

# **ORDINANCES**

Of

**M.Tech. in Artificial Intelligence and Data Science**

**(CHOICE BASED CREDIT SYSTEM)**

**First Year (Semester I<sup>st</sup> and II<sup>nd</sup>)**

**(2019-2020 and 2020-21)**



**PUNJABI UNIVERSITY, PATIALA - 147002**

## ORDINANCES OF COURSES

### **M.Tech in Artificial Intelligence and Data Science**

Notwithstanding the integrated nature of a course spread over more than one semester, the Ordinances in force at the time, a student joins a course shall hold good only for the examination held during or at the end of the semester. Nothing in these ordinances shall be deemed to debar the University from amending the ordinances subsequently and the amended ordinances, if any, shall apply to all the students whether old or new. In case of any dispute arising out of these Ordinances, the decision of the Vice Chancellor shall be final and binding.

#### **1. Structure and Duration of the Programme:**

- i. The course for the degree of M.Tech in Artificial Intelligence and Data Science in regular mode shall be spread over two years to be called semester I, II, III and IV. The end-semester examination for I and III semesters, i.e. odd Semesters shall be held tentatively in the month of November/December and for the II and IV semesters i.e. even semester tentatively in the month of May/June or on such other dates as may be decided by Punjabi University.

The programme of instruction will consist of:

- Core courses
- Elective courses
- Research Project and Dissertation

- ii. The outlines of tests and syllabi shall be such as prescribed by the concerned Academic Faculty from time to time.
- iii. Maximum period for the degree shall be 4 years for regular course.
- iv. The medium of examination shall be English.

#### **2. No. of Seats:**

Total number of seats in M.Tech. shall be 50. The distribution of seats will be as per Punjabi University norms.

#### **3. Eligibility of Admission:**

Master's degree in (Mathematics/Statistics/Physics/Operational Research/Electronics/IT/ICT/Computer Science/AI/DS/AI&DS) or equivalent or MCA or equivalent degree with 60% (55% for SC/ST and differently-abled persons) marks (or equivalent Grade point) from recognized University/Institution.

OR

B.E./B.Tech. in any branch of Engineering or equivalent degree in Engineering with 60% (55% for SC/ST and differently-abled persons) marks (or equivalent Grade point) from recognized University/Institution.

OR

B.Sc. in Computer Science / Information Technology/Software Engineering or equivalent degree of 4-year duration with 60% (55% for SC/ST and differently-abled persons) marks (or equivalent Grade point) from recognized University/Institution.

#### **4. Basis for Admission:**

Admission will be made purely on the merit of qualifying examination.

#### **Attendance:**

Attendance is taken compulsorily by the Teacher.

A candidate admitted to the M.Tech. Course must fulfill the following requirements:

- i. Has been on the rolls of the Department throughout the semester preceding the

examination.

- ii. Every candidate will be required to attend a minimum of 75% of the delivered number of periods in each paper. For Teaching/Seminars/Tutorials and Lab Practicals, period of one hour's duration shall be counted as one attendance.
- iii. For late admission, the counting of lectures will be considered from the date of deposit of fee.
- iv. In case of students, whose names are struck off on account of non-payment of fee, their periods, for the time they were not on the rolls, shall not be accounted for.
- v. The shortage in the attendance of lectures by the candidate will be condoned as per rules made by the University from time to time.

**5. Schedule for Examination Fees:**

Candidates shall submit their application forms for admission to the examination duly countersigned by the Head of the Department/Director/Concerned Authority. The candidate will be required to pay examination fees as per the schedule prescribed by the University from time to time.

**6. Minimum Requirements to continue the Programme:**

(I)

- a) In each theory paper, 50% of the total marks are assigned to the continuous assessment and 50% marks to the University examination; and in each laboratory practical paper, 60% of the marks are assigned for continuous assessment and 40% marks for University Examination. The minimum number of marks required to pass each theory and practical examination shall be 40% in each paper for continuous assessment as well as university examination.
- b) When a candidate has failed or placed under 'reappear' in the University examination but passes in the continuous assessment, the marks of continuous assessment shall be carried forward for subsequent examinations. If a candidate has failed or placed under 'reappear' in the continuous assessment, but passes in the University examination, the marks in the University examination shall be carried forward for subsequent examinations. In that case, the candidate will have to improve his/her score in the continuous assessment by taking only a single test covering entire syllabus for that subject, which will consist of total marks assigned to Internal Assessment for that paper. Such candidate will have to inform the Department in writing and in turn the test will be scheduled by the Department. The grace marks shall be allowed to the student as per general ordinances of University.

(II)

- a) There will be no condition of passing papers for promotion from odd semester to even semester in an Academic Session.
- b) To qualify for admission to 2<sup>nd</sup> year of the Course, the candidate must have passed 50% of total papers of the two semesters of the 1<sup>st</sup> year.
- c) A candidate placed under re-appear in any paper, will be allowed two chances to clear the reappear which should be availed within consecutive two years/chances, i.e. to pass in a paper, the candidate will have a total of three chances, one as regular student and two as reappear candidate.

The examination of the reappear papers of odd semester will be held with regular examination of the odd semester and reappear examination of even semester will be held with regular examination of even semester. But if a candidate is placed under reappear in the last semester of the course, he/she will be provided chance to pass the reappear with

the examination of the next semester, provided his/her reappear of lower semester does not go beyond next semester. Option of re-evaluation shall be available to the candidates.

(III) A candidate shall be allowed to join:

- a) Second Semester: Provided that he/she has undergone a regular course of studies of First Semester as provided under the regulations and fulfills the conditions as laid in Ordinances 7 (I) and 7 (II).
- b) Third Semester: provided that he/she has undergone a regular course of studies of First and Second Semesters as provided under the regulations in sequential order and fulfills the conditions as laid in Ordinances 7 (I) and 7 (II).
- c) Fourth Semester: Provided that he/she has undergone a regular course of studies of First, Second and Third semesters as provided under the regulations in sequential order and fulfills the conditions as laid in Ordinances 7 (I) and 7 (II).

#### 7. System of Tests and Weightage:

The system of tests will comprise of Internal assessment and University examination for theory papers and laboratory practicals for Semester I, Semester II and Semester III for regular course. The following will be criteria of weightage for these two examinations for each paper/practical:

<b>Continuous Assessment (Theory Papers)</b>	<b>Continuous Assessment (Practical Labs)</b>
<ol style="list-style-type: none"> <li>1. Two tests will be conducted during the semester. Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment.</li> <li>2. Assignments/Quizzes: 20% of the marks allotted for continuous assessment.</li> <li>3. Attendance: 10% of the marks allotted for continuous assessment.</li> <li>4. Class Participation and behaviour: 10% of the marks allotted for continuous assessment.</li> </ol>	<ol style="list-style-type: none"> <li>1. Two tests will be conducted during the semester. Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment.</li> <li>2. Lab Assignments: 30% of the marks allotted for continuous assessment.</li> <li>3. Attendance: 10% of the marks allotted for continuous assessment.</li> </ol>
<b>University Examination (Theory Papers)</b>	<b>University Examination (Practical Labs)</b>
<p>End Semester Examination for theory papers will be of 3 hours duration. The question paper will consist of three Sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and each question will carry 7.5 marks. Section C will consist of 10 short-answer type questions of 2 marks each covering the entire syllabus uniformly and will carry 20 marks in all. Candidates are required to attempt five questions in all, selecting two questions each from section A and B and compulsory question of section C.</p>	<p>Maximum Marks for End-Semester Practical Examination: 40. The evaluation will be done jointly by the team of internal and external examiner. The examiners will give due weightage to Logic development/Program execution, Lab records and viva-voce of the student while awarding marks to the student during end-semester final practical examination.</p>

#### 8. Research Project Synopsis:

##### A. Allocation of Supervisor:

Regular faculty members of the Department shall act as supervisors of M.Tech. (AI&DS) Students.

