

Program Name : Computer Engineering Program Group / Diploma in Electronics and Computer Engineering / Diploma in Computer Hardware & Maintenance / Diploma in Artificial Intelligence and Machine Learning / Diploma in Cloud Computing and Big Data

Program Code : CO/CM/CW/TE/HA/AN/BD

Semester : Third

Course Title : Database Management System

Course Code : 22319

1. RATIONALE

Each and every organization like shopping mall, hospital, banking, institutes, industry needs to share huge amount of data in effective manner. This course aims to develop skills in students to create, store, modify, manage and extract information from a database. Database system can be used as a backend for developing database applications.

2. COMPETENCY

The aim of this course is to help the student to attain the following *industry identified* competency through various teaching learning experiences:

- Apply Database management concept using SQL.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Design Normalized database on given data.
- Create and Manage Database using SQL command.
- Write PL/SQL code for given database.
- Apply triggers on database also create procedure and function according to condition.
- Apply security and confidentiality on given Database.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Mln
4	2	2	8	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

Legends: L-Lecture; T- Tutorial/Teacher Guided Theory Practice; P - Practical; ESE - End Semester Examination; PA - Progressive Assessment



5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

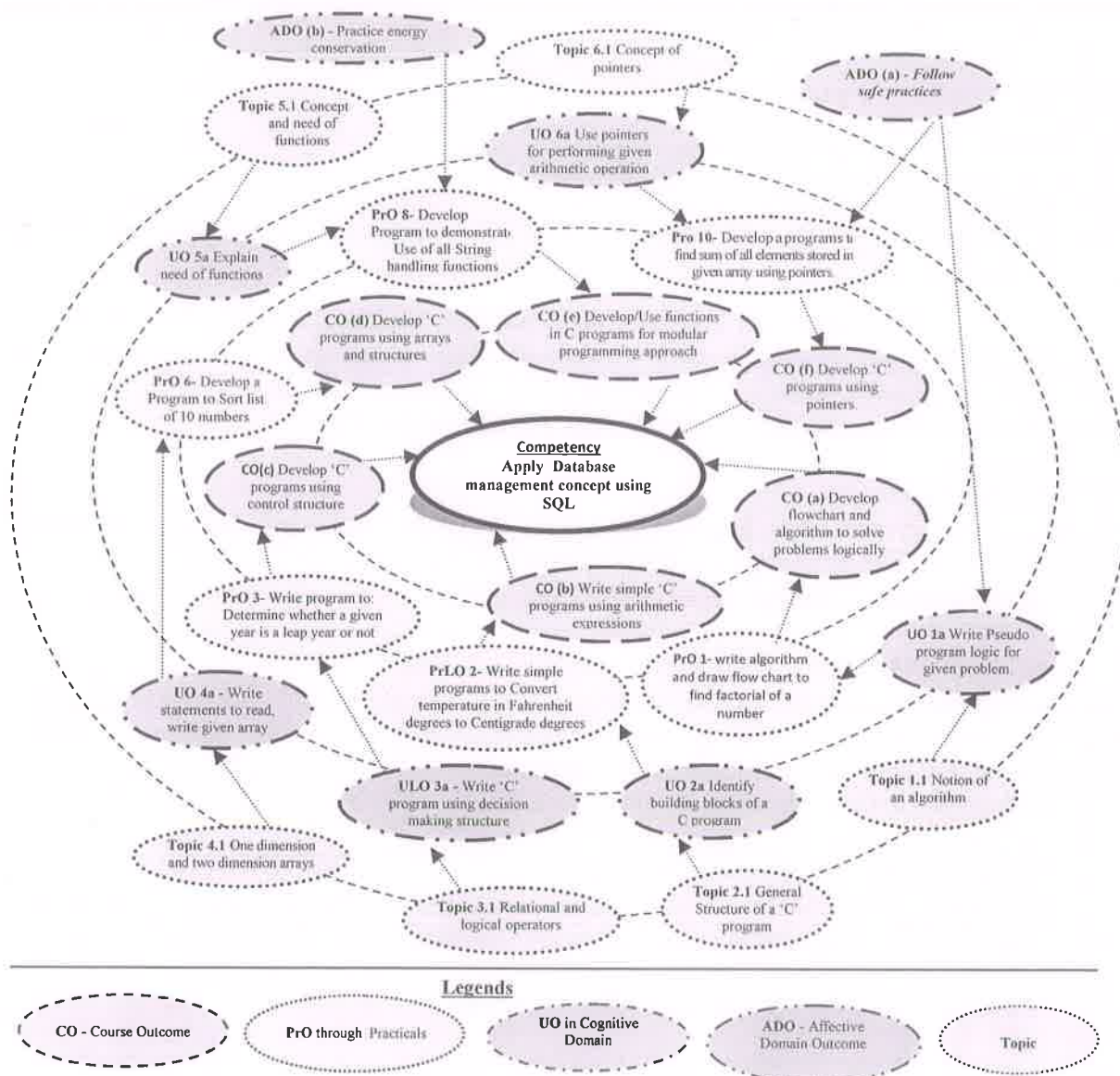
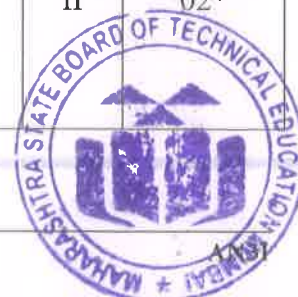


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Perform following in GUI based database software using GUI only i) Create Database ii) Create tables and assign primary key .	II	02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	iii) Modify the table structure-add column ,change the data type of column, delete the column from table. iv) Insert, update and delete the record from table. v) Retrieve data from the table according to condition given.		
2	Perform following in GUI based database using GUI only i) Apply given validation on table and set error messages. ii) Set default value for column. iii) Set and remove database password.	II	02
3	Design E-R diagram and Create Normalized Database on given data.	II	02
4	i) Create and Execute DDL commands using SQL. ii) Apply following Integrity constraints on table: iii) Primary key, Foreign key, Unique key constraint, Null , Not Null and Check constraint.	II	02*
5	Create and Execute DML commands using SQL.	II	02*
6	Write Queries using following operators: Arithmetic Operators, Comparison Operators, Logical Operators, Set Operators, Range Searching operators-Between, Pattern matching operators-Like.	II	02*
7	Write Queries using following Functions: String, Arithmetic, Date and time, Aggregate Functions.	III	02*
8	Execute Queries using the Select command with Where, Having, Group by and order by clauses.	III	02*
9	Execute the queries for implementation of Inner and Outer Join.	III	02
10	Implement Views i) Create different views ii) Insert, modify and delete records through views. iii) Delete the views.	III	02
11	Create and Execute Indexes, Sequences, and synonyms in SQL.	III	02*
12	Write a PL/SQL programs using if then else, for, while and nested loop.	IV	02*
13	Write a PL/SQL code to implement implicit and explicit cursors.	IV	02
14	Write PL/SQL Programs based on Exceptions handling.(Predefined and user-defined exceptions)	IV	02
15	Write PL/SQL code to create Procedures and functions.	IV	02
16	Write PL/SQL code to create triggers on given database.	IV	02
17	Executing DCL commands using SQL i) Create users ii) Grant privileges to users iii) Revoke privileges from users.	V	02*
	Total		34

Note

i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.



ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	SQL queries and PL/SQL programming	60
b.	Database Integrity	10
c.	Quality result displayed by SQL queries.	10
d.	Answer to sample questions	10
e.	Submit report in time	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Pro. S. No.
1	Computer system (Any computer system with basic configuration)	All
2	Any GUI based database software (MS-Access/Visual Foxpro/MySQL)	1-2
3	Any RDBMS software (MySQL/SQL server)	3-16

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

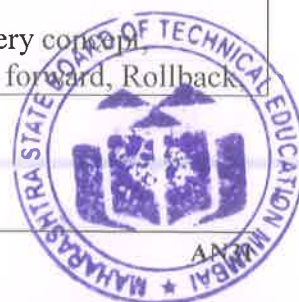
Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Database System	1a State the importance of DBMS over file processing in the	1.1 Concept of Data, database, DBMS, advantages of DBMS over file processing system, Application of database.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Concept	<p>given situation.</p> <p>1b Describe the overall structure of the given DBMS</p> <p>1c Identify the relevant database model in the given situation.</p> <p>1d Draw the E-R diagram of the given database and identify relationship between the entities.</p>	<p>1.2 Three level Architecture for Database System.</p> <p>1.3 Data abstraction: Different levels of Data abstraction, Instance and schema, Data independence - Logical and Physical Independence.</p> <p>1.4 Overall Structure of DBMS.</p> <p>1.5 Data Modeling: Record based logical model- Relational, Network, Hierarchical</p> <p>1.6 Data Modeling Using the E-R Model: Entity Relationship Model, Strong Entity set, Weak Entity set, Types of Attributes, E-R Diagrams.</p>
Unit- II Relational Data Model	<p>2a Explain the concept of RDBMS also appropriateness for the given problem.</p> <p>2b Design Normalized database structure in the given problem.</p> <p>2c Design SQL queries to create Relational database and apply in the given data constraints.</p> <p>2d Identify the operators for queries implementation of the given problem.</p>	<p>2.1 Fundamentals of RDBMS – Record, fields, data types, tables and database</p> <p>2.2 Concept of RDBMS, E.F.Codd's Rule for RDBMS, Key concepts- Candidate key, Primary key, Foreign key.</p> <p>2.3 Normalization: Normalization Concepts, Need of Normalization, Types of Normalization- 1NF, 2NF, 3NF</p> <p>2.4 Introduction to Structured Query Language, Data Types in SQL, components of SQL- DDL, DML, DCL, DQL</p> <p>2.5 DDL Commands: CREATE, ALTER, DROP, TRUNCATE, DESC, RENAME</p> <p>2.6 Data Integrity Constraint: Types of Data Integrity Constraint: I/O constraint- Primary key, Foreign key, Unique key constraint, Business Rule Constraint-Null, Not Null and Check constraint.</p> <p>2.7 DML Commands: INSERT, UPDATE, DELETE</p> <p>2.8 DCL Commands: COMMIT, SAVEPOINT, ROLLBACK, GRANT, and REVOKE.</p> <p>2.9 DQL Commands: SELECT.</p> <p>2.10 SQL Operators: Arithmetic Operators, Comparison Operators, Logical Operators, Set Operators, Range Searching operators- Between, Pattern matching operators-Like.</p>
Unit III- Interactive SQL and Advance SQL: SQL Performanc	<p>3a. Write the given queries using relevant functions.</p> <p>3b. Write query to combine the given multiple table using</p>	<p>3.1 In-built Functions: String, Arithmetic,</p> <p>3.2 Date and time, Aggregate functions.</p> <p>3.3 Queries using Group by, having, and Order by clause, Joins-Inner and Outer Join</p> <p>3.4 Views: Concept of View, The Create View</p>



