | | 2 | | |
| CO2 | | | 1 | 3 | | | 1 | | 2 | 1 | 2 | | | 2 | |
| CO3 | | | | | | | | | | | | | | | 2 |

**3– High 2 – Medium 1 - Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-10

**ISE II:** Class Test-II of Maximum Marks-10

**ESE**: End Semester Examination of Maximum Marks-30

**Assessment Pattern:**

| Assessment Pattern Level No. | Knowledge Level | ISE I | ISE II | End Semester Examination |
|---|---|---|---|---|
| K1 | Remember | 3 | 2 | 5 |
| K2 | Understand | 3 | 4 | 10 |
| K3 | Apply | 4 | 4 | 5 |
| K4 | Analyze | - | | 10 |
| K5 | Evaluate | | | |
| K6 | Create | | | |
| **Total Marks 100** | | 10 | 10 | 30 |

**Assessment table**:

| **Assessment Tool** | **K1** | **K2** | **K3** |
|---|---|---|---|
| | CO1 | CO2 | CO3 |
| **ISE I** (10 Marks) | 7 | 3 | 0 |
| **ISE II** ( 10 Marks) | 0 | 4 | 6 |
| | | | |
| **ESE Assessment** (30 Marks) | 10 | 10 | 10 |
| **Total Marks 50** | 17 | 17 | 16 |

| ITPEC4042: Generative Artificial Intelligence | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 02hrs/ week** | **ISE I** | **10 Marks** |
| **Tutorial: 0** | **ISE II** | **10 Marks** |
| **Credits:02** | **ISE III** | |
| | **End Semester Examination** | **30 Marks** |

**Course description**

This course provides a comprehensive exploration of Generative AI, beginning with its historical evolution and the fundamental shift from discriminative to generative modeling. This course covers cutting-edge techniques like Prompt Engineering, RLHF, and Retrieval Augmented Generation (RAG), alongside the practical use of open-source frameworks like Hugging Face and LangChain. Beyond technical implementation, the course emphasizes Ethical AI and Responsible AI, addressing critical issues like hallucinations and mode collapse. By the end, you will be equipped to fine-tune, program, and deploy sophisticated AI agents for diverse real-world use cases.

**Course Outcomes**

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

**CO1:** Understand the concepts of Generative Modeling.

**CO2:** Apply Gen AI to Generating Texts.

**CO3:** Apply Gen AI for generating Image.

**CO4:** Apply Gen AI for generating video.

**CO5:** Apply Open Source Tools for solving problems using Gen AI.

Detailed Syllabus

| | |
|---|---|
| **UNIT I** | **Introduction to GEN AI**<br>Historical Overview of Generative modeling - Difference between Gen AI and Discriminative Modeling, Importance of generative models in AI and Machine Learning Types of Generative models ,GANs,VAEs, Autoencoding ,Regression Models , Exploring ChatGPT , Prompt Engineering, Designing Prompts– Revising Prompts using Reinforcement Learning from Human Feedback (RLHF),Retrieval Augmented Generation (RAG) – Multimodal LLM ,Issues of LLM like hallucination. |
| **UNIT II** | **Generation of Images**<br>Introduction to Generative Adversarial Networks – Adversarial Training Process – Nash Equilibrium ,VariationalAutoencoders – Encoder-Decoder Architectures - Stable Diffusion Models. Variants of GAN – Types of GAN - Cyclic GAN – Using Cyclic GAN to Generate Paintings |
| **UNIT III** | **Open source models and programming frameworks**<br>Neural Style Transfer ,Style Transfer - Music Generating RNN, MuseGAN ,Autonomous agents, Deep Q Algorithm ,Actor-critic Network.Training and Fine tuning of Generative models ,GPT4All - Transfer learning and Pretrained models, Training vision models, Google Copilot - Programming LLM ,LangChain ,Open Source Models ,Llama - Programming for TimeSformer – Deployment – Hugging Face. |