## **B. Submission of Synopsis:**

Each student is required to submit his/her research synopsis after 3<sup>rd</sup> semester. However, student can submit his/her synopsis:

- i. up to January 31, with a fine of Rs. 5,000/-
- ii. After January 31, the synopsis will be accepted with a fine of Rs. 10,000/-  
However synopsis will not be accepted after April 30.
- iii. Submission of synopsis after April 30 shall be permitted only after depositing fee for full semester (including tuition fee, other funds and examination fee).

In any case, the total period of extension in submission of synopsis cannot exceed 2 semesters after April 30.

Furthermore, each student is required to give a certificate, duly signed by the student and counter signed by the supervisor, certifying that the synopsis of the student is free of any kind of plagiarism along with the report of plagiarism detection tool/website as mandated by Punjabi University (if any).

## **C. Evaluation of Synopsis:**

The synopsis will be evaluated by a committee having following members:

- i. Head of the Department
- ii. Supervisor of the student
- iii. Two teachers of the Department nominated by Head of the Department (at least one teacher must be present).

There will not be any marks for the synopsis. After presentation and viva of the student, the evaluation committee will either accept or reject the synopsis. The decision of the evaluation committee will be displayed on the Department's notice board within 7 working days from the presentation of the synopsis by the student.

In case of rejection of the synopsis, the student will submit the revised synopsis along with a fee of Rs. 10,000/- up to April 30. Submission of revised synopsis after April 30 shall be permitted only after depositing fee for full semester (including tuition fee, other funds and examination fee). In any case, the total period of extension in submission of synopsis cannot exceed 2 semesters after April 30.

## **9. Dissertation:**

### **A. Allocation of Supervisor:**

- i. The supervisor assigned to a student for research project, in 3<sup>rd</sup> semester will continue to supervise the student for the 4<sup>th</sup> semester. However, in case of exceptional circumstances, the supervisor may be changed with the approval of the Head of the Department.
- ii. The cases of those M.Tech. students who want to do dissertation work outside the Department, will also be finalized by the Head of the Department.
- iii. In lieu of the thesis work, the student may pursue Software development/Industrial project in industry. However, before proceeding on such a project, the student will have to obtain prior permission from the Head of the Department through Internal supervisor.
- iv. Joint projects may also be allowed subject to the condition that students shall highlight their individual contributions in the joint project at the time of viva-voce.

### **B. Submission of Dissertation:**

The student is required to submit the final dissertation any time after April 30 but not later than August 31. Before submission of dissertation, the student must have published/presented at least one paper, related to his/her area of research, in some reputed national/international

journal/conference of repute (proof of publication/presentation must be attached with the Dissertation).

Furthermore, each student is required to give a certificate, duly signed by the student and counter signed by the supervisor, certifying that the dissertation of the student is free of any kind of plagiarism along with the report of plagiarism detection tool/website as mandated by Punjabi University (if any).

### **C. Extension of Dissertation Semester:**

If a student is unable to complete the dissertation work in last semester, i.e. Fourth Semester, then the candidate will submit an application, along with dissertation extension fee, through supervisor that an extension of more time, i.e. next semester is required to complete the dissertation work. In this way such extensions may be given up to maximum period of degree (refer to Ordinance No.1 (iii): maximum period for the degree shall be four (04) years).

The concerned fee details are given below:

- i. **Dissertation Extension Fee:** The extension period will be granted one semester at a time. Such candidates will pay full semester fee (including tuition fees, other funds and examination fee). But in no case, the total period to complete the degree will extend more than 4 years.
- ii. **Special Extension Fee:** However, despite the above extensions, if the candidate further fails to submit his/her dissertation work within the stipulated extension period as mentioned in the clause (i) above, then he/she could submit the dissertation in the next one semester by depositing the one-time extension fee of Rs. 25,000/- in addition to full semester fee (including tuition fees, other funds and examination fee). In such cases, the candidate must apply to the Department Research Board (DRB) through his/her supervisor for granting the special extension by specifying the valid reasons for delay in submission of dissertation work and submit comprehensive report before seeking such extension. After the recommendation by the Department Research Board, the final approval regarding special extension will be granted by Dean (Academic Affairs). No further extension will be possible after this period for completion of dissertation work.

### **D. Evaluation of Dissertation:**

- i. The seminar and viva-voce for dissertation will be conducted by the Department after August 31. However, in special cases, where a student wishes to defend his/her dissertation before the aforesaid dates respectively, the Department may arrange the same and the student will have to pay Rs. 5,000/- as special fee.
- ii. The student will defend his/her dissertation before the following committee:
  - Head of the Department /Nominee
  - Supervisor
  - External Examiner
- iii. The break-up of marks will be:
  - Dissertation Evaluation – 100 Marks
  - Seminar and Viva voce – 300 Marks

### **10. Declaration of Results:**

Three weeks after the termination of examination or as soon thereafter as possible, the Registrar shall publish the result of the candidates. Each candidate shall receive a certificate indicating details of marks obtained in each examination. Successful candidates at the end of Semester IV examination shall receive a degree stating the Division/Cumulative Grade Points according to Ordinance 12.

**11. Award for Division and Distinction:**

Successful candidates who obtain 60% or more of the aggregate number of marks of all the semester examinations taken together, shall be placed in the First division, those who obtain 50% marks or more but less than 60% in the Second division and below 50% marks shall be placed in the Third Division. Successful candidates who obtain 75% marks or more in aggregate in a single attempt without any reappear in any subject/paper shall be placed in First division with distinction.

**12. Award of University Medals:**

University medal will be awarded to M.Tech in Artificial Intelligence and Data Science candidate who secured first position in the University on the basis of the marks of all semesters taken together. In addition to this condition, candidate must complete his/her M.Tech in Artificial Intelligence and Data Science degree in minimum duration with single attempt in all subjects/papers. However the general rules and conditions of the University for the award of medal/prizes etc. will be applicable in the award of University medal to the topper of the respective admission batch.

**13. Degree Equivalence**

M.Tech. in Artificial Intelligence & Data Science will be considered equivalent to M.Tech. Computer Science and Engineering wherever the candidate needs such clarification for job or higher education. The Controller of Examination will be the competent authority for the issue of the equivalence certificate. The certificate will be issued on the request of the candidate after the payment of the required fees as decided by the University from time to time.

**14. This course falls under the Faculty of Computing Sciences.**

**Note:** The duration of fourth Semester will be up to August and the duration of extended Semesters will be from September to February/ and from March to August. The last date for depositing the fees in the extended Semester will be September 30. Thereafter, the fees will be deposited with a late fee of Rs. 1000/- per delayed month.