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
e Tuning	<p>Join.</p> <p>3c. Design SQL queries to implement VIEWS on the given tables.</p> <p>3d. Apply and drop INDEXES and SYNONYM on the given table.</p>	<p>Command, Updating Views, Views and Joins, Views and Sub queries, Dropping Views.</p> <p>3.5 Sequences: Creating Sequences, Altering Sequences, Dropping Sequences.</p> <p>3.6 Indexes: Index Types, Creating of an Index: Simple Unique, and</p> <p>3.7 Composite Index, Dropping Indexes</p> <p>3.8 Synonyms: Creating Synonyms, Dropping Synonyms.</p>
Unit IV- PL/SQL Programming	<p>4a. Write simple PL/SQL Code using control structure and handle various exceptions in the given situation.</p> <p>4c. Create cursor for retrieving multiple records in the given situation.</p> <p>4d. Create and Execute stored procedures and functions in the given situation.</p> <p>4e. Create and apply database trigger using PL/SQL in the given situation.</p>	<p>4.1 Introduction of PL/SQL, Advantages of PL/SQL, The PL/SQL Block Structure, PL/SQL execution environment, PL/SQL data Types, Variables, Constants.</p> <p>4.2 Control Structure: Conditional Control, Iterative Control, Sequential Control.</p> <p>4.3 Exception handling: Predefined Exception, User defined Exception.</p> <p>4.4 Cursors: Implicit and Explicit Cursors, Declaring, Opening and Closing a Cursor, Fetching a Record from Cursor, Cursor for loops, Parameterized Cursors.</p> <p>4.5 Procedures: Advantages, Creating, Executing and Deleting a Stored Procedure.</p> <p>4.6 Functions: Advantages, Creating, Executing and Deleting a Function.</p> <p>4.7 Database Triggers: Use of Database Triggers, How to apply database Triggers, Types of Triggers, Syntax for Creating Trigger, Deleting Trigger.</p>
Unit V- Database security and Transaction Processing	<p>5a. Provide security to the given database by assigning various privileges to the user.</p> <p>5b. Create and manage the given database Users.</p> <p>5c. Explain the importance of Transaction in the given situation.</p> <p>5d. Explain advantages of Database Backup and Recovery in the given situation.</p>	<p>5.1 Database security: Introduction to database security, Data security Requirements, Types of Database Users-Creating, altering and Deleting Users.</p> <p>5.2 Protecting the data within database-Database Privileges: Systems privileges and object Privileges, Granting and Revoking Privileges: Grant and Revoke command.</p> <p>5.3 Transaction: Concept, Properties and States of Transaction.</p> <p>5.4 Database Backup -Types of Failures, Causes of failures, Database Backup Introduction, Types of Database Backups-Physical and Logical.</p> <p>5.5 Database Recovery-Recovery concepts, Recovery Techniques-Roll forward, Rollback</p>



Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Database System Concepts	10	04	04	04	12
II	Relational Data Model	16	02	04	12	18
III	Interactive SQL and Advance SQL: SQL Performance Tuning	14	02	04	08	14
IV	PL/SQL Programming	14	02	04	10	16
V	Database security and Transaction Processing	10	02	04	04	10
Total		64	12	20	38	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Prepare journal of practical.
- Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- 'L' in item No. 4** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide student(s) in undertaking micro-projects.
- Demonstrate students thoroughly before they start doing the practice.
- Encourage students to refer different websites to have deeper understanding of the subject.
- Observe continuously and monitor the performance of students in Lab



12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- Survey on various database System Software and compare it.
- Design E-R Diagram for Hospital/college/medical/Jewellery Shop/Library/Blood Bank.
- Design Normalized Database for Hospital/college/medical/Jewellery Shop / Library / Blood Bank.
- Apply trigger on given database.
- Create procedure and function according to given condition.
- Any other micro-projects suggested by subject faculty on similar line.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Introduction to Database Management Systems	ISRD Group	McGraw Hill Education, New Delhi, 2015
2	Introduction to Relational databases & SQL programming	Allen	McGraw Hill Education, New Delhi, 2015
3	Database System Concepts McGraw Hillin ANSI C	Korth	McGraw Hill Education, New Delhi, 2015
4	Complete Reference:Mysql	Vikram Vaswani	McGraw Hill Education, New Delhi, 2015

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

- www.tutorialpoint.com (Important website)
- wielyIndia.com or DreamtechPress.com
- <http://phindia.com/gupta/chapter/chapter1.pdf>
- www.williamstannings.com
- www.nptel.ac.in
- <https://www.khanacademy.org/>



Program Name : Computer and Electronics Engineering Program Group / Diploma in Electronics & Computer Engineering / Diploma in Computer Hardware & Maintenance/ Diploma in Artificial Intelligence and Machine Learning

Program Code : CO/CM/CW/DE/EJ/ET/EN/EX/EQ/IE/IS/IC/MU/TE/HA/AN

Semester : Third

Course Title : Digital Techniques

Course Code : 22320

1. RATIONALE

In the present scenario most of the electronic equipment like computers, mobiles, music systems, ATM, automation and control circuits and systems are based on digital circuits which the diploma electronic engineering passouts (also called technologists) have to test them. The knowledge of basic logic gates, combinational and sequential logic circuits using discrete gates as well as digital ICs will enable the students to interpret the working of equipment and maintain them. After completion of the course, students will be able to develop digital circuits based applications.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Build/ test digital logic circuits consist of digital ICs.

3. COURSE OUTCOMES (COs)

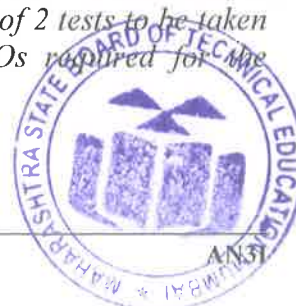
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Use number system and codes for interpreting working of digital system.
- Use Boolean expressions to realize logic circuits.
- Build simple combinational circuits.
- Build simple sequential circuits.
- Test data converters and PLDs in digital electronics systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.



Legends: *L* - Lecture; *T* – Tutorial/Teacher Guided Theory Practice; *P* - Practical; *C* – Credit, *ESE* - End Semester Examination; *PA* - Progressive Assessment.

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

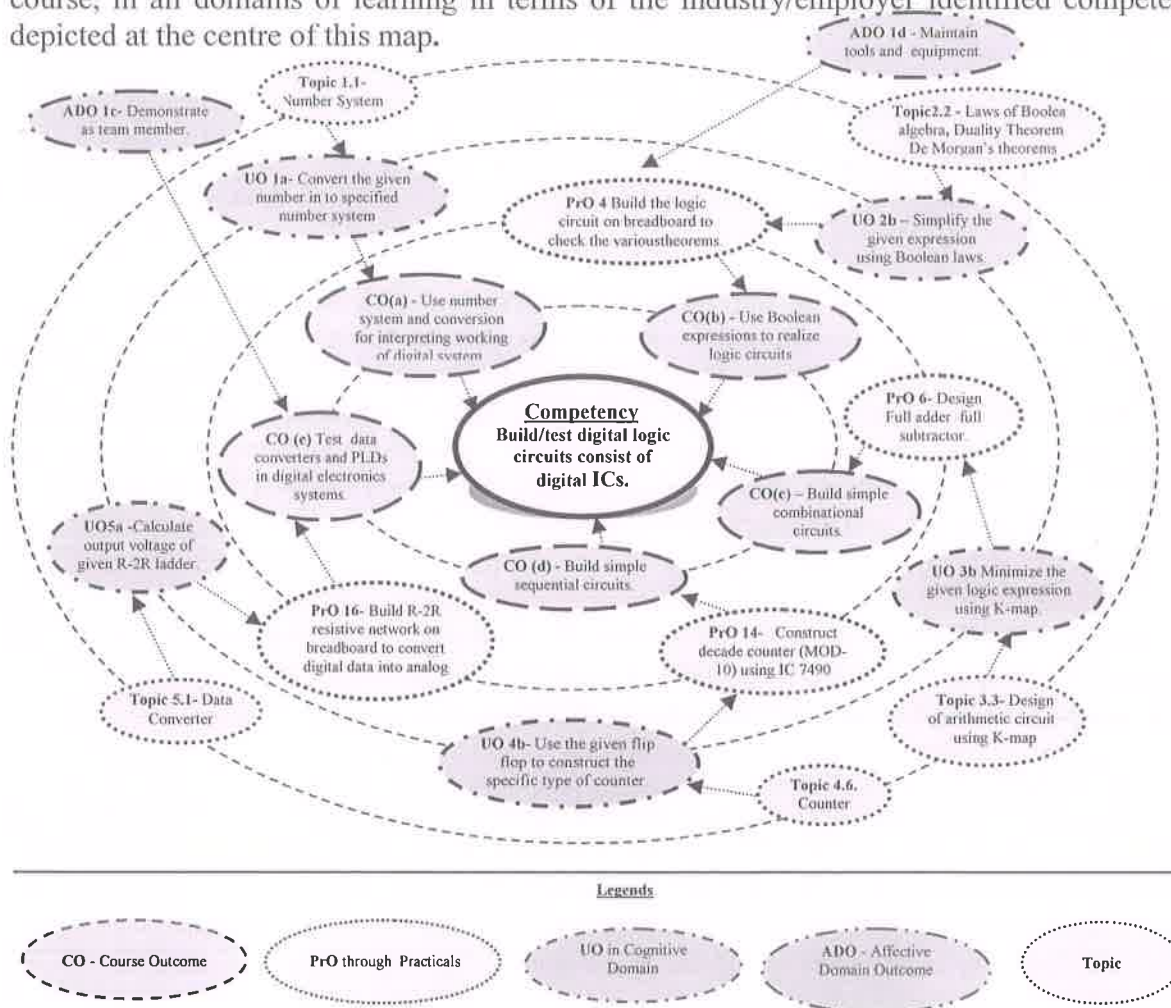
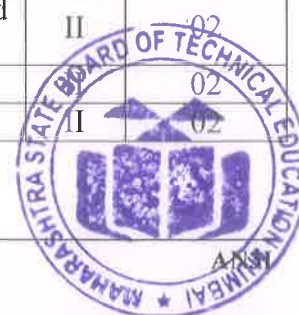