Text Books


- Denis Rothman, “Transformers for Natural Language Processing and Computer Vision”, Third Edition ,Packt Books, 2024

- Omar Sanseviero" Hands-On Generative AI with Transformers and Diffusion Models"O'Reilly Media
- Valentina Alto" Modern Generative AI with ChatGPT and OpenAIModels"Packt Publishing

Additional References

- David Foster, "Generative Deep Learning", O'Reilly Books, 2024.
- AltafRehmani, "Generative AI for Everyone", BlueRose One, 2024


**Mapping of Course Outcomes with Program Outcomes**

| Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 2 | | | | | 1 | | 1 | | | | | |
| CO2 | 2 | 2 | 2 | 1 | | | | | | 2 | 2 | | | | |
| CO3 | | 2 | 3 | 3 | | | | | | | | | | | |
| CO4 | | | 3 | 3 | | | | | 3 | | | | | | |
| CO5 | 3 | 2 | 3 | 2 | | | | 2 | | | | 3 | | | |
| 3 – High, 2 – Medium, 1 - Low | | | | | | | | | | | | | | | |

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-10
**ISE II:** Class Test-II of Maximum Marks-10
**ESE**: End Semester Examination of Maximum Marks-30

| ITELC4001: Project-II | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Practical: 08 hrs/ week** | **ISE III** | **100 Marks** |
| **Credits:04** | **End Semester Examination** | **100 Marks** |

| ITHNC7003: Advanced Machine Learning | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 03 hrs/ week** | **ISE I** | **15 Marks** |
| **Tutorial: 1** | **ISE II** | **15 Marks** |
| **Credits:03** | **ISE III** | **10 Marks** |
| | **End Semester Examination** | **60 Marks** |

**Course description:** The course aims to provide knowledge of various advanced machine learning techniques. It also covers several ensemble methods, Bayesian learning, and deep neural network (DNN) techniques, and prepares students for research or industry applications of machine learning.

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Understand ensemble learning, reinforcement learning, Bayesian learning techniques to real-world problems in various domains. |
| **CO2** | Build the recommender system for given application scenario. |
| **CO3** | Explore and investigate deep learning architectures components. |
| **CO4** | Illustrate the technique of Convolution (CNN) and Recurrent Neural Network (RNN) for implementing Deep |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | **Ensemble Learning and Reinforcement Learning**<br>Classification trees, Regression trees, Regularization and pruning, Gini Index, Gain ratio,ID3, C4.5, CART, Random Forest, Ensemble Learning: Bagging, boosting, Ad boost. Introduction to Reinforcement Learning, Markov Decision Process |
| **Unit 2** | **Bayesian Learning**<br>Classical, Empirical, Subjective methods, Types of events, Types of probabilities, Normal Distribution, Bayes' Theorem, Naïve Bayes' classifier, Bayesian Learning. |
| **Unit 3** | **Advanced Supervised and Unsupervised Learning**<br>Gradient Boosting Machines (XGBoost, LightGBM – overview)**,**Support Vector Machines with kernels**,** Learning with imbalanced data**,** Cost-sensitive learning, Performance metrics and model selection, Clustering algorithms (Hierarchical, DBSCAN), Gaussian Mixture Models, Dimensionality reduction (PCA, t-SNE, UMAP – overview) |
| **Unit 4** | **Recommendation System**<br>Machine Learning based Recommendation System, Top recommendation Systems on the Internet, Approaches to recommendation system design: Collaborative Filtering, Content Based Filtering and hybrid approach. |
| **Unit 5** | **Deep Neural Network**<br>Introduction to Neural Networks, Training Neural Networks: Back propagation and Forward propagation Activation Functions, Loss Functions, Hyper-parameters, Gradient-Based Learning. |