**PUNJABI UNIVERSITY PATIALA**

**M.Tech in Artificial Intelligence and Data Science  
First Year – First Semester Examinations  
For Session 2019-2020 and 2020-21**

CODE NO.	TITLE OF THE PAPER	Schedule of Teaching (Hrs/Week)			TOTAL HOURS	CREDITS	MARKS	
		L	T	P			Internal	External
MTAI-111	Introduction to Artificial Intelligence and Data Science	4	1	0	5	4	50	50
MTAI-112	Mathematical Foundation Course	4	1	0	5	4	50	50
MTAI-113	Data Structures and Algorithms	4	1	0	5	4	50	50
MTAI-114	Problem Solving and Programming in Python	4	1	0	5	4	50	50
MTAI-115	<b>Elective –I*</b>	4	1	0	5	4	50	50
MTAI-116	Programming Lab – I and Minor Project	0	0	6	6	3	60	40
	<b>Total</b>	<b>20</b>	<b>5</b>	<b>6</b>	<b>31</b>	<b>23</b>	<b>310</b>	<b>290</b>

**Elective –I\*** (Choose any one among below)

MTAI-115(i) Cyber Security and Information Assurance

MTAI-115(ii) Web Analytics

MTAI-115(iii) Healthcare Data Analytics

MTAI-115(iv) Logistics and Supply Chain Management

MTAI-115(v) Cyber Laws

**CONTINUOUS ASSESSMENT (THEORY)**

1.	Two tests will be conducted during the course. Both tests will be counted for assessment	60% of the total marks allotted for continuous assessment
2.	Assignments / Quizzes	20% of the total marks allotted for continuous assessment
3.	Attendance	10% of the total marks allotted for continuous assessment
4.	Class Participation and Behavior	10% of the total marks allotted for continuous assessment

**CONTINUOUS ASSESSMENT (PRACTICAL LAB)**

1.	Two tests will be conducted during the course. Both tests will be counted for assessment	60% of the total marks allotted for continuous assessment
2.	Lab Assignments	30% of the total marks allotted for continuous assessment
3.	Attendance	10% of the total marks allotted for continuous assessment



**PUNJABI UNIVERSITY PATIALA**

**M.Tech in Artificial Intelligence and Data Science  
First Year - Second Semester Examinations  
For Session (2019-2020 and 2020-21)**

CODE NO.	TITLE OF THE PAPER	Schedule of Teaching (Hrs/Week)			TOTAL HOURS	CREDITS	MARKS	
		L	T	P			Internal	External
MTAI-121	Data Analysis using Python	4	1	0	5	4	50	50
MTAI-122	Machine Learning with R	4	1	0	5	4	50	50
MTAI-123	Research Methodology	4	1	0	5	4	50	50
MTAI-124	Natural Language Processing with Python	4	1	0	5	4	50	50
MTAI-125	Elective –II*	4	1	0	5	4	50	50
MTAI-126	Programming Lab – II (Based on 121,122 and 124) and Minor Project	0	0	6	6	3	60	40
	<b>Total</b>	<b>20</b>	<b>5</b>	<b>6</b>	<b>31</b>	<b>23</b>	<b>310</b>	<b>290</b>

**Elective –II\*** (Choose any one among below)

- MTAI-125(i) Digital Marketing
- MTAI-125(ii) Block Chain and Bitcoin Fundamentals
- MTAI-125(iii) Neural Networks and Fuzzy Logic
- MTAI-125(iv) Social Networking and Mining
- MTAI-125(v) Digital Forensics

**CONTINUOUS ASSESSMENT (THEORY)**

1.	Two tests will be conducted during the course. Both tests will be counted for assessment	60% of the total marks allotted for continuous assessment
2.	Assignments / Quizzes	20% of the total marks allotted for continuous assessment
3.	Attendance	10% of the total marks allotted for continuous assessment
4.	Class Participation and Behavior	10% of the total marks allotted for continuous assessment

**CONTINUOUS ASSESSMENT (PRACTICAL LAB)**

1.	Two tests will be conducted during the course. Both tests will be counted for assessment	60% of the total marks allotted for continuous assessment
2.	Lab Assignments	30% of the total marks allotted for continuous assessment
3.	Attendance	10% of the total marks allotted for continuous assessment

# MTAI-111 : Introduction to Artificial Intelligence and Data Science

L T P C

4 1 0 4

**Max. Marks : 50**

**Maximum Time : 3 Hrs.**

**Min. Pass Marks: 40%**

**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION A**

**Introduction to Artificial Intelligence:** Definitions of AI, Intelligent Agents, Problem solving.

**Knowledge, Reasoning and Planning:** Logical Agents, Classical Planning, Knowledge Representation and Reasoning.

**Learning:** Learning from examples, Knowledge in learning.

**Communicating, Perceiving and Acting:** Communication, Natural Language Processing, Perception, Computer Vision, Robotics.

**AI Applications (General):** Speech Recognition, Image Recognition, Natural Language Processing, Autonomous Transportation. Natural Language understanding, Recognizing objects and describing images, Dimensionality reduction, feature selection and feature extraction.

**AI Applications (Specific):** Virtual Personal Assistants/ Chatbots, Gaming, Smart Cars, Drones, Fraud Detection, Software Testing and Development, Business, Health Care, Education, Finance.

## **SECTION B**

**Introduction to Data Science:** Data Science-a discipline, Landscape-Data to Data science, Data Growth-issues and challenges, data science process. Foundations of data science.

**Data Exploration and Preparation:** Structured vs unstructured data, Quantitative vs qualitative data. Four levels of data – nominal, ordinal, interval, ratio. Messy data, Anomalies and artifacts in datasets. Cleaning data.

**Data Representation and Transformation:** Forms of data-tabular, text data, graph-based data. Modern databases- text files, spreadsheets, SQL databases, NoSQL databases, distributed databases, live data streams.

Representation of data of special types-acoustic, image, sensor and network data.

**Computing with Data:** Overview of various tools

**Data Modeling:** Basics of Generative modeling and Predictive modeling.

**Data Visualization and Presentation:** Charts-histograms, scatter plots, time series plots etc.

**Applications of Data Science** in Business, Insurance, Energy, Health care, Biotechnology, Manufacturing, Utilities, Telecommunication, Travel, Governance, Gaming, Pharmaceuticals, Geospatial analytics and modeling

**Text Books:**

1. S.J. Russell and P.Norving: “Artificial Intelligence: A Modern Approach”, Pearson.
2. Sinan Ozdemir, “Principles of Data Science”, Packt Publishing.

**Reference Books:**

1. E.Rich, K.Knight, S.B. Nair: “Artificial Intelligence”, Tata McGraw Hill Ed Pvt Ltd.
2. Joel Grus: “Data Science from Scratch”, O’Reilly.
3. Foster Provost & Tom Fawcett: “Data Science for Business” O’Reilly (SPD)
4. Roger D. Peng & Elizabeth Matsui: “The Art of Data Science” Lean Publishing.
5. Artificial Intelligence and Soft Computing for Beginners, Anindita Das(Bhattacharjee), Shroff Publications and Distributors.

# MTAI-112 Mathematical Foundation Course

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## Instructions for the Paper Setter

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## Instructions for the Candidates

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## Section A

Set Theory, Binary Operations, Functions and Relations; Recurrence relations and Generating Functions; Permutations and Combinations ; Pigeon Hole Principle ; Probability Theory ; Propositional calculus ; Tautology & Contradiction ; Boolean Algebra ; Idea of Continuity ; Differentiation, Logarithmic differentiation, Partial differentiation, Euler 's Theorem For homogenous Functions ; Maxima and Minima. Integration ; Double Integration; Range of Order Of Integration, Find Ideas ; Vectors, dot product, cross product; Divergence and convergence of a vector.

## Section B

**Matrices & Determinants:** Matrix, Def., types, Addition, Substraction, Multiplication of Matrices, Singular and Non-Singular Matrices, Rank of a Matrix, Solution of Simultaneous Equations, Cayleg Hamilton Theorem, Eigen Values & Eigen Vectors , Diagonalization of a Matrix, Concept of Positive Definite, Semi Definite.