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Test the functionality of specified logic gates using breadboard. (IC 7404, 7408, 7432, 7486)	II	02*
2	Test the functionality of NAND and NOR gate of using breadboard (IC 7400 and 7402)	II	02
3	Construct AND, OR, NOT gates using universal gates.	II	02
4	Build the logic circuit on breadboard to check the De Morgan's	II	02



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	theorems.		
5	Design Half adder and Half subtractor using Boolean expressions.	III	02*
6	Design Full adder and full subtractor.	III	02
7	Construct and test BCD to 7 segment decoder using IC 7447/ 7448.	III	02
8	Build / test function of MUX 74151/74150/any other equivalent.	III	02
9	Build / test function of DEMUX 74155/74154/any other equivalent.	III	02
10	Build / test function of RS flip flop using NAND Gate.	IV	02*
11	Build / test function of MS JK flip flop using 7476.	IV	02
12	Use IC 7476 to construct and test the functionality of D and T flip flop.	IV	02
13	Implement 4 bit ripple counter using 7476.	IV	02
14	Use IC 7490 to construct decade counter (MOD-10).	IV	02
15	Implement 4 bit universal shift register.	IV	02
16	Build R-2R resistive network on breadboard to convert given digital data into analog.	V	02*
Total			32

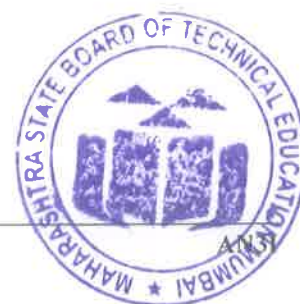
Note

- A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.



The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Digital Multimeter: 3 and ½ digit with R, V, I measurements, diode and BJT testing.	All
2	CRO : Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 MHz X10 magnification 20 ns max sweep rate, Alternate triggering Component tester and with optional features such as Digital Read out.	16
3	Pulse Generator: TTL pulse generator	10-15
4	DIGITAL IC tester: Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	1-15
5	Bread Board Development System: Bread Board system with DC power output 5V, +/-12V and 0-5V variable, digital voltmeter, ammeter, LED indicators 8 no, logic input switches 8 no, 7 segment display 2 no, clock generator, Manual pulser, Breadboard with about 1,600 points, Potentiometer, relay etc	1-15
6	Trainer kits for digital ICs: Trainer kit shall consists of digital ICs for logic gates, flop-flop, shift registers, counter along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	1-15
7	Regulated power supply: Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation Digital Display for Voltage and Current Adjustable Current Limiter Excellent Line and Load Regulation	1-16
8	Trainer kit for 4 bit Counter using Flip Flops: 4 bit ripple counter, Synchronous Counter, IC 7476 based circuit. Input given by switches and output indicated on LED. Facility to select MOD 8 or MOD 16 mode. Built in DC power supply and manual pulser with indicator.	13

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Number System and Codes	1a. Convert the given number into the specified number system. 1b. Perform the binary	1.1 Number System: base or radix of number system, binary, octal, decimal and hexadecimal number system. 1.2 Binary Arithmetic: Addition, subtraction,



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	arithmetic operation on the given binary numbers. 1c. Convert the given coded number into the other specified code. 1d. Add the given two decimal numbers using BCD code.	multiplication, division. 1.3 Subtraction using 1's complement and 2's complement. 1.4 Codes: BCD, Gray Code, Excess-3, and ASCII code. 1.5 BCD Arithmetic: BCD Addition
Unit – II Logic gates and logic families	2a. Develop the basic gates using the given NAND/NOR gate as universal gate. 2b. Simplify the given expression using Boolean laws. 2c. Develop logic circuits using the given Boolean expressions. 2d. Compare the salient characteristics of the given digital logic families.	2.1 Logic gates: Symbol, diode/ transistor switch circuit and logical expression, truth table of basic logic gates (AND, OR, NOT), Universal gates (NAND and NOR) and Special purpose gates (EX-OR, EX-NOR), Tristate logic 2.2 Boolean algebra: Laws of Boolean algebra, Duality Theorem, De-Morgan's theorems 2.3 Logic Families: Characteristics of logic families : Noise margin, Power dissipation, Figure of merit, Fan-in and fan-out, Speed of operation, Comparison of TTL, CMOS, types of TTL NAND gate
Unit– III Combinational Logic Circuits	3a. Develop logic circuits in standard SOP/ POS form for the given logical expression. 3b. Minimize the given logic expression using K-map. 3c. Use IC 7483 to design the given adder/ subtractor. 3d. Draw MUX/DEMUX tree for the given number of input and output lines. 3e. Write the specifications of the component for the given application. 3f. Develop the specified type of code converter.	3.1 Standard Boolean representation: Sum of Product (SOP) and Product of Sum (POS), Min-term and Max-term, conversion between SOP and POS forms, realization using NAND /NOR gates 3.2 K-map reduction technique for the Boolean expression: Minimization of Boolean functions up to 4 variables (SOP and POS form) 3.3 Design of arithmetic circuits and code converter using K-map: Half and full Adder, half and full Subtractor, gray to binary and binary to gray (up to 4 bits) 3.4 Arithmetic circuits: (IC 7483) Adder and Subtractor, BCD adder 3.5 Encoder/Decoder: Basics of encoder, decoder, comparison, (IC 7447) BCD to 7 segment decoder/driver 3.6 Multiplexer and Demultiplexer: working, truth table and applications of Multiplexers and Demultiplexers, MUX tree, IC 74151 as MUX; DEMUX tree, IC 74155 as DEMUX



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		3.7 Buffer: Tristate logic, unidirectional and bidirectional buffer (IC74LS244, 74LS245)
Unit– IV Sequential Logic Circuit	4a. Use relevant triggering technique for the given digital circuit. 4b. Use the given flip-flop to construct the specific type of counter. 4c. Use excitation table of the given flip-flop to design synchronous counter. 4d. Design the specified modulo-N counter using IC7490. 4e. Construct ring/ twisted ring counter using the given flip-flop.	4.1 Basic memory cell: RS-latch using NAND and NOR 4.2 Triggering Methods: Edge trigger and level trigger 4.3 SR Flip Flops: SR-flip flop, clocked SR flip flop with preset and clear, drawbacks of SR flip flop 4.4 JK Flip Flops: Clocked JK Flip flop with preset and clear, race around condition in JK flip flop, Master slave JK flip flop, D and T type flip flop Excitation table of flip flops, Block schematic and function table of IC-7474, 7475 4.5 Shift Register: Logic diagram of 4-bit Shift registers – Serial Input Serial Output, Serial Input Parallel Output, Parallel Input Serial Output, Parallel Input Parallel Output, 4 Bit Universal Shift register 4.6 Counters: Asynchronous counter: 4 bit Ripple counter, 4 bit up/down Counter, modulus of counter Synchronous counter: Design of 4 bit synchronous up/down counter Decade counter: Block schematic of IC 7490 Decade counter, IC 7490 as MOD-N Counter, Ring counter, Twisted ring counter
Unit– V Data Converters and PLDs	5a. Calculate the output voltage of the R-2R ladder for the given specified digital input. 5b. Calculate the output voltage of the weighted resistor DAC for the given specified digital input. 5c. Explain with sketches the working principle of the given type of ADC. 5d. Explain with sketches the working principle of the given types of memories. 5e. Explain with basic block diagram the working	5.1 Data Converter: DAC: Types, weighted resistor circuit and R-2R ladder circuit, DAC IC 0808 specifications ADC: Block Diagram, types, and working of Dual slope ADC, SAR ADC, ADC IC 0808/0809, specification 5.2 Memory: RAM and ROM basic building blocks, read and write operation, types of semiconductor memories 5.3 PLD: Basic building blocks and types of PLDs, PLA, PAL, GAL 5.4 CPLD: Basic Building blocks functionality.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	principle of the given type of programmable logic device.	

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Number System	06	2	2	4	08
II	Logic gates and logic families	10	4	4	4	12
III	Combinational Logic Circuits	16	4	6	8	18
IV	Sequential Logic Circuit	16	4	6	8	18
V	Data Converters and PLDs	16	4	4	6	14
Total		64	18	22	30	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Prepare the survey report on the applications of different types of number system and code converters used in the design of digital system.
- Compare technical specifications and applications of various types of memory, PLDs, CPLDs and Prepare report.
- Test digital IC's using various testing equipment like digital IC tester, Digital multi-meter etc.
- Give seminar on any course relevant topic.
- Conduct library / internet survey regarding different data sheet and manuals.
- Prepare power point presentation on digital circuits and their applications.
- Undertake a market survey of different digital IC's required for different applications.
- Search for video / animations / power point presentation on internet for complex topic related to the course and make a presentation.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.



