M.Sc.

INFORMATION TECHNOLOGY

SYLLABUS

THOSE WHO JOINED FROM THE ACADEMIC YEAR

2026 - 2027

MANONMANIAM SUNDARANAR UNIVERSITY
THIRUNELVELI – 627 012

MANONMANIAM SUNDARANAR UNIVERSITY,
TIRUNELVELI
PG COURSES–AFFILIATED COLLEGES
M.Sc. INFORMATION TECHNOLOGY

OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

(with effect from the academic year 2026-2027)

1. VISION

"To provide quality education to reach the un-reached"

2. MISSION

- To conduct research, teaching and outreach programmes to improve conditions of human living
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled

3. PREAMBLE

Outcome Based Education (OBE) is the order of the day in all Higher Education Institutions to emphasize quality mandate. Curriculum tailored with Choice Based Credit System (CBCS) for ensuring flexibility; Exposure to learning opportunities using the latest technological advancements to the learners for continuous lifelong learning; and Adoption of Revised Bloom's Taxonomy (RBT) in the assessment mechanism are essential to add value to the existing OBE. The current revision is aimed at providing scope for effective implementation of OBE by including Programme Educational Outcomes, Programme Outcomes, and Programme Specific Outcomes in alignment to the vision and mission of the University. Courses need to be framed and mapped such that the compilation of the Outcomes of all Courses in the programme ensures the attainment of the programme outcomes in terms of RBT.

The Master of Science in Information Technology (M.Sc. IT) programme is designed to provide advanced knowledge and specialized skills in the field of information technology, preparing graduates to address complex technological challenges in a rapidly evolving digital environment. The programme aims to develop highly skilled professionals, researchers, and innovators capable of contributing to the advancement of computing technologies and their

applications across diverse sectors. The curriculum offers an in-depth understanding of advanced topics such as software engineering, data science, artificial intelligence, cloud computing, cybersecurity, big data analytics, Internet of Things (IoT), distributed systems, and emerging digital technologies. It integrates theoretical foundations with practical applications, enabling students to analyze, design, develop, and manage sophisticated information systems and technology solutions. Emphasis is placed on research, innovation, critical thinking, problem-solving, and ethical practices. Through project work, internships, seminars, and research-oriented activities, students gain hands-on experience and develop the ability to apply contemporary technologies to real-world problems. The programme also fosters leadership, teamwork, communication skills, and professional responsibility, preparing graduates for managerial, technical, and academic roles.

The M.Sc. Information Technology programme promotes lifelong learning and adaptability, enabling students to remain competitive in the global technology landscape. By nurturing advanced technical expertise and research capabilities, the programme contributes to the development of competent IT professionals who can drive digital transformation, technological innovation, and sustainable development in industry, government, education, and society.

4. PROGRAMME EDUCATIONAL OUTCOMES (PEOs)

In alignment with the Vision and Mission of the University, the following have been defined as the PEO for the graduates.

PEO1: Developing strong positive attitude to learn independently the concepts in the field of study

PEO2: Ensuring confidence among the learners to apply the knowledge and skills gained to solve real life issues

PEO3: Habituating ethical values among the learners to succeed in personal and professional life

5. PROGRAMME OUTCOMES (POs)

After the successful completion of P o s t graduate Programme from the University, the learner should be able to

PO1: Comprehend the knowledge acquired and share the knowledge with others to convince them in a discussion.

PO2: Analyze and compare the factual data / situation and formulate the problem in to a

conceptual model to critically evaluate for finding solution.

PO3: Apply the theories and philosophies learned in formulating theoretical research problem with underlying assumptions and solve the problem scientifically.

PO4: Think reflectively on the earlier attempts for applications of the concepts with a sense of inquiring practices and attempt for self directed lifelong learning process.

PO5: Understand the existence of multicultural practices and global viewpoint and utilization of knowledge with the ability to prolong moral/ethical values in personal and professional life.