**Matrix Algebra and Linear Algebra :** Introduction of groups, rings and Vector Spaces. Linear Independence and Dependence of Vectors, Linear Combination. Basis and Dimension Of Vector space, Sub-Space, Intersection, Union of sub Spaces.

**Linear Transformation:** Matrices as Linear Mapping, Kernel and Image. Statement of Rank Nullity Theorem, Singular and Non- Regular Linear Mappings.

## Text Book:

1. Seymour Lipschutz, Marc Lipson, Linear Algebra, Schaum Series
2. Seymour Lipschutz , Marc Lipson , H. Patil, Discrete Structures, Schaum Series
3. Elliott Mendelson , Frank Ayres , Calculus, Schaum Series

## Reference Books:

1. Coding the Matrix: Linear Algebra Through Applications to Computer Science by Philip N. Klein, Lightning Source Inc.
2. Linear Algebra Done Right by Sheldon Axler, Springer.
3. Linear Algebra by Kenneth M. Hoffman, Ray Kunze, Pearson.
4. Linear Algebra and its Applications by David C. Lay and Steven R. Lay, Pearson.
5. Elementary Matrix Theory by Howard Eves, Dover Publications.

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## Instructions for the Paper Setter

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## Instructions for the Candidates

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## SECTION A

**Data Structure:** Introduction to data structure and algorithm.

**Algorithm analysis:** Time space trade off algorithms and Big O notation, efficiency of algorithms, Worst case and average case analysis.

**Arrays:** Introduction, one dimensional and multidimensional arrays, memory representation of arrays, operations on arrays, sparse arrays and sparse matrices and their implementation, Advantages and limitation of arrays.

**Stacks:** Introduction; Operation on stacks; Implementation of stacks.

Application of stacks: matching parenthesis, evaluation of arithmetic expressions, conversion from infix to postfix, recursion.

**Queues:** introduction, operation on queues, circular queue, memory representation of queues, priority queues, application of queues.

**Linked List:** Introduction; operation on linked list, circular linked list, doubly linked list, header linked list, implementation of linked list, application of linked lists.

**Trees:** Introduction; Binary Tree; Threaded Binary Trees; Binary Search Tree; AVL Trees,

**Balanced Trees;** B-Trees, Heap.

## SECTION B

**Graphs:** Introduction Graph: Graph terminology.

**Memory Representation of Graphs:** adjacency matrix representation of graphs, adjacency list or linked representation of graphs.

**Operations performed on graphs:** Breadth-first and Depth-first search, Dijkstra Shortest Path algorithm, Minimum Spanning Tree, Kruskal Algorithm, Prims Algorithms  
Application of graphs.

**Hashing:** Hashing techniques; Collision resolution; open addressing, chaining; Application of hashing.

**Sorting:** Selection Sort, Insertion Sort, Merge Sort, Bucket Sort, Radix Sort, Quick Sort and Heap Sort, External Sorting techniques. Lower bound for sorting, Decision Trees.

**Algorithm Design Techniques:** Divide and Conquer Algorithms, Greedy Algorithms, Dynamic Programming, Back Tracking Algorithms.

**TEXT BOOKS:**

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education.
2. Tanenbaum, Y. Lanhsam and A. J. Augenstein, "Data Structures Using C", Prentice Hall of India.

**REFERENCE BOOKS:**

1. Vishal Goyal, Lalit Goyal, Pawan Kumar, A Simplified Approach to Data Structures, Shroff Publishers and Distributors.
2. CORMAN, Introduction to Algorithms
3. S. Sahni, "Data Structures, Algorithms and Application in C++", McGraw-Hill.
4. Donald Knuth : Fundamental Algorithms. Vol-1
5. Donald Knuth : Sorting & Searching. Vol-3

# MTAI-114 Problem Solving and Programming in Python

L T P C

4 1 0 4

**Maximum Marks : 50**

**Maximum Time : 3 Hrs.**

**Minimum Pass Marks: 40%**

**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **Section A**

**Introduction to Python:** History of Python, Strength and Weakness, Different Versions, Installing Python , Setting up in local environment, IDLE, Executing from file, command line from interactive mode, Python Identifiers and reserved key words.

**Python syntax:** Variables and Variables type, Data types, Data Types Conversion, Operators (Arithmetic, Comparison, Assignment, Bitwise, Logical, Membership, Identity), Operators Precedence, Python Decision making (if, el if, else, nested if), Python loops (while, for, nested loops), Break and continue statements.

**Python Collections or Sequence:** Sequence introduction, Number operations, String Operations, List, Tuple, Dictionary, Set.

**Python Functions:** Function introduction, User defined functions, Functions with parameters, Keywords and optional parameters, Scope of variables (Global and Local), Anonymous function – Lambda, In-build function, List comprehension.

## **Section B**

**Python Modules:** Modules, Standard Modules (Sys, Math, Time), Import Statement, from statement, Dir() functions.

**Python File handling:** Sending Output to STDOUT Using the print() Method, Reading Input with the input() Method, Creating File Objects with the open() Method, Controlling File Access Modes, Working with File Object Attributes, Closing File Objects with the close() Method, Reading and Writing to File Objects with read() and write(), Using File Processing Functions from the OS Module.

**OOP:** Class and object, Attributes, Inheritance, Overloading, Overriding, Polymorphism, Iterators and Generators, Decorators, Static and Class Methods, Meta Classes.

**Regular Expressions:** Introduction, Simple Character Matches, Special Characters, Files I/O, Exceptions, Match function, Search function, Matching v/s Searching, Modifiers, Patterns.

**Exceptions handling:** Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Raise, Writing Your Own Exception Classes.

## **Text Books:**

1. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming- An Introduction to Computer Science Using Python 3.6, Shroff Publications and Distributors

## **Reference books:**

1. John V Guttag, Introduction to Computation and Programming Using Python“, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python 3, Second edition, Pragmatic Programmers, LLC, 2013.
5. Rossum, Introduction To Python ,Shroff Publications and Distributors
6. Downey, Think Python 2/ED, Shroff Publications and Distributors
7. Lutz, Learning Python, 5/ED, Shroff Publications and Distributors
8. Campbell ,Practical Programming: An Introduction to Computer Science Using Python, Shroff Publications and Distributors



# MTAI-116: Programming Lab – I and Minor Project

L T P C  
0 0 6 0

**Maximum Marks: 100\***

**Maximum Time: 3 Hrs.**

**Minimum Pass Marks: 40%**

**Practical Sessions to be conducted: 55-65 Hrs.**

The Laboratory assignments for this lab will include the assignments mainly from the Paper MTAI-114: Problem Solving and Programming in Python

## **\*The splitting of marks is as under:**

Maximum Marks for Continuous Assessment: 60

Maximum Marks for University Examination: 40

## **Continuous Assessment (Practical Labs)**

\*Maximum Marks for Continuous Assessment: 60

- Two tests will be conducted during the semester.
- Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment.
- Lab Assignments: 30% of the marks allotted for continuous assessment.
- Attendance: 10% of the marks allotted for continuous assessment.

## **University Examination (Practical Labs)**

\*Maximum Marks for University Examination: 40

The evaluation will be done jointly by the team of internal and external examiner.

The examiners will give due weightage to Logic development/Program execution, Lab records and viva -voce of the student while awarding marks to the student during end-semester final practical examination.

# MTAI-115(i) Cyber Security and Information Assurance

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **Section A**

**Critical characteristics of Information** - NSTISSC Security Model -Components of information System –SDLC – Information assurance - Security Threats and vulnerabilities - Overview of Security threats— Security Standards .