- c. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- e. Guide student(s) in undertaking micro-projects.
- f. PPTs/Animations may be used to explain the construction and working of electronic circuits.
- g. Guide students for using data sheets / manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- a. Build a Digital IC tester circuit.
- b. Build a 4bit parity generator and parity checker circuit.
- c. Build a circuit to implement 4 bit adder.
- d. Build a circuit to test 7 segment display.
- e. Build a circuit to implement debounce switch.
- f. Build a circuit for LED flasher.
- g. Build a circuit for LED BAR display
- h. Design and analyze digital arithmetic circuit

Note: Use general purpose PCB for making micro projects

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009 ISBN: 9780070669116
2	Digital Circuits and Design	Salivahanan S.; Arivazhagan S.	Vikas Publishing House, New Delhi, 2013, ISBN: 9789325960411
3	Digital Electronics	Puri, V.K.	McGraw Hill , New Delhi, 2016, ISBN: 9780074633175
4	Digital Principles	Malvino, A.P.; Leach, D.P.; Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

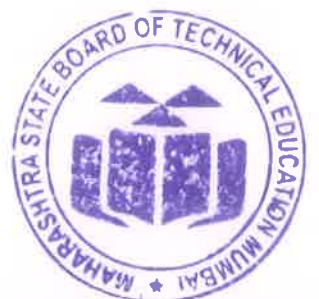


S. No.	Title of Book	Author	Publication
5	Digital Design	Mano, Morris; Ciletti, Michael D.	Pearson Education India, Delhi, 2007, ISBN: 9780131989245
6	Digital Electronics, Principles and Integrated Circuits	Maini, Anil K.	Wiley India, Delhi, 2007, ISBN: 9780470032145
7	Digital Fundamentals	Floyd, Thomas	Pearson Education India, Delhi, 2014, ISBN : 9780132737968

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

- a. www.cse.yorku.ca/~mack/1011/01.NumberSystems.ppt
- b. www.people.sju.edu/~ggrevera/arch/slides/binary-arithmetic.ppt
- c. www.mathsisfun.com/binary-number-system.html
- d. www.codesandtutorials.com/hardware/electronics/digital_codes-types.php
- e. www.ee.surrey.ac.uk/Projects/Labview/gatesfunc/
- f. www.ee.surrey.ac.uk/Projects/Labview/boolalgebra/
- g. www.eng.auburn.edu/~strouce/class/elec2200/elec2200-8.pdf
- h. www.maxwell.ict.griffith.edu.au/yp/teaching/dns/dns_module3_p3.pdf
- i. www.scs.ryerson.ca/~aabhari/cps213Chapter5.ppt
- j. www.eng.wayne.edu/~singhweb/seq1.ppt
- k. www.cs.sjsu.edu/faculty/lee/Ch2Problems2.ppt
- l. www.rogtronics.net/files/datasheets/dac/SedraSmith.pdf
- m. www-old.me.gatech.edu/mechatronics_course/ADC_F04.ppt
- n. www.allaboutcircuits.com/vol_4/chpt_13/3.html
- o. www.youtube.com/watch?v=5Wz5f3n5sjs
- p. www.eee.metu.edu.tr/~cb/e447/Chapter%209%20-%20v2.0.pdf
- q. www2.cs.siu.edu/~hexmoor/classes/CS315-S09/Chapter9-ROM.ppt
- r. www.cms.gcgl1.org/attachments/article/95/Memory2.ppt
- s. www.cosc.brocku.ca/Offerings/3P92/seminars/Flash.ppt
- t. www.webopedia.com/TERM/R/RAM.html
- u. www.cs.sjsu.edu/~lee/cs147/Rahman.ppt





Program Name : Diploma in Artificial Intelligence and Machine Learning
Program Code : AN
Semester : Third
Course Title : Data Structure using Python
Course Code : 22395

1. RATIONALE

Python is powerful programming language Python code is simple, short, readable, intuitive, and powerful, and thus it is effective for introducing computing and problem solving to beginners. Data structures are mathematical and logical model of storing and organizing data in a particular way in computer. Python has efficient high-level data structures and a simple but effective approach to object-oriented programming After studying this course, student will be able to understand and identify different types of data structures to solve real life problems.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Implement data structures using Python to solve problems**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following **industry-oriented** COs associated with the above-mentioned competency:

- Develop python program using basic syntactical constructs.
- Perform operations on data structures in Python.
- Implement modules, packages in python for given problem.
- Design classes for given problem.
- Implement programs for Arrays and Linked List.
- Develop a program to implement Graphs, Trees data structure.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

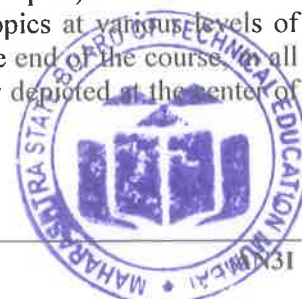
(*): Under the theory PA, out of 30 marks 10 marks are for micro-project assessment to facilitate attainment of COs and the remaining 20 marks is the average of 2 test to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

#: External Exam

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA – Progressive

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course in all domains of learning in terms of the industry/employer identified competency depicted at the center of this map.



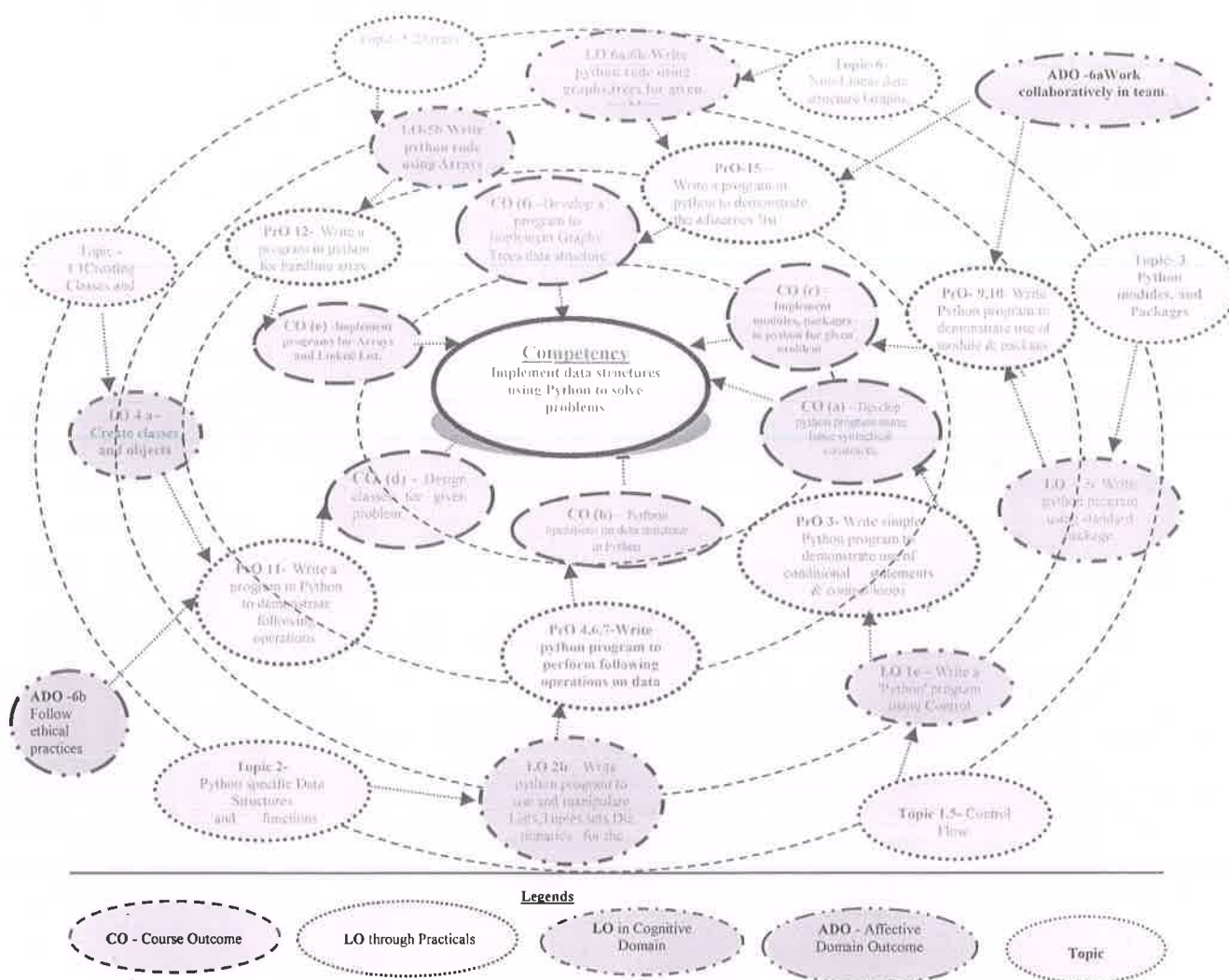


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub- components of the COs) are to be **developed** and assessed in the student to lead to the attainment of the competency.