**Text Books & Reference Books**


1. Tom Mitchell, " Machine learning", McGraw-Hill series in Computer Science (Unit 1,2,3)
2. Goodfellow I., Bengio Y. Courville A., "Deep Learning", MIT Press, 2016. (Unit 4,5,6)
3. Parag Kulkarni: Reinforcement and Systematic Machine Learning for Decision Making, Wiley IEEE Press, , July 2012.
4. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd edition-2013.
5. Charu Agarwal,"Neural Networks and deep learning", Springer 2023, ISBN: 978-3-031-29642-3.
6. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2 nd Edition. MIT Press. ISBN 0262039249
7. SethWeidman,,"Deep Learning from Scratch: Building with Python from First Principles", O'Reily, ISBN:978-93- 5213-902-6.


**Web Resources**

1. **https://onlinecourses.nptel.ac.in/noc21_cs25/preview, Prof. Balaraman Ravindran IIT Madras.**
2. **https://onlinecourses.nptel.ac.in/noc23_ee87/preview, Prof. M. K. Bhuyan IIT Guwahati.**
3. **https://onlinecourses.nptel.ac.in/noc25_cs49/preview, Prof. Balaji Srinivasan, Prof. Ganapathy Krishnamurthi IIT Madras**

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | | | | | | | | 2 | | |
| CO2 | | 1 | | | 3 | | | | | | | | | 2 | |
| CO3 | | | 3 | | | 1 | | | | | | | | | 2 |
| CO4 | | | | | | | | | | 2 | 1 | 2 | | 1 | 2 |

**3– High 2 – Medium 1 - Low**

**Assessment:**

**ISE I:** Class Test-I of Maximum Marks-15

**ISE II:** Class Test-II of Maximum Marks-15

**ISE III:** Teacher's Assessment of Maximum Marks-10

Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Power point presentation
2) Question & answer / Numerical solution
3) Surprise test
4) Any other activity suggested by course coordinator

**ESE**: End Semester Examination of Maximum Marks-60

**Assessment Pattern:**

| Assessment Pattern Level No. | Knowledge Level | ISE I | ISE II | ISE III | End Semester Examination |
|---|---|---|---|---|---|
| K1 | Remember | 5 | 5 | 2 | 10 |
| K2 | Understand | 7 | 7 | 3 | 20 |
| K3 | Apply | 3 | 3 | 5 | 20 |
| K4 | Analyze | - | - | | 10 |
| K5 | Evaluate | | | | |
| K6 | Create | | | | |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**:

| **Assessment Tool** | **K1** | **K2** | **K3** |
|---|---|---|---|
| | CO1 | CO2,CO3 | CO4 |
| **ISE I** (15 Marks) | 3 | 5 | 7 |
| **ISE II** ( 15 Marks) | 5 | 4 | 6 |
| **ISE III** (10 Marks) | 2 | 4 | 4 |
| **ESE Assessment** (60 Marks) | 10 | 30 | 20 |
| **Total Marks 100** | 20 | 43 | 37 |

| ITELC4003: Internship/OJT | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Practical: 24 hrs/ week** | **ISE I** | |
| **Credits:12** | **ISE II** | |
| | **ISE III** | **100 Marks** |
| | **End Semester Examination** | **100 Marks** |

| ITHNC7004: Advanced Deep Learning | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 03 hrs/ week** | **ISE I** | **15 Marks** |
| **Tutorial:1** | **ISE II** | **15 Marks** |
| **Credits:04** | **ISE III** | **10 Marks** |
| | **End Semester Examination** | **60 Marks** |