**Classical Cryptography** - Symmetric Cryptography- Asymmetric Cryptography - Modern Cryptography – Access Control - DRM – Steganography – Biometrics.

**Network security** - Intrusion Prevention, detection and Management - Firewall – Ecommerce Security - Computer Forensics - Security for VPN and Next Generation Networks.

## **Section B**

**Host and Application security** -Control hijacking, Software architecture and a simple buffer overflow - Common exploitable application bugs, shellcode - Buffer Overflow - Side-channel attacks - Timing attacks, power analysis, cold-boot attacks, defenses – Malware - Viruses and worms, spyware, key loggers, and botnets; defenses auditing, policy - Defending weak applications - Isolation, sandboxing, virtual machines.

**Mobile, GSM and Wireless LAN security** - Protection measures - Business risk analysis – Information Warfare and Surveillance – Case study on Attack prevention, detection and response.

## **References:**

1. William Stallings, “Cryptography and Network Security: Principles and Practice”, 6 th Edition, PHI, 2014.
2. Michael E. Whitman and Herbert J Mattord, "Principles of Information Security", 6 th edition, Vikas Publishing House, 2017.
3. Bill Nelson, Amelia Phillips, F.Enfinger and Christopher Stuart, “Guide to Computer Forensics and Investigations, 4 th ed., Thomson Course Technology, 2010.
4. Matt Bishop, “Computer Security: Art and Science”, 1 st edition, Addison-Wesley Professional, 2015.

# MTAI-115(ii) Web Analytics

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **Section A**

**Web Analytics** – Basics – Traditional Ways – Expectations – Data Collection – Clickstream Data – Weblogs – Beacons – JavaScript Tags – Packet Sniffing – Outcomes data – Competitive data – Search Engine Data.

**Qualitative Analysis** – Customer Centricity – Site Visits – Surveys – Questionnaires – Website Surveys – Post visits – Creating and Running- Benefits of surveys – Critical components of successful strategy.

## **Section B**

**Web Analytic concepts** – URLs – Cookies – Time on site – Page views – Understand standard reports – Website content quality – Navigation reports (top pages, top destinations, site overlay). – Search Analytics – Internal search, SEO and PPC – Measuring Email and Multichannel Marketing - Competitive intelligence and Web 2.0 Analytics – Segmentation – Connectable reports.

**Google Analytics:** Analytics - Cookies - Accounts vs Property - Tracking Code - Tracking Unique Visitors - Demographics - Page Views & Bounce Rate Acquisitions - Custom Reporting.

**Goals & Funnels** – Filters - Ecommerce Tracking - Real Time Reports - Customer Data Alert - Adwords Linking - Adsense Linking -Attribution Modeling - Segmentation - Campaign Tracking - Multi-Channel Attribution.

## **References:**

1. Avinash Kaushik, “Web Analytics 2.0: The Art of Online Accountability and Science Of Customer Centricity “, 1st edition, Sybex, 2009.
2. Michael Beasley, “Practical Web Analytics for User Experience: How Analytics can help you Understand your Users”, Morgan Kaufmann, 2013.

3. Magy Seif El-Nasr, Anders Drachen, Alessandro Canossa, eds., “Game Analytics: Maximizing the Value of Player Data”, Springer, 2013.
4. Bing Liu, “Web Data Mining: Exploring Hyperlinks, Content, and Usage Data”, 2 nd Edition, Springer, 2011.
5. Justin Cutroni, “Google Analytics”, O’Reilly, 2010.
6. Eric Fettman, Shiraz Asif, Feras Alhlou , “Google Analytics Breakthrough”, John Wiley & sons, 2016.

# MTAI-115(iii) Healthcare Data Analytics

L T P C

4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **Section A**

**Introduction:** Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges- Phenotyping Algorithms.

**Analysis:** Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine.

**Analytics:** Natural Language Processing and Data Mining for Clinical Text- Mining the Biomedical- Social Media Analytics for Healthcare.

## **Section B**

**Advanced Data Analytics:** Advanced Data Analytics for Healthcare– Review of Clinical Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.

**Applications:** Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.

## **References:**

1. Chandan K. Reddy and Charu C Aggarwal, “Healthcare data analytics”, Taylor & Francis, 2015
2. Hui Yang and Eva K. Lee, “Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.

# MTAI-115(iv) Logistics and Supply Chain Management

L T P C

4 1 0 4

**Maximum Marks : 50**

**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**

**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **Section A**

**Understanding of Supply Chain :** Objectives of a supply chains - decision phases - stages of supply chain-supply chain process view- cycle view of supply chain process - push/pull view of supply chain processes - key issues in SCM - Supply chain drivers and obstacles - - inventory- transportation- facilities and information – Overview of Retail/FMCG industries.

**Inventory Management :** A framework for structuring drivers in supply chain - supply chain strategies - strategic fit - Obstacles to achieve strategic fit - value of information - Role of cycle inventory- Economics of scale to exploit fixed costs and discounts- cycle time related costs- levels of safety- single stage inventory model- risk pooling centralized and decentralized systems of planning inventory in supply chain.

## **Section B**

**Network Planning and supply chain Integration:** Network design- warehouse location service level requirements- integrating inventory positioning and network design- supply chain integration. Push-pull and pull-push type systems- demand driven strategies Impact of internet on supply chain strategies- Transportation in a supply chain facilities affecting transportation decision- modes of transportation and their performance characteristics.

**Distribution strategies and strategic alliances:** Introduction- Centralized vs. decentralized control- direct shipment- cross docking- push based vs. pull based supply chain- third party logistics (3PL) - Retailer-Supplier relationship issues- requirements success and failures- distributor integration types and issues.

**Global logistics and Risk management :** Agile supply chains- Introduction to global SCM-risk management- issues in international SCM- regional differences in logistics- design for logistics- supplier integration in to new product development- pricing issues and smart pricing. IT and Business processes in supply chain.

## **References**

1. Christopher Martin, “Logistics And Supply Chain Management”, Pearson Education Asia, 2002
2. Kapoor K.K., Kansal Purva, “Marketing Logistics: A Supply Chain Approach”, Pearson Education Asia, 2003
3. David Simchi-Levi, Ravi Shankar, “Designing And Managing Supply Chain Concepts-Strategies and Case Studies”, 3 rd Edition, McGraw Hill Publication, 2008.
4. Sunil Chopra, Peter Meindl, “Supply Chain Management: Strategy, Planning, and Operation”, 6 edition, Pearson, 2014

# MTAI-115(v) Cyber Laws

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION A**

Introduction , Computers and Society, Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level, Cyber Law - International Perspectives, UN & International Telecommunication Union (ITU) Initiatives, Council of Europe - Budapest Convention on Cybercrime  
Human Rights Issues in Cyberspace, Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace – Access to Internet, Right to Privacy, Right to Data Protection, Cyber Crimes & Legal Framework, Cyber Crimes against Individuals, Institution and State

## **SECTION B**

Hacking , Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud , Cyber terrorism, Cyber Defamation, Different offences under IT Act, 2000  
Intellectual Property Issues in Cyber Space, Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues, Online contracts, Click Wrap Contracts, Dispute Resolution in Cyberspace, Concept of Jurisdiction, Indian Context of Jurisdiction and IT Act, 2000, International Law and Jurisdictional Issues in Cyberspace

## **References:**

1. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
2. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)
3. Jonthan Rosenoer, Cyber Law, Springer, New York, (1997).