Sr. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
1	Install and configure Python IDE and Write Python program to display message on screen	I	02*
2	Write simple Python program using operators: a. Arithmetic Operators b. Logical Operators c. Bitwise Operators	I	02
3	Write simple Python program to demonstrate use of conditional statements & control loops: a. if b. if...else c. Nested if d. Switch case e. for f. while g. do..... while	I	02*



Sr. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
4	Write python program to perform following operations on Lists: a. Create b. Access c. Update d. Delete elements in list	II	02*
5	Write python program to perform following operations on Tuples: a. Create b. Access c. Update d. Delete Tuple elements	II	02*
6	Write python program to perform following operations on Set: a. Create b. Access c. Update d. Delete Access Set elements	III	02
7	Write python program to perform following operations on Dictionaries: a. Create b. Access c. Update d. Delete e. Looping through Dictionary	III	02*
8	a. Write Python program to demonstrate math built- in functions b. Write Python program to demonstrate string built - in functions c. Develop user defined Python function for given problem: - Function with minimum 2 arguments	III	02*
9	Write Python program to demonstrate use of: a. Built-tin module (e.g. keyword, math, number, operator) b. User defined module.	III	02*
10	Write Python program to demonstrate use of: a. Built-in packages (e.g. NumPy, Pandas, matplotlib) b. User defined packages	IV	02*
11	Write a program in Python to demonstrate following operations: a. Method overloading b. Method overriding c. Single inheritance	IV	02*
12	Write a program in python for handling array to demonstrate following operations a. Array declaration b. Insertion c. Deletion d. Append e. Index f. Reverse	V	02*
13	Write a program in python for linked list to demonstrate following operations a) Insertion b) Deletion c) Updating d) Merging to list	V	02*



Sr. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
14	Write a program in python to demonstrate queues using list, deque	V	02*
15	Write a program in python to demonstrate the adjacency list representation of graphs	VI	02*
16	Write a program in python to Create binary tree from the given list using Binary tree module in python	VI	02*
Total			32

Note

- A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below

S.No.	Performance Indicators	Weightage in %
1	Correctness of business logic	40
2	Debugging ability	20
3	Quality of input and output displayed (messaging and formatting)	10
4	Answer to sample questions	20
5	On time term work submission	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- Work collaboratively in team
- Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year.
- 'Organization Level' in 2nd year.
- 'Characterization Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Expt. S. No.
1	Computer system (Any computer system with basic configuration)	All
2	'Python' Interpreter/ IDE	

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.



Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-I Introduction on and Control Flow statements	1a Install the given Python IDE and editor. 1b Identify the given Variables, Keywords and constants in Python. 1c Use indentation, comments in the given program. 1d. Use different types of operators for writing arithmetic expressions. 1e. Write a 'Python' program using Control flow.	1.1 Features of Python - Interactive, Object oriented, Interpreted, platform independent 1.2 Python building blocks - Identifiers, Keywords, Indention, Variables, Comments 1.3 Python Data Types: Numbers, String, Tuples, Lists, Dictionary. 1.4 Basic Operators: Arithmetic, Comparison/ Relational, Assignment, Logical, Bitwise, Membership, Identity operators , Python Operator Precedence 1.5 Control Flow: Conditional Statements (if, if else, nested if). Looping in python (while loop, for loop, nested loops) loop manipulation using continue, pass, break, else.
Unit-II Python specific Data Structures and functions	2a. Write python program to use and manipulate Lists for the given problem. 2b. Write python program to use and manipulate Tuples for the given problem. 2c. Write python program to use and manipulate Sets for the given problem. 2d. Write python program to use and manipulate Dictionaries for the given problem. 2e Develop relevant user defined functions for the given problem using Pythoncode.	2.1 Lists: a) Defining lists, accessing values in list, deleting values in list, updating lists. b) Basic List Operations c) Built - in List functions 2.2 Tuples: a) Accessing values in Tuples, deleting values in Tuples, and updating Tuples. b) Basic Tuple operations. c) Built - in Tuple functions 2.3 Sets: a) Accessing values in Set, deleting values in Set and updating Sets. b) Basic Set operations. c) Built - in Set functions 2.3 Dictionaries: a) Accessing values in Dictionary, deleting values in Dictionary and updating Dictionary. b) Basic Dictionary operations. c) Built- in Dictionaries functions 2.4 Use of Python built- in functions (e.g.type/ data conversion functions, math functions etc.) 2.5 User defined functions: Function definition, Function calling, function arguments and parameter passing, Return statement, Scope of Variables, Global variable and Local Variable



Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-III Python modules, and Packages	3a. Write Python module for the given problem. 3b. Write Python package for the given problem. 3c. Write python program using standard package (NumPy, Pandas).	3.1 Modules: Writing modules, importing modules, importing objects from modules, Python built-in modules (e.g. Numeric and mathematical module, Functional Programming Module) 3.2 Python Packages: Introduction, Writing Python packages, 3.3 Using standard (scipy, Numpy, matplotlib, pandas). Numpy: Methods in Numpy, Creating arrays and initializing, Reading arrays from files. Special initializing functions, Slicing and indexing, reshaping arrays, combining arrays, NumPy maths. 3.4 Pandas: Methods, Creating Data structures (Series and Data Frames)
Unit-IV Object Oriented Programming in Python	4a. Create classes and objects 4b. Describe Method Overloading , Method Overriding 4c. Write Python code for data hiding for the given problem 4d. Write Python code using data abstraction for the given problem. 4e. Write Python program using inheritance for the given problem	4.1 Creating Classes and Objects. 4.2 Method Overloading and Overriding. 4.3 Data Hiding. 4.4 Data abstraction. 4.5 Inheritance and composition classes Customization via inheritance specializing inherited methods
Unit-V Linear data structure Arrays, Link List, Queues using Python	5a. Describe data structures in python. 5b. Write python code using Arrays for given problem. 5c. Write python code using link list for given problem. 5d. Write python program using queues.	5.1 Data Structures – Definition, Linear Data Structures, Non-Linear Data Structures use of Python Specific Data Structures: List, Tuples, Set, Dictionaries, 5.2 Arrays - Overview, Types of Arrays, Operations on Arrays, Arrays vs List. Time complexity, Searching -Linear Search and Binary Search. Sorting - Bubble Sort, Insertion Sort, 5.3 Linked Lists – Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists. implementation using python packages for link list 5.4 Queues: Implementation of Queue (List & Linked list),
Unit-VI Non-Linear data structure Graphs, Trees using Python	6a. Write python program using graphs 6b. Write python code using trees for given problem	6.1 Graphs -Introduction, Directed vs Undirected Graphs, Weighted vs Unweighted Graphs, Representations, Breadth First Search, Depth First Search. 6.2 Trees - Tree Terminology, Binary Trees: implementation, Tree Traversals, Binary Search Trees

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'



9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER (INTERNAL DESIGN)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction and Control Flow statements	06	02	02	04	08
II	Python specific Data Structures and functions	08	02	04	06	12
III	Python modules, and Packages	08	02	02	08	12
IV	Object Oriented Programming in Python	06	02	02	04	08
V	Linear data structure Arrays, Link List, Queues using Python	12	02	04	12	18
VI	Non-Linear data structure Graphs, Trees using Python	08	02	02	08	12
Total		48	12	16	42	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table. This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidence s for their (students) portfolio which will be useful for their placement interviews:

- Prepare journal of practical's.
- Undertake micro-projects

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- With respect to item No. 10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide student(s) in undertaking micro-projects.
- Demonstrate students thoroughly before they start doing the practice.
- Encourage students to refer different websites to have deeper understanding of the subject.
- Observe continuously and monitor the performance of students in Lab



12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably being **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

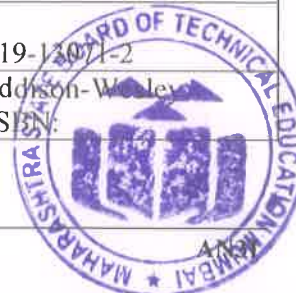
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- a) Create an English dictionary which is able to perform following function.
 - i) Add a word and its meaning.
 - ii) Delete a word and its meaning.
 - iii) Update word or its meaning.
 - iv) Print list of word and its meaning.
- b) Develop an application to create tic-tac-toe game.
- c) Develop library management system which will able to:
 - i) Add
 - ii) Delete
 - iii) Update
 - iv) Display books related information like book no, book name, date of issue, date of deposited, and student details etc.
- d) Develop Python application for performing following operations
 - i. Deposit
 - ii. Withdraw
 - iii. Balance enquiry.
 Select appropriate data structure.
- e) Develop Python application that creates tree to store given data set using Link list representation. Locate and display specific data from data set.
- f) Any other micro-projects suggested by subject faculty on similar line. (Use functions, Classes, Objects and other features of 'Python' to develop applications.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Data Structures and Algorithms in Python	Michael T. Goodrich, Roberto Tamassia Michael H. Goldwasser	Wiley India Pvt. Ltd. ISBN: 978-93-5424-786-6
2	Learning Python	Lutz, Mark	5th Edition, O'Reilly Publication ISBN-13: 978-1449355739
3	Python Programing	Rao, K. Nageswara Shaikh Akbar	Scitech Publications (India) Pvt. Ltd. ISBN: 9789385983450
4	Data Structures and Algorithms with Python	Kent D. Lee Steve Hubbard	Springer ISBN: 978-3-319-13071-2
5	Python Essential Reference	Beazley, David	4th Edition, Addison-Wesley Professional, ISBN:



S. No.	Title of Book	Author	Publication
			9780672329784
6	Head First Python, 2nd Edition	Paul, Barry	O'Reilly Publication, 2 nd Edition, ISBN:1491919531

14. SOFTWARE / LEARNING WEBSITES

- a. <https://www.tutorialspoint.com/python/index.htm>
- b. <https://www.nptel.ac.in/courses/117106113/34>
- c. <https://www.w3schools.com/python/default.asp>
- d. <https://www.programiz.com/python-programming>
- e. <http://spoken-tutorial.org/>
- f. <https://www.w3resource.com/python-exercises/>
- g. <https://www.anandology.com/python-practice-book/>
- h. <https://www.edureka.co/blog/data-structures-in-python/>
- i. <https://www.geeksforgeeks.org/graph-data-structure-and-algorithms/>





Program Name : Diploma in Artificial Intelligence and Machine Learning
Program Code : AN
Semester : Third
Course Title : Data Story Telling and Visualization
Course Code : 22396

1. RATIONALE

This course will cover the basics of Data Story Telling and Data Visualization. This course also covers the constructing data stories, extracting meaningful data and representing data for effective visualization. This course gives better visualization to attract audiences. This course will enable the students to inculcate concept of Data Story Telling and methodology to create various visual effects.