PO6: Explore through multiple sources and get exposed to the digital literacy and information explosion with latest technology.

PO7: Act as a responsible member in the varied teams with facilitating capability and formulate teams as a leader for defined purposes.

6. PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Communication & Persuasion

Develop the ability to synthesize complex theoretical knowledge and articulate it with clarity and conviction. Graduates will be proficient in defending specialized concepts during professional discourse and persuading stakeholders through evidence-based arguments.

PSO2: Analytical Modeling & Problem Formulation

Acquire the skill to deconstruct real-world data and scenarios into structured conceptual models. This involves identifying core variables and using critical evaluation techniques to propose viable, data-driven solutions for complex industry challenges.

PSO3: Scientific Research & Theory Application

Master the application of discipline-specific philosophies to formulate rigorous research problems. Graduates will be able to establish sound underlying assumptions and employ scientific methodologies to test hypotheses and solve theoretical dilemmas.

PSO4: Reflective Practice & Lifelong Learning

Cultivate a habit of reflective inquiry by auditing past applications of concepts to improve future outcomes. Graduates will demonstrate an autonomous, self-directed approach to professional development, ensuring they remain current in an evolving landscape.

PSO5: Global Ethics & Cultural Competency

Integrate a global perspective with local multicultural awareness to navigate professional environments with high moral and ethical standards. This includes applying specialized knowledge in a way that respects diversity and upholds social responsibility.

PSO6: Digital Literacy & Information Management

Navigate the modern "information explosion" by leveraging cutting-edge digital tools and technology. Graduates will be adept at sourcing, filtering, and synthesizing information from multiple digital platforms to maintain a competitive edge.

PSO7: Collaborative Leadership & Team Dynamics

Function effectively as both a contributing member and a strategic leader within diverse teams. Graduates will be capable of facilitating group synergy, managing conflicts, and organizing task-oriented teams to achieve specific organizational goals.

7. PROGRAMME DETAILS

Eligibility Criteria:

Candidates who have studied Bachelor's degree in relevant disciplines like B.Sc. in IT/CS/Mathematics/Statistics, and BCA from recognized university are eligible for this

programme (as specified in the admission guidelines given by the Directorate of Collegiate Education 2026-2027 www.tndce.tn.gov.in)

Duration of the Course:

M.Sc. Information Technology is a 2 years full time programme spread over four semesters.

8. EXAMINATION SCHEME

Scheme of Evaluation (THEORY): Core/Elective/ Skill Enhancement Courses
Total Marks:100 (Internal:25Marks, External:75Marks)

There is no Passing Minimum for the CIA component. But overall(CIA+ External), the student should get 50% or more to get a pass	
CIA-Internal Marks	**External Marks**
Average of best two tests from three: 15 Marks Assignment: 05 Marks Seminar: 05 Marks	End Semester Examination
Total: 25 Marks	Total : 75 Marks

Scheme of Evaluation (PRACTICAL): Core/ Skill Enhancement Course
Total Marks:100 (Internal:50Marks, External:50Marks)

There is no Passing Minimum for the CIA component. But overall(CIA+ External), the student should get 50% or more to get a pass	
CIA-Internal Marks	**External Marks**
Completion of Practical in time : 20Marks Model Practical Test : 20Marks Completion of Record work : 10 Marks	End Semester Practical Examination
Total: 50 Marks	Total: 50 Marks

Scheme of Evaluation (PROJECT)

Total Marks:100 (Internal:50Marks, External:50 Marks

There is no Passing Minimum for the CIA component. But overall(CIA+ External), the student should get 50% or more to get a pass	
CIA-Internal Marks	**External Marks**
Completion of Project in time : 10Marks Review Marks (3 reviews) : 30Marks Completion of Report work : 10Marks	End Semester Examination [Project Presentation and viva-voce]
Total: 50 Marks	Total: 50 Marks