# MTAI-121: Data Analysis using Python

L T P C  
4 1 0 4

**Maximum Marks : 50**

**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**

**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION-A**

**Introduction to Data Analysis, Kinds of Data, Essential Python Libraries:** NumPy, Pandas, Matplotlib, IPython, Jupyter, SciPy, Scikit-learn, Statsmodels

**Introduction to IPython, and Jupyter Notebooks:** The Python Interpreter

### **Python Language Basics**

**NumPy Basics:** Arrays and Vectorized Computation, The NumPy ndarray: A Multidimensional Array Object, Universal Functions: Fast Element-Wise Array Functions, Array-Oriented Programming with Arrays.

**Advanced NumPy:** ndarray Object Internals, Advanced Array Manipulation, Broadcasting, Advanced ufunc Usage, Structures and Record Arrays, More About Sorting, Writing Fast NumPy Functions with Numba, Advanced Array Input and Output

**Getting Started With Pandas:** Introduction to pandas Data Structures

**Essential Functionality:** Reindexing, Dropping Entries from an Axis, Indexing, Selection, Filtering, Integer Indexes, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Axis Indexes with Duplicate Labels

**Summarizing and Computing Descriptive Statistics:** Data Loading, Storage, and File Formats, Reading and Writing Data in Text Format: Binary Data Formats

**Data Cleaning and Preparation:** Handling Missing Data, Data Transformation, String Manipulation, Data Wrangling, Join, Combine, and Reshape, Hierarchical Indexing, Combining and Merging Datasets, Reshaping and Pivoting

## **Section B**

**Data Aggregation and Group Operations: GroupBy Mechanics, Data Aggregation**

**General split-apply-combine:** Suppressing the Group Keys, Quantile and Bucket Analysis, Example: Filling Missing Values with Group-Specific Values, Example: Random Sampling and Permutation, Example: Group Weighted Average and Correlation, Example: Group-Wise Linear Regression

**Pivot Tables and Cross-Tabulation: Time Series:** Date and Time Data Types and Tools, Time Series Basics, Date Ranges, Frequencies, and Shifting, Time Zone Handling, Periods and Period Arithmetic, Resampling and Frequency Conversion, Moving Window Functions

**Advanced pandas:** Categorical Data, Advanced GroupBy Use, Techniques for Method Chaining

**Introduction to Modeling Libraries in Python:** Interfacing Between pandas and Model Code, Creating Model Descriptions with Patsy

**Introduction to statsmodels:** Estimating Linear Models, Estimating Time Series Processes

**Introduction to scikit-learn**

**Plotting and Visualization:** A Brief matplotlib API Primer, Plotting with pandas and seaborn, Other Python Visualization Tools

**Case Studies:** USA.gov Data from Bitly, MovieLens 1M Dataset, US Baby Names 1880-2010, USDA Food Database, 2012 Federal Election Commission Database

**Text Book:**

1. Wes McKinney, Python for Data Analysis, Shroff Publications and Distributors

**Reference Book:**

1. Michael Milton, A Brain Friendly Guide: Head First Data Analysis, Shroff Publications and Distributors.

# MTAI-122: Machine Learning with R

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## Instructions for the Paper Setter

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## Instructions for the Candidates

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## Section A

**Introduction to R:** R Installation Guide and Installing R Packages; Basic data types and data structures in R; Reading, writing, manipulating and visualizing data in R

**Introduction to Machine Learning:** Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation

**Linear Regression:** Introduction, Definition, (Linear functions and other functions), Various Types of regression models, multiple linear regression, Assumption for errors, The least square regression line

**Bayesian Learning:** Bayes theorem, Bayes Optimal Classifier, Naïve Bayes classifier, Gibbs algorithm, Bayesian belief networks

## Section B

**Classification Techniques:** K-Nearest Neighbors, Support Vector Machines, Linear SVM formulation, Nonlinear SVM, Feature Space Kernel Function, KNN modeling, SVM modeling, Decision Trees

**Neural networks:** Perceptron, Multilayer Neural Network, Backpropagation Algorithm, Recurrent Networks, Introduction to Deep Neural Network

**Unsupervised Learning:** Hierarchical Clustering, K-means Clustering, Expectation Maximization (EM) Algorithm, Principal components analysis)

**Combining Multiple Classifiers:** Voting, Bagging, Boosting, AdaBoost

**Solving Machine Learning based Problems with R:** Face Recognition, Text Mining, Sentiment Analysis

## Text Books:

1. Cory Lesmeister, Mastering Machine Learning with R, Packt Publishing
2. Abhijit Ghatak, Machine Learning with R, Springer

## Reference Books:

1. Kevin Murphy, Machine Learning, MIT Press
2. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, Packt Publishing

3. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
4. Stephen Marsland, Machine Learning: An Algorithmic Perspective CRC Press
5. Machine Learning Online Course: <http://nptel.ac.in/courses/106105152/>
6. Chio, Machine Learning & Security Protecting Systems with Data, Shroff Publications and Distributors
7. Conway, Machine Learning for Hackers, Shroff Publications and Distributors

# MTAI-123: Research Methodology

L T P C

4 1 0 4

**Maximum Marks : 50**

**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**

**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **Section-A**

Measures of Central Tendency, measures of dispersion, measures of skewness, measures of kurtosis. Probability, conditional probability, independent events, permutations and combinations.

**Random variables and Probability Distribution:** Discrete probability distributions: Binomial and multinomial distributions, hyper-geometric distribution, negative binomial and geometric distributions, Poisson distribution, continuous probability distributions: Normal distribution, areas under the normal curve, normal approximation to the binomial, gamma and exponential distributions, chi-squared distribution, lognormal distribution, two-dimensional or joint probability distributions, transformation of one-dimensional and two-dimensional random variable, Mathematical expectation: Mean of a random variable, variance and co-variance of random variables, means and variances of linear combinations of random variables, Chebyshev's theorem.

**Sampling distributions and data descriptions:** Sampling distribution of means and central limit theorem, sampling distribution of  $\chi^2$ , t-distribution, F-distribution. One-and two-sample estimation problems: Statistical inference, classical methods of estimation, single sample: estimating mean, standard error of a point estimate, prediction intervals, two samples: estimating the difference between two means, paired observations, single sample: estimating a proportion, two samples: estimating the difference between two proportions, single sample: estimating the variance, two samples: estimating the ratio of two variances, maximum likelihood estimation.

**Tests of Hypotheses:** Significance level, types of errors in tests, null hypothesis, alternative hypothesis, test for mean with and without known variance, comparison of means and variances, choice of sample size for testing means. Correlation: correlations, Karl Pearson's coefficient of correlation, correlation coefficient for bivariate frequency distribution, probable error of correlation coefficient, rank correlation.

**Analysis of variance:** One-way ANOVA, two-way ANOVA, Latin-square design, analysis of covariance.

**Factor analysis:** Centroid method, principal components method, maximum likelihood method, rotation in factor analysis, R-type and Q-type factor analysis.

Linear regression, regression coefficient, properties of regression coefficients, standard error of estimate, curvilinear regression, and regression curves.

## **Section B**

**Basics of Research Methodology:** Meaning, objectives and types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, research process, criteria of good research.

**Defining the research problem:** Meaning of research problem, selecting the problem, necessity of defining the problem, techniques involved in defining a problem.

**Research design:** Meaning, need and features of good research design, concepts relating to research design, different research designs, basic principles of experimental designs, and various experimental designs.

**Design of sample surveys:** Sample design, sampling and non-sampling errors, types of sampling designs.

**Data collection:** Experiments and surveys, collection of primary data, collection of secondary data, selection of appropriate method for data collection.

**Data preparation:** Data preparation process, questionnaire checking, editing, coding, classification, tabulation, graphical representation, data cleaning, data adjusting, problems in data preparation process, missing values and outliers, types of analysis.