| **Course Outcome:** After completing the course, students will be able to | |
|---|---|
| **CO1** | Analyze the performance of task of object detection for a given image. |
| **CO2** | Apply segmentation techniques in real world problems. |
| **CO3** | Apply deep generative model to represent complex data distributions and to generate new data samples that are similar to the training data. |
| **CO4** | Use deep learning techniques in natural language processing. |
| **CO5** | Use attention model and transformer to enhance the understanding and generation of sequential data for a given real world problem. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | CNN for object detection: overview, challenges in object detection, region based CNN, single shot multibox detector, YOLO, anchor box and multiscale detection, Evaluation metrics |
| **Unit 2** | CNN for segmentation: image segmentation, autoencoder, U-net, segmentation loss function, applications |
| **Unit 3** | Deep Generative Models: Introduction of GANs(Generative Modeling) , Different Types of GANs, Components of GANs, Training and Prediction of GANs, Brief on GAN Loss Function, Challenges Faced by GANs, Application of GANs, VariationalAutoencoders and Disentanglement, |
| **Unit 4** | Introduction to NLP and Deep Learning: introduction to NLP, Word Vector representation, word2vec model, Continuous Skip-Gram model, Continuous Bag-of-Words model, Language modelling and neural network, Information Retrieval tasks using Neural Networks- Learn to Rank, Understanding Phrases, analogies. |
| **Unit 5** | Attention Models and Transformers: Attention in Vision Models: An Introduction, Soft and Hard Attention: Image Captioning, Self-Attention and Transformers, Transformers to Vision Transformers, Transformers for Detection, Transformers for Segmentation, Stable diffusion model: LDM, Latent space, Text to image generation,Large Language Models (LLMs). |

**Text Books & Reference Books**

1. Michael Nielsen, Neural Networks and Deep Learning, 2016

| Course outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | 2 | | |
| CO2 | | 1 | | | 2 | | | | | | | | | 2 | |
| CO3 | | | 3 | | | 1 | | | | | | | | | 2 |
| CO4 | | | | | | | | | | 2 | 1 | 2 | | 1 | 3 |
| CO5 | | | | | | | | 1 | 2 | | | | | | 1 |


2. Zaccone, G., Karim, M. R., Menshawy, A. "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
3. Ian GoodfellowYoshuaBengio Aaron Courville , Deep Learning, , MIT Press, 2017
4. Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing
5. Jacek M. Zurada,"Introduction to artificial neural systems", West Publishing Co., 1992, ISBN: 0-3 14-93391 - 3.
6. Bishop C. M., "Pattern Recognition and Machine Learning", Springer, 2006, ISBN: 978-0-387-31073-2
7. Deep Learning with Python", Francois Chollet, Manning Publications, 2017


**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

**3– High 2 – Medium 1 - Low**

**Assessment:**
**ISE I:** Class Test-I of Maximum Marks-15
**ISE II:** Class Test-II of Maximum Marks-15
**ISE III:** Teacher's Assessment of Maximum Marks-10
Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Power point presentation
2) Question & answer / Numerical solution
3) Surprise test
4) Any other activity suggested by course coordinator

**ESE**: End Semester Examination of Maximum Marks-60

**Assessment Pattern:**

| **Assessment Pattern Level No.** | **Knowledge Level** | **ISE I** | **ISE II** | **ISE III** | **End Semester Examination** |
|---|---|---|---|---|---|
| K1 | Remember | 5 | 5 | 2 | 10 |
| K2 | Understand | 7 | 7 | 3 | 20 |
| K3 | Apply | 3 | 3 | 5 | 20 |
| K4 | Analyze | - | - | | 10 |
| K5 | Evaluate | | | | |
| K6 | Create | | | | |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**:

| **Assessment Tool** | **K1** | **K2** | **K3** |
|---|---|---|---|
| | CO1 | CO2,CO3 | CO4,CO5 |
| **ISE I** (15 Marks) | 3 | 5 | 7 |
| **ISE II** ( 15 Marks) | 5 | 4 | 6 |
| **ISE III** (10 Marks) | 2 | 4 | 4 |
| **ESE Assessment** (60 Marks) | 10 | 30 | 20 |
| **Total Marks 100** | 20 | 43 | 37 |

| **ITHNC7005: Project** | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Lectures: 04hrs/ week** | **ISE I** | **25 Marks** |
| **Credits:02** | **End Semester Examination** | **25 Marks** |