2. COMPETENCY

The aim of this course is to help the student to attain the following *industry identified* competency through various teaching learning experiences:

- **Construct Data Story Telling and create various visual effects for better visualization**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- Understand the context and visual effects of data story telling.
- Eliminate clutter and focus audience attention. (Focus audience attention after eliminating clutter)
- Prepare data storytelling according to designer's view.
- Construct/Build data storytelling.
- Create data visualization via single distribution.
- Create data visualization via many distributions.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(**) marks should be awarded on the basis of internal end semester theory exam of 50 marks based on the specification table given in S. No. 9.

(~): For the **practical only courses**, the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.



Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment, '#': No Theory Examination

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

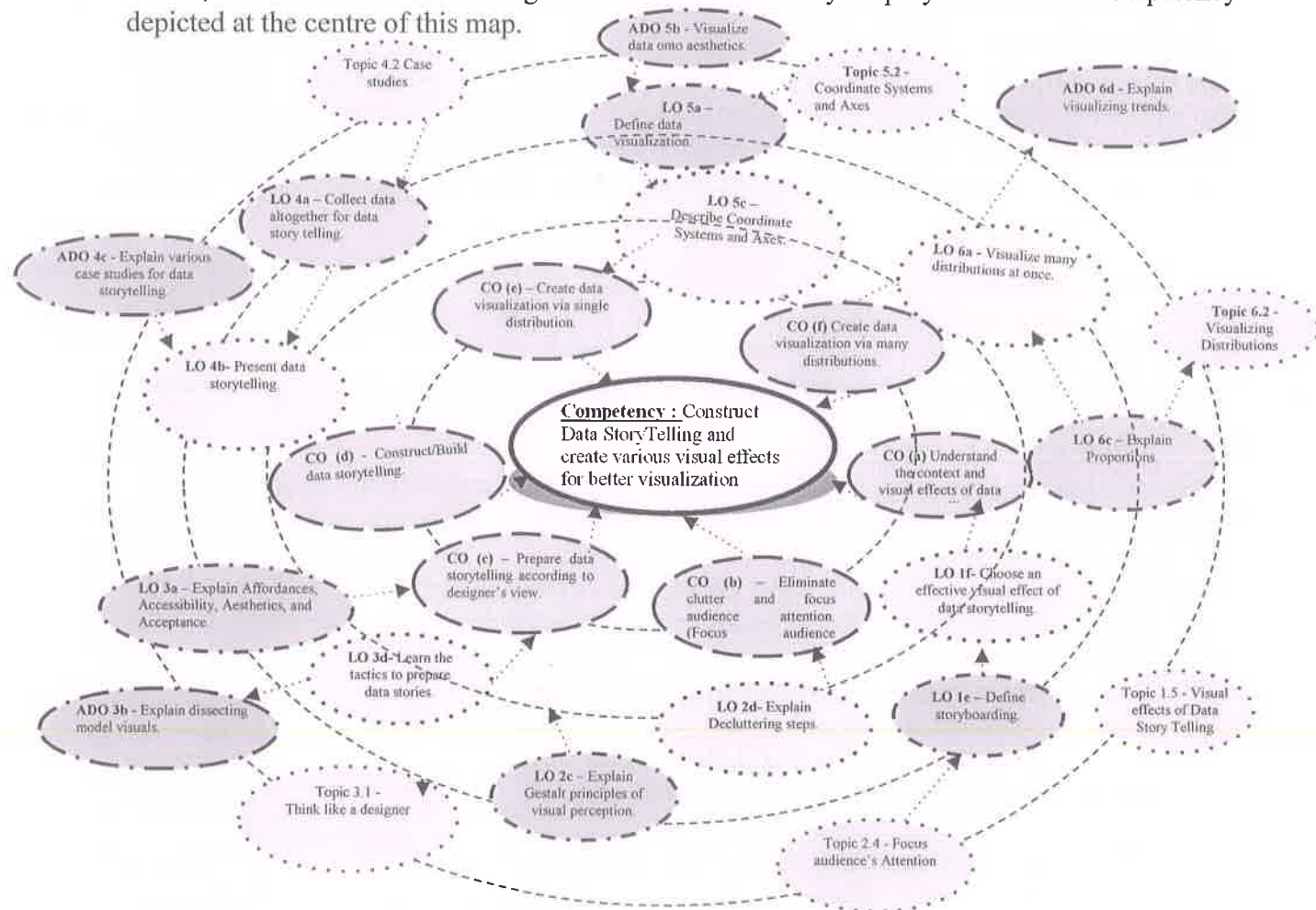


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) are to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs Required
1	Identify a project you are working on where you need to		



S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
	communicate in a data-driven way. Reflect upon and write the answers of following questions. 1) WHO IS YOUR AUDIENCE? a. List the primary groups or individuals to whom you'll be communicating. b. If you had to narrow that to a single person, who would that be? c. What does your audience care about? d. What action does your audience need to take?		
2	Identify a project you are working on where you need to communicate in a data-driven way. Reflect upon and write the answers of following questions. 1) WHAT IS AT STAKE? a. What are the benefits if your audience acts in the way that you want them to? b. What are the risks if they do not? 2) FORM YOUR BIG IDEA It should: a. Articulate your point of view b. Convey what's at stake c. Be a complete (and single!) sentence.	I	2*
3	Buses Bunching (Part-I) - Make a data story on bus bunching, (Bus Bunching means when a bus gets delayed and later causes multiple buses to arrive at a single stop at the same time.) a. Find audience, communication mechanism, and desired tone. b. Select effective visual.	I	2*
4	Buses Bunching (Part-II) a. Identify and eliminate clutter. b. Select suitable pre attentive attributes. c. Explore affordances, accessibility, and aesthetics as per designers view.	II, III	2*
5	Create a video (up to 5 minutes) telling your story on practical no. 3 and 4.	I, II, III, IV	2*
6	Make a data story on Percentage of Indian Population by Age Group.	I, II, III, IV	2*
7	Create a data story w.r.t. following observations: a. What are the most popular pick-up locations across the city for Citi Bike rental? b. How does the average trip duration vary across different age groups, and over time? c. Which age group rents the most bikes? d. How does bike rental vary across the two user groups (one-time users vs. long-term subscribers) on different days of the week?	I, II, III, IV	2



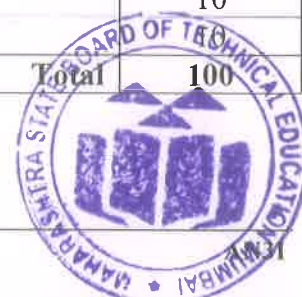
S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
	e. Do factors like weather and user age impact the average bike trip duration?		
8	Create a video (up to 5 minutes) telling your story. You might want to record a video of yourself speaking, or narrate while showing visual props or sketches, or screencast a PowerPoint presentation, etc. You get to choose how you present the story. You should produce a single video file (formatted as a .mov file)	I, II, III, IV	2*
9	Implement python program that loads any dataset and plot the grouped bars.	V	2*
10	Implement python program that perform data cleaning on any dataset.	V	2*
11	Implement Python program to perform data pre-processing, analysis and visualization.	V	2*
12	Apply Data analysis using Python for available data set. (Apply Supervised machine learning algorithm.)	V	2
13	Implement Python program to apply Image Processing functions like display, plot and colour by using sklearn or other libraries	V	2
14	Connecting to Database and extracting data from database table in Python.	V	2*
15	Develop worksheet, add filters and create chart using dataset in Python.	VI	2
16	Create and organize above (Practical No. 6) data visualizations into the bar chart.	VI	2*
17	Create and organize above (Practical No. 7) data visualizations into the bar chart.	VI	2
Total			34

(*): compulsory practicals to be performed.

Note

- Given in above tables is suggestive list of practical exercises. Teachers can design other similar exercises.
- Assessment of the 'Process' and 'Product' related skills in the laboratory/workshop/field work should be done as per suggested sample below:

S. No.	Performance Indicators	Weightage in %
1	Gather information for data story and select proper visualization method.	20
2	Use standard statements to prepare data story and represent it pictorially.	40
3	Present data story and execute visualization programs.	20
4	Able to answer oral questions.	10
5	Submission of report in time.	
Total		100



Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

- Present data story.
- Demonstrate working as a leader / a team member.
- Maintain tools and equipment.
- Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year and
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Expt. S. No.
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 2 GB onwards.	For all Experiments
2	Operating system: Windows 7 onwards	
3	Software: Python	

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Context and Visual effects of Data Story Telling	1a. Understand the importance of context. 1b. Differentiate between exploratory and explanatory analysis. 1c. Identify audience. 1d. Explain 3-minutes story. 1e. Define storyboarding. 1f. Choose an effective visual effect of data storytelling.	1.1 Concept / Importance of Context 1.2 Exploratory vs. explanatory analysis 1.3 Who - Your audience, You, What – Action, Mechanism, Tone, How, Example 1.4 The 3 minutes story, Big Idea, Storyboarding. 1.5 Visual effects of Data Story Telling - Choosing an effective visual - Simple text, Tables, Graphs, Points, Bars - Vertical bar chart, Horizontal bar chart
Unit– II Focus audience's Attention by eliminating clutter	2a. Define clutter. 2b. Define cognitive load. 2c. Explain Gestalt principles of visual perception. 2d. Explain Decluttering steps. 2e. Describe Preattentive attributes in text, graphs, page.	2.1 Clutter is our enemy - Cognitive load, Clutter 2.2 Gestalt principles of visual perception, Lack of visual order 2.3 Decluttering: step-by-step 2.4 Focus audience's Attention - Preattentive attributes signal when to look 2.5 Preattentive attributes in text



Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		2.6 Preattentive attributes in graphs 2.7 Size, Color, Position on page
Unit– III Storytelling from designers view	3a. Explain Affordances, Accessibility, Aesthetics, and Acceptance. 3b. Explain dissecting model visuals. 3c. Understand the magic of story. 3d. Learn the tactics to prepare data stories.	3.1 Think like a Designer -Affordances 3.2 Accessibility 3.3 Aesthetics 3.4 Acceptance 3.5 Dissecting model visuals - line graph, 100% stacked bars 3.6 Lessons in storytelling - The magic of story 3.7 Constructing the story 3.8 The narrative structure 3.9 The power of repetition 3.10 Tactics to help ensure that your story is clear
Unit-IV Pulling it all together for data storytelling	4a. Collect data altogether for data story telling. 4b. Present data storytelling. 4c. Explain various case studies for data storytelling.	4.1 Pulling it all together for data storytelling 4.2 Case studies -Color considerations with a dark background, Leveraging animation in the visuals you present 4.3 Final Thoughts - Where to go from here, Building storytelling with data competency in your team or organization
Unit –V Visualizati on Part - I	5a. Define data visualization. 5b. Visualize data onto aesthetics. 5c. Describe Coordinate Systems and Axes. 5d. Explain Directory of Visualizations.	5.1 From Data to Visualization – Introduction, Visualizing Data: Mapping Data onto Aesthetics. 5.2 Coordinate Systems and Axes 5.3 Directory of Visualizations - Visualizing Amounts - Bar Plots, Grouped and Stacked Bars, Visualizing Distributions - Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile-Quantile Plots
Unit –VI Visualizati on Part - II	6a. Visualize many distributions at once. 6b. Visualize distributions along the axes. 6c. Explain Proportions. 6d. Explain visualizing trends.	6.1 Visualizing Many Distributions at Once 6.2 Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis 6.3 Proportions 6.4 Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition



Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER (INTERNAL) DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Context and Visual effects of Data Story Telling	06	02	02	04	08
II	Focus audience's Attention by eliminating clutter	08	02	04	06	12
III	Storytelling from designers view	08	02	04	06	12
IV	Pulling it all together for data storytelling	06	02	02	06	10
V	Visualization Part - I	10	02	04	08	14
VI	Visualization Part - II	10	02	04	08	14
Total		48	12	20	38	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

- Prepare journals based on practical performed in laboratory.
- Library/E-Book survey regarding Python programming used in Computer industries.
- Prepare power point presentation for showing different types of Python Programming Applications.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- '**L**' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.



- e. Guide student(s) in undertaking micro-projects.
- f. No. of practical's selection to be performed should cover all units.
- g.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course.

A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

- a. Car Racing in last 5 years
- b. Corona Virus Breakdown
- c. Regional Language Awareness
- d. Percentage of candidates in various countries on Twitter
- e. Indian Industry Revolution
- f. Cricket Scorecard of different matches for particular player

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Storytelling with data – a data visualization guide for business professionals	Cole Nussbaumer Knaflic	Wiley India Pvt. Ltd ISBN: 978-1-119-00225-3
2	Fundamentals of Data Visualization	Claus O. Wilke	O'Reilly Media, Inc. ISBN: 9781492031086
3	Fundamentals of PYTHON	Kenneth A Lambert, B.L. Juneja	CENGAGE Learning, ISBN:978-81-315- 2903-4

14. SOFTWARE/LEARNING WEBSITES

- a. <https://nptel.ac.in/courses/106106182>
- b. <https://careerfoundry.com/en/tutorials/data-analytics-for-beginners/storytelling-with-data/>
- c. <https://blog.hubspot.com/marketing/great-data-visualization-examples>



Program Name : Diploma in Artificial Intelligence and Machine Learning
Program Code : AN
Semester : Third
Course Title : Mathematics for Machine Learning-I
Course Code : 22397

1. RATIONALE

Machine Learning refers to the automated identification of patterns in data. This course is included in curriculum as Mathematics is foundation for AI and ML. Statistic and Probability are the core components of AI/ML. This course deals with concept of R-Programming to enhance the knowledge of statistics and Probability. This course will enable the students to inculcate programming concepts and methodology to solve AI/ML based Engineering problems.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Write Programs using R-Programming to solve Statistics and Probability based problems.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Solve the given problem based on Statistic Techniques using R-Programming.
- Implement Statistic methods using R-Programming.
- Use Probability Theorems to solve Real-Time Problems.
- Apply Probability Distribution in R-Programming.
- Apply Sampling Methods in R-Programming.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(**) marks should be awarded on the basis of internal end semester theory exam of 50 marks based on the specification table given in S. No. 9.

(~): For the **practical only courses**, the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.



Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment, '#': No Theory Examination

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

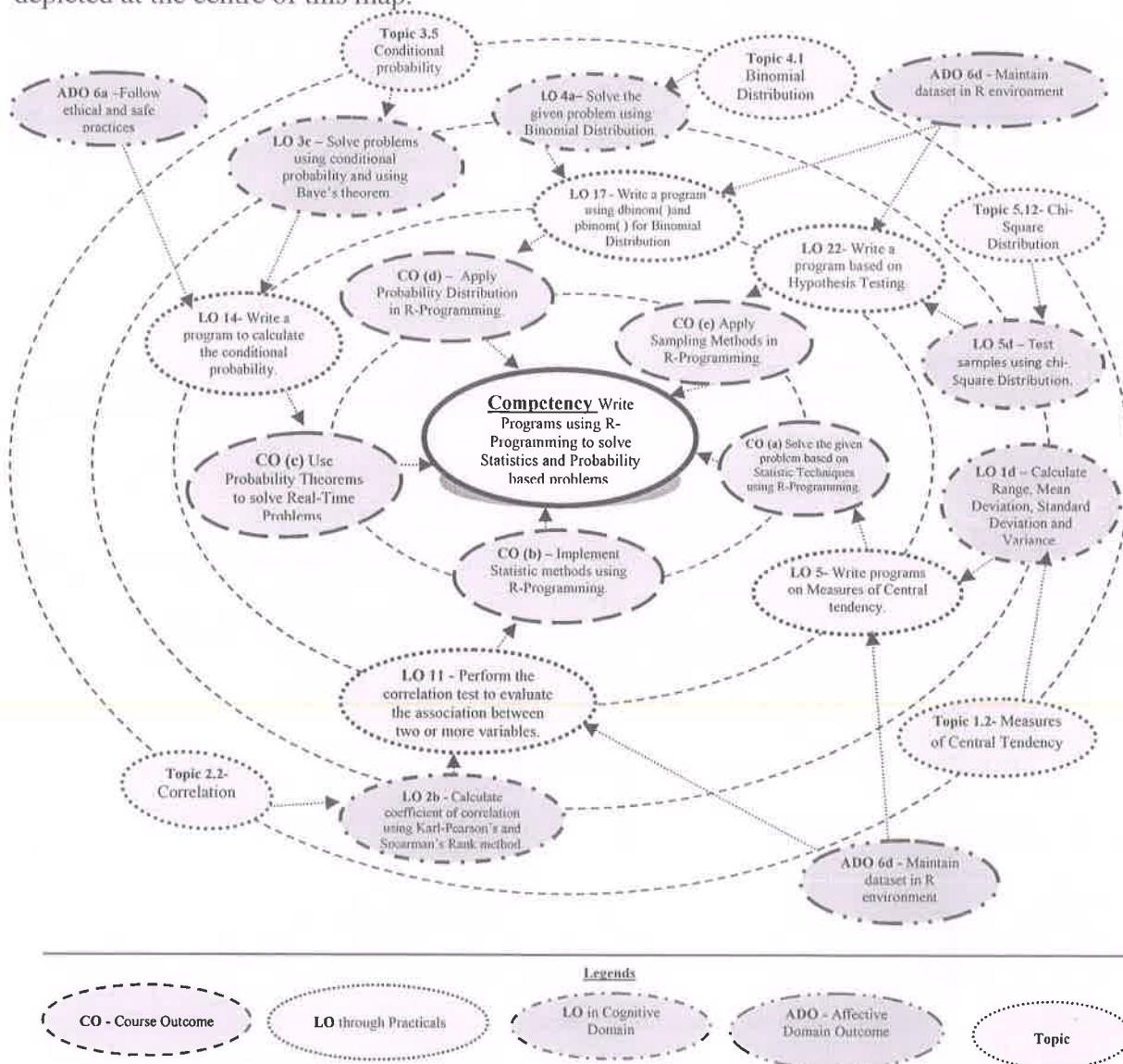


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) are to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Install R studio and R Packages.	I	02*
2	a. Write simple programs using R-Numbers. (numeric, integer, complex). b. Write simple programs to convert from one type to other using functions. c. Write simple programs to perform following operations. i. Addition and Subtraction ii. Find Square root using built-in function.	I	02*
3	a. Print any built-in data set of R. b. Get information about the data set. c. Find the dimensions of the data set and view the names of the variables. (Hint: Use dim() and names() function). d. Find the name of each row in the first column.(Hint: Use the rownames() function . e. Print all values that belong to a variable. f. Sort the values of variable. g. Get the statistical summary of the data.	I	02*
4	a. Find the lowest or highest value in a data set. (Hint: Use min() and max() functions). b. Find the index position of the max and min value in the table (Hint: use which.max() and which.min() functions).	I	02*
5	Write programs on Measures of Central tendency. a. Import data into R. b. Calculate the Mean (Average value) of a variable from the given data set. c. Find the Median (Mid-Point value) of the variable from the given data set. d. Calculate the mode for the variable from the given data set.(by sorting the column of the dataframe and by using the 'modest' package) e. Calculate the Percentile of the variable from the given data set.		02*
6	Write a program to make a frequency distribution table in R. a. Print Original Data Frame, Modified Frequency Table, Cumulative Frequency Table, Relative Frequency Table. b. Create the Frequency Table by using multiple arguments. c. Plot the frequency table using ggplot function.	I	02*
7	Write programs to calculate Variance, Standard Deviation, Range, Mean Deviation for the given data.	I	02
8	a. Draw Histogram for the given data. b. Draw Ogive Curve for the given data.	I	02*
9	Write a Program to calculate Skewness for the given data.	I	02
10	Write a Program to draw a scatterplot for two variables for the given dataset.	I	02*
11	Perform the correlation test to evaluate the association between two or more variables. a. Install and load required R packages	II	02*