**Interpretation and report writing:** Meaning, techniques, and precautions, significance of report writing, different steps in writing report, layout of research report, types of reports, oral presentation, mechanics of writing a research report, precautions for writing research reports.

**Software:** Introduction of common software viz. SPSS, Mini Tab and/or MAT LAB for statistical analysis, Latex.

### **Text Books:**

1. Gupta, S.C. & Kapoor, V.K., Fundamentals of Mathematical Statistics, 11th Edition, S. Chand & Sons, 2015.
2. C. R. Kothari, G. Garg, Research Methodology, 3rd Edition, New Age International Publishers, 2015.

### **Reference Books:**

1. R.E. Walpole, H. Myers, L. Myers, E. Ye, Probability and Statistics for Engineers, 9th Edition, Pearson, 2016.
2. M. R. Spiegel, L. J. Stephens, Statistics, 4th Edition, McGraw Hill, 2015.
3. John W. Creswell, Research Design, Qualitative, Quantitative, and Mixed Methods Approaches, 4th Edition, SAGE Publications Inc, 2013.

# MTAI-124: Natural Language Processing with Python

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION A**

**Introduction to NLP:** Definition, History, Applications, Goals.

Regular expressions and Automata, Morphology and Finite State Transducers.

N-grams: Introduction, Simple (Unsmoothed) N-Grams, Smoothing: Add-one smoothing, Witten-Bell Discounting, Good-Turing Discounting, Back off, Deleted Interpolation. Entropy

**HMM:** Overview, Viterbi Algorithm

**Syntax:** Word Classes and Part-of Speech Tagging, Context Free Grammars for English, Parsing with Context-Free Grammars.

**Word Sense Disambiguation:** Selection Restriction Based Disambiguation, Robust WSD: Machine Learning, Supervised Learning Approaches, Bootstrapping Approaches, Unsupervised Methods, Dictionary Based Approaches.

**Machine Translation:** Introduction, Language Similarities and Differences, Approaches, Steps involved in machine translation system design.

## **SECTION B**

**Language Processing and Python:** Computing with Language: Texts and Words, A Closer Look at Python: Texts as Lists of Words, Computing with Language: Simple Statistics, Back to Python: Making Decisions and Taking Control, Automatic Natural Language Understanding.

**Accessing Text Corpora and Lexical Resources:** Accessing Text Corpora, Conditional Frequency Distributions, More Python: Reusing Code, Lexical Resources, Wordnet.

**Processing Raw Text:** Accessing Text from the Web and from Desk, Strings: Text processing at the Lowest level, Text Processing with Unicode, Regular Expression for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings.

**Writing Structured Programs:** Back to Basics, Sequences, Questions of Style, Functions: The Foundations of Structured Programming, Doing more with Functions, program Development, Algorithm Design, A Sample of Python Libraries.

**Categorizing and Tagging Words:** Using a Tagger, Tagged Corpora, mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation Based Tagging, How to determine the category of a word.

**Learning to Classify Text:** Supervised Classification, Further Examples of Supervised Classification, Evaluation, Decision Trees, Naïve Bayes Classifiers, Maximum Entropy Classifiers, Modeling Linguistics Patterns.

**Extracting Information from Text:** Information Extraction, Chunking, Development and Evaluating Chunkers, Recursion in Linguistics Structure, Named Entity Recognition, Relation Extraction.

**Analyzing Sentence Structure:** Some Grammatical Dilemmas, Use of Syntax, Context Free Grammar, Parsing with Context Free Grammar, Dependencies and Dependency Grammar, Grammar Development.

**Building Feature Based Grammar:** Grammatical Features, Processing Feature Structures, Extending a Feature-Based Grammar.

**Analyzing the meaning of Sentences:** Natural Language Understanding, Propositional Logic, First Order Logic, The Semantics of English Sentences, Discourse Semantics.

**Managing Linguistic Data:** Corpus Structure: A Case Study, The Life Cycle of Corpus, Acquiring Data, Working with XML, Working with Toolbox Data, Describing Language Resources using OLAC Metadata.

#### **Text Books:**

1. Jurafsky, D. & J. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing Computational Linguistics, and Speech Recognition" Prentice Hall.
2. Steven Bird, Ewan Klein, Edward Loper. Natural Language Processing with Python- Analyzing Text with the Natural Language Toolkit, Shroff Publications and Distributors - O'Reilly Media.

#### **Reference Books:**

1. Grosz, B.J., Sparck Jones, K. & Webber, B.L. (eds) "Readings in natural language processing", Los Altos, CA. Morgan Kaufmann.
2. Allen, J., "Natural Language Understanding", Redwood City, Benjamin/Cummings.
3. Bharti, Akshar, Chaitanya Vineet, Sangal Rajeev, "Natural Language Processing", Prentice Hall.
4. Palash Goyal, Sumit Pandey, Karan Jain. Deep Learning for Natural Language Processing. Apress.



# MTAI-125(i) DIGITAL MARKETING

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION A**

**Meaning and Definition of Marketing-** Basics of Marketing, Features of Marketing, Importance of Marketing, Functions of Marketing, Core Concept of Marketing - Need, Want, Demand, Value and Satisfaction, Production-Concept, Product concept, selling concept Marketing concept, Marketing Mix: Meaning, Seven Ps of marketing mix.

**Introduction to Digital Marketing-** Key Concepts of Digital Marketing, Traditional Marketing vs. Digital Marketing, The Opportunity of Digital Marketing, Characteristics of Digital Marketing, Implications of Digital Marketing, Strategies in Digital Marketing.

**Internet and WWW:** Introduction to internet and its working, business use of internet, services offered by Internet, evaluation of internet, internet service provider (ISP), internet addressing (DNS and IP addresses). Introduction and working of WWW, Web browsing (opening, viewing, saving and printing a web page and bookmark).

**Search Engine:** About search engine, component of search engine, working of search engine, Difference between search engine and web directory.

## **SECTION B**

**HTML:** Basics of HTML, HTML Tags, Elements of Web page (Text , Image & Hyperlink Elements).

**SMO (Social Media Optimization) –Facebook, Twitter, YouTube:** Introduction to Social Media, Types of Social Media, How Social Media is affecting Google Search, How to choose right social media, Integrating social media into your website and blogs, Facebook Marketing, Introduction to Facebook, Difference between Profiles, Places, Groups and Pages, Social media and communications strategy, Facebook Connect(Like, Share, Comment), Facebook pages(Creating, Managing, Retention), Facebook Apps, Measuring and Monitoring, Advantages and Challenges

**Twitter Marketing:** Introduction to Micro blogging and Twitter, Twitter Demographics, Use for reputation, promotion, sales, conversing, Who to follow, Tweeting, Searching tweets and users, Measuring Influence, Tools, Tracking Code, Twitter Account Promotion, How to Shorten and Measure your URLs , **Photo Sharing Social Network** : Picasa, Video Sharing Social Network : YouTube

**Email Marketing:** Introduction to Email Marketing, How Email Marketing Works, Sending Email

**Reference Books:**

1. William I. Stanton, Ajay Pandit-Marketing Concepts & Cases,- The McGraw Hill companies Ltd.New Delhi
2. Search Engine Optimization Bible, Jerri L. Ledford, Wiley Publishing
3. S.A. Sherlekar, "Marketing Management", Himalaya Publishing House, Mumbai.
4. E. Stephen Mack, Janan Platt, "HTML 4.0" BPB Publications, New Delhi

# MTAI-125(II) BLOCK CHAIN AND BITCOIN FUNDAMENTALS

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION A**

**Blockchain definition:** Bitcoin & Blockchain, Blockchain Structure, Basic Operations.

**Ethereum Blockchain:** Smart Contracts, Ethereum Structure, Ethereum Operations.

**Integrity of transactions and blocks in blockchain:** Algorithms & Techniques: Public-Key Cryptography, Hashing, Transaction Integrity.

**Introduction to Crypto and Cryptocurrencies:** Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities.

## **SECTION B**

**Mechanics of Bitcoin :** components of the Bitcoin protocol ,Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network.

**How Bitcoin Achieves Decentralization:** Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity: the Block Chain, Incentives and Proof of Work

**How to Store and Use Bitcoins:** Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges,Payment Services,Transaction Fees,Currency Exchange Markets

## **Reference Books:**

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - <https://www.hyperledger.org/projects/fabric>
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits
5. <https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html>

# MTAI-125(iii) Neural Networks and Fuzzy Logic

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION A**

**Introduction of Neural Networks:** Concepts of neural networks, Network Properties, Systems Dynamics.

**Inference & Learning :** Neural Networks, Learning Algorithm, Data representation, Functional Classification, Neuron Concept, terminology, Notation & representation of Neural Networks.

**Perception:** Single layer perceptrons, Multilayer Perceptrons, perceptron learning & training.

**Back propagation:** Concept, Back Propagation, Learning Algorithm. A derivation of Back propagation, Kohonen Network, Gross berg networks.

**Counter Propagation Networks:** Counter propagation Algorithm & its Applications.

**Hopfield nets:** Concept, Hopfield net Algorithm for Auto-association, Capacity of Hopfield Nets. Hopfield net Algorithm for optimization, stability of Hopfield nets.

## **SECTION B**

**Fuzzy Set:** Introduction, uncertainty, Newtonian mechanics, Probability Theory, organized simplicity, disorganized complexity, trans computational problems.

**Crisp Sets:** An overview, fuzzy sets: Basic types, basic concepts. Fuzzy sets versus crisp sets, additional properties of alpha-cuts, representations of fuzzy sets.

**Operations on Fuzzy sets:** Types of operations, fuzzy complements, Fuzzy instructions: t-Norms. Fuzzy Unicons: t-co norms, combination of operations, aggregation operations.

**Fuzzy Logic :** Classical logic, logic, reasoning, propositional logic, logic operation's logic formulas, tautology, inference rules, Boolean algebra, properties of Boolean algebra, quantification, predicate logic, multi-valued logic, fuzzy propositions, fuzzy quantifiers, linguistic hedges, Inference from conditional Fuzzy propositions,

Inference from conditional and quantified propositions. Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Model, Input space partitioning, Fuzzy modeling.

## **Text Book:**

1. Li Min Fu, "Neural Networks in Computer Intelligence", McGraw-Hill, Inc.

## **Reference Books:**

1. George J Klir/Bo Yuan, "Fuzzy sets & Fuzzy Logic, Theory & Applications", PHI.
2. "Neuro Fuzzy & Soft Computing: A Computational approach to learning & Machine Intelligence", J.S.R. Jang, C.T. Sun, E. Mizutani. Pearson Education.
3. Ian Cloete & Jack M. Zurada, "Knowledge based Neuro Computing", University Press.

# MTAI-125(iv) SOCIAL NETWORKING AND MINING

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **SECTION A**

**Introduction- Introduction to Web** - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

**Modeling And Visualization-** Visualizing Online Social Networks - A Taxonomy of 26 Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

**Mining Communities-** Aggregating and reasoning with social network data- Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

## **SECTION B**

**Text and Opinion Mining-** Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time.

**Tools for Social Network Analysis-** UCINET – PAJEK – ETDRAW – StOCNET – Splus – R – NodeXL – SIENA and RSIENA – Real world Social Networks (Facebook- Twitteretc.)

## **References:**

1. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2011.
2. Peter Mika, “Social Networks and the Semantic Web”, 1 st edition, Springer, 2007.
3. BorkoFurht, “Handbook of Social Network Technologies and Applications”, 1st edition, Springer, 2010.

4. GuandongXu, Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, 1st edition, Springer, 2011.
5. Giles, Mark Smith, John Yen, “Advances in Social Network Mining and Analysis”, Springer, 2010.
6. Ajith Abraham, Aboul Ella Hassanien, VáclavSnáel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2009.
7. Toby Segaran, “Programming Collective Intelligence”, O’Reilly, 2012.
8. Sule Gündüz-Ogüdücü, A. Şima Etaner-Uyar, “Social Networks: Analysis and Case Studies”, Springer, 2014.

# MTAI-125(v) Digital Forensics

L T P C  
4 1 0 4

**Maximum Marks : 50**  
**Minimum Pass Marks: 40%**

**Maximum Time : 3 Hrs.**  
**Lectures to be delivered: 45-50 Hrs.**

## **Instructions for the Paper Setter**

The question paper will consist of three sections: A, B & C. Sections A & B will have four questions each from the respective sections of the syllabus carrying 7.5 marks for each question. Section C will have 10 short-answer type questions carrying at total of 20 marks, which will cover the entire syllabus uniformly.

## **Instructions for the Candidates**

1. Candidates are required to attempt two questions each from the sections A & B of the question paper and the entire section C.
2. Use of non-programmable scientific calculator is allowed.

## **Section A**

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

**Understanding Computing Investigations** – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

**Data acquisition**- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisition tools.

## **Section B**

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

**Current computer forensics tools**- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions.

**E-Mail investigations**- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

## **References:**

1. Warren G. Kruse II and Jay G. Heiser, “Computer Forensics: Incident Response Essentials”, Addison Wesley, 2002.
2. Bill Nelson, Amelia Phillips, F.Enfinger and Christopher Stuart, “Guide to Computer Forensics and Investigations”, 2 nd edition. Thomson Course Technology, 2006.
3. John R. Vacca, Computer Forensics, “Computer Crime Scene Investigation”, 2 nd Ed, Charles River Media, 2005.
4. Bill Nelson, Amelia Phillips, F.Enfinger and Christopher Stuart, “Guide to Computer Forensics and Investigations, 4 th ed., Thomson Course Technology, 2010.
5. Anthony T. S. Ho and Shujun Li, “Handbook of Digital Forensics of Multimedia Data and Devices”, IEEE Press, John Wiley & Sons, 2015.

# MTAI-126: Programming Lab – II and Minor Project

**Maximum Marks: 100\***

**Maximum Time: 3 Hrs.**

**Minimum Pass Marks: 40%**

**Practical Sessions to be conducted: 55-65 Hrs.**

The Laboratory assignments for this lab will include the assignments mainly from the Paper Based on MTAI-121, MTAI-122 and MTAI-124

## **\*The splitting of marks is as under:**

Maximum Marks for Continuous Assessment: 60

Maximum Marks for University Examination: 40

## **Continuous Assessment (Practical Labs)**

\*Maximum Marks for Continuous Assessment: 60

- Two tests will be conducted during the semester.
- Both the tests will be considered for assessment: 60% of the marks allotted for continuous assessment.
- Lab Assignments: 30% of the marks allotted for continuous assessment.
- Attendance: 10% of the marks allotted for continuous assessment.

## **University Examination (Practical Labs)**

\*Maximum Marks for University Examination: 40

The evaluation will be done jointly by the team of internal and external examiner.

The examiners will give due weightage to Logic development/Program execution, Lab records and viva -voce of the student while awarding marks to the student during end-semester final practical examination.