S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
	b. Compute correlation in R c. Import your data into R d. Visualize your data using scatter plots e. Preliminary test to check the test assumptions		
12	Perform the correlation test to evaluate the association between two or more variables. a. Pearson correlation test b. Interpretation of the result c. Use Spearman rank correlation coefficient to estimate a rank-based measure of association.	II	02*
13	Write a Program based on Line of Regression.	II	02*
14	Write a program to calculate the conditional probability.	III	02
15	Write a program to compute probability using prod() function.	III	02
16	Write a program to use Bayes' Theorem in R-Programming.	III	02*
17	Write a program using dbinom() and pbinom() for Binomial Distribution.	IV	02*
18	Write a program using dpois() and ppois() for Poisson Distribution.	IV	02
19	Write a program using dnorm () and pnorm () for Normal Distribution.	IV	02
20	Write a program to generate a Samples Using the Sampling Functions in R.	V	02*
21	Write a program to generate a Sampling Distribution in R.	V	02
22	Write a program based on Hypothesis Testing.	V	02*
23	Write a program based on t-Distribution using dt, pt, qt & rt functions.	V	02*
24	Write a program based on Chi-Square Distribution using dchisq, pchisq, qchisq & rchisq functions.	V	02
Total			48

Note

- Given in above tables is suggestive list of practical exercises. Teachers can design other similar exercises.
- Practicals Marked as * are Compulsory. Other practicals can be given to fast learners/Bright students.
- The faculty from Computer/Information Technology Department teaching listed practicals should co-ordinate with the Math's faculty teaching theory contents to formulate the problem Statement to perform above practicals,
- To attain the COs and competency, a judicious mix of practical from above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Applying Level' of Blooms's 'Cognitive Domain Taxonomy'.

Assessment of the 'Process' and 'Product' related skills in the laboratory/workshop/field work should be done as per suggested sample below:



S.No.	Performance Indicators	Weightage in %
1	Import Packages and use libraries.	20
2	Use R-Studio/R-Environment to create, edit, compile the 'R' programs/applications.	40
3	Debug, test and execute the programs/applications.	20
4	Able to answer oral questions.	10
5	Submission of written assignment in time.	10
Total		100

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

- Handle R-Programming environment.
- Experiment with R-Programming environment.
- Import, construct, compile, debug, test and execute R programs.
- Maintain dataset in R environment.
- Manage R packages.
- Follow ethical and safe practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

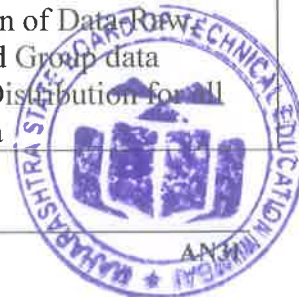
The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Expt. S. No.
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 2 GB onwards.	For all Experiments
2	Operating system: Windows XP/Windows 7/LINUX onwards.	
3	Software: R-Studio	

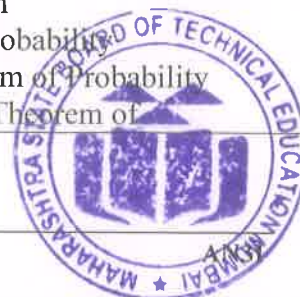
8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Statistical Techniques	1a. Solve problems based on Frequency Distribution. 1b. Calculate Mean, Median and Mode for all types of data. 1c. Calculate Geometric, Harmonic and Combined	1.1. Frequency Distribution 1.1.1. Definition- Basic terms 1.1.2. Classification of Data into Ungroup and Group data 1.1.3. Frequency Distribution for all types of data



Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	Mean for raw data. 1d. Calculate Range, Mean Deviation, Standard Deviation and Variance. 1e. Find Mode and Median using Graphical methods. 1f. Find Co-efficient of Skewness for given data.	1.2. Measures of Central Tendency 1.2.1. Mean, Median, mode for all types of Data 1.2.2. Concept of quartiles, deciles, percentiles. 1.2.3. Geometric mean and Harmonic mean 1.2.4. Combined mean 1.3. Measures of Dispersion 1.3.1. Range 1.3.2. Mean Deviation 1.3.3. Standard Deviation 1.3.4. Variance 1.3.5. Graphical Representation of mode and median 1.3.6. Find mode of data using Histogram 1.3.7. Find median using ogive curve 1.4. Skewness for given data 1.4.1. Types of skewness 1.4.2. Test of skewness 1.4.3. Measures of Skewness 1.4.4. Karl Perason's coefficient of skewness 1.4.5. Bowley's coefficient of skewnes 1.4.6. Types of skewness in terms of Mean and Mode 1.4.7. Measures of Kurtosis
Unit- II Statistical methods	2a. Fit straight line and parabolic curve using Least Square method. 2b. Calculate coefficient of correlation using Karl-Pearson's and Spearman's Rank method. 2c. Obtain the equation to the Line of Regression.	2.1 Method of Least Square 2.1.1. Fitting of Straight Line $y=a+bx$ 2.1.2. Fitting of Parabolic $y=a+bx+cx^2$ 2.2 Correlation 2.2.1. Covariance 2.2.2. Correlations, types of Correlations 2.2.3. Scatter or Dot-Diagram 2.2.4. Karl-Pearson's Co-efficient of Correlation 2.2.5. Spearman's Rank Co-efficient of Correlation 2.3 Regression 2.3.1. Line of Regression 2.3.2. Equations to Line of Regression
Unit- III Probability of Random Variable	3a. Solve simple problems on probability. 3b. Solve problems using addition and multiplication probability	3.1. Basic Definition 3.2. Definition of Probability 3.3. Addition theorem of Probability 3.4. Multiplication Theorem of Probability



Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	theorem. 3c. Solve problems using conditional probability and using Baye's theorem.	Probability 3.5. Conditional probability 3.6. Baye's theorem
Unit-IV Probability Distributio n	4a. Solve the given problem using Binomial Distribution. 4b. Solve the given problem using Poisson Distribution. 4c. Solve the given problem using Normal Distribution.	4.1. Binomial Distribution 4.2. Poisson Distribution 4.3. Normal Distribution
Unit –V Sampling methods	5a. Solve the given problem using Sampling methods. 5b. Solve the given problem using Sampling distribution. 5c. Test samples using t-Distribution. 5d. Test samples using chi-Square Distribution. 5e. Use Chi-Square test to test the independence.	5.1. Population, Sampling: Aim of Sampling, Types of Sampling, Parameters and Statistic. 5.2. Sampling Distribution 5.3. Standard Error. 5.4. Hypothesis: Testing Hypothesis, Null Hypothesis, 5.5. Errors 5.6. Level of Significance, Test of Significance 5.7. Confidence Limits 5.8. Test of Significance of Large Samples ($N > 30$) 5.9. Sample Distribution of proportion 5.10. Comparison of Large Samples. 5.11. The t-Distribution (For Small Samples) 5.12. Chi-Square Distribution 5.13. Condition for Chi Square test 5.14. Degree of freedom 5.15. Chi -Square Test of Goodness of fit 5.16. Chi – Square test as a test of Independence.

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Statistical Techniques	14	02	06	12	20
II	Statistical methods	10	02	04	08	14
III	Probability of Random Variable	08	02	04	04	10
IV	Probability Distribution	08	02	02	08	12
V	Sampling methods	08	02	04	08	14
Total		48	10	20	40	70



Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

- Prepare journals based on practical performed in laboratory.
- Execute programs using different data sets in R-Programming.
- Library/E-Book survey regarding 'Mathematics' used in Artificial Intelligence and Machine Learning.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

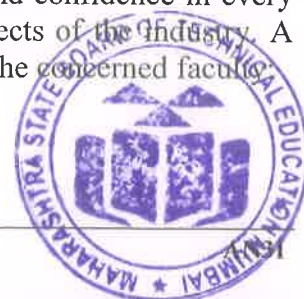
These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide student(s) in undertaking micro-projects.
- No. of practical's selection to be performed should cover all units.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty.



- Write a program to apply Marginal frequency distribution of predictors and response variable.
- Write Code for ATM Card Fraud Detection System using Machine Learning Techniques using R-Programming.
- Create a probabilistic model for credit card fraud detection
- For a payroll dataset create Measure of central tendency and its measure of dispersion for statistical analysis of given data.
- Case Study on probabilistic model for predicting relations in social websites system.
- Demonstrate the case study of real direct online real estate using R language.
- Design a microproject to analyze Uber Data.
 - Design data analysis using the R libraries like ggplot2.
 - Create a precise prediction of customers who will avail Uber trips and rides.
 - Analyze different parameters like the number of trips made in a day, the number of trips during a particular month, average passenger that uber can have in a day, the peak hours where more customers are available, the number of trips found maximum on which day of the month, etc.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	H.K.Dass, Er.Rajnish Verma	S. Chand Technical ISBN: 9788121938907, 9788121938907
2	Statistical Methods	S. P. Gupta	Sultan Chand and sons Education Publisher, New Delhi. ISBN13: 978-93-5161-176-9
3	Higher Engineering Mathematics	B. V. Ramana	Tata Mcgraw Hill Education private limited, New Delhi. ISBN: 9780070634190, 9780070634190
4	Higher Engineering Mathematics	B. S Grewal	Khanna Publishers ISBN-10. 9788193328491 ISBN-13. 978-8193328491
5	R Programming For Dummies	Andrie de Vries, Joris Meys	Wiley india ISBN: 9788126562183
6	Introduction to R Programming	Hicham and Mohamed Ibnalkadi	(202 Non Fiction Book 4) Kindle Edition

14. SOFTWARE/LEARNING WEBSITES

- <https://www.w3resource.com/r-programming-exercises/basic/r-programming-basic-exercise-3.php>
- www.datamentor.io/r-programming/examples/
- https://www.tutorialspoint.com/r_programming_language/index.asp
- <https://www.freecodecamp.org/news/all-the-math-you-need-in-artificial-intelligence/>
- <https://byjus.com/maths/least-square-method/>
- <https://www.coursera.org/learn/r-programming>