Internship/Industrial visit/Field visit/Research Knowledge Updation Activity:

- A report should be submitted at the end of III semester and evaluated by external examiners.
- Students should submit certificate of attendance from the industry along with report.
- Internal – 50 Marks, External – 50 Marks (Total : 100 Marks)

Extension Activity :

- Outreach Activities / Conducting Virtual Presentations
  - Outreach Activities
    - Creating awareness of the usage of Computers in remote places
    - Performing any computer exhibition in a village
    - Conducting any type of awareness programmes using computers/ software
  - Conducting Virtual Presentations
    - Encourage the school students through some presentations
    - Conducting higher education awareness among school students using computers
- External examination will be conducted at the end of IV semester.
- Internal – 50 Marks, External – 50 Marks (Total : 100 Marks)

9. QUESTION PAPER PATTERN

External (End Semester) Examination Question Pattern

Time : 3 Hrs Max.Marks: 75

Part – A (15x1 = 15 Marks)
Answer all the questions
Fifteen Questions, Three objective type questions from each unit.
[Two questions from K1 category
Two questions from K2 category
Two questions from K3 category

Three questions from K4 category
Three question from K5 category
Three question from K6 category]

Part – B (5x4 = 20 Marks)
Answer all the questions
Five Questions, two short answer type questions from each unit with internal choice (Either.. or .. type)
[Unit -I questions from K1 category
Unit -II questions from K2 or K3 category
Unit -III questions from K4 category
Unit -IV questions from K5 category
Unit-V questions from K6 category]

Part – C (5x8 = 40 Marks)
Answer all the questions
Five Questions, two descriptive type questions from each unit with internal choice (Either.. or .. type)
[Unit -I questions from K1 category
Unit -II questions from K2 or K3 category
Unit -III questions from K4 category
Unit -IV questions from K5 category
Unit-V questions from K6 category]

NOTE:
In both Internal and External (End Semester) Examinations
40% of the questions should be from the Lower Order Thinking (K1, K2 & K3) category
60% of the questions should be from the Higher Order Thinking (K4, K5 & K6) category

10.MODEL QUESTION PAPER

Course: Python Programming

Time: 3 Hours **Max. Marks:** 75

PART – A (15 × 1 = 15 Marks)
Answer ALL the questions.

1. Which of the following is a valid identifier in Python? **(K1)**
   a) 2_variable
   b) var_2
   c) var-2
   d) break
2. What is the standard file extension used for Python modules? **(K1)**
   a) .py
   b) .pyc
   c) .mod
   d) .pyd
3. What does the type() function in Python return? **(K2)**
   a) The value of the object
   b) The memory address of the object
   c) The data type class of the object
   d) The size of the object
4. Which GUI widget is specifically designed to allow users to select only one option out of a predefined set? **(K2)**
   a) Check Button
   b) List Box
   c) Entry
   d) Radio Button
5. What is the output of the slice expression 'Python'[1:4]? **(K3)**
   a) Pyth
   b) yth
   c) ytho
   d) ythn
6. Consider a dictionary data = {'a': 1, 'b': 2}. Which method will completely empty this dictionary to leave it as {}? **(K3)**
   a) data.remove()
   b) data.pop()
   c) data.clear()
   d) data.delete()
7. Analyze the following code snippet and identify what it outputs: **(K4)**

```
def check(x=[]):
    x.append(1)
    return x
print(check(), check())
```

a) [1] [1]
b) [1] [1, 1]
c) [1, 1] [1, 1]
d) Error

8. Evaluate the cause of a TypeError exception in Python when handling class properties. Which scenario triggers it? **(K4)**
   a) Accessing an unassigned local variable
   b) Attempting to concatenate a string with an integer
   c) Importing a module that does not exist
   d) Accessing a dictionary key that isn't present
9. Review the execution of the following MongoDB statement: db.collection.delete_many({"status": "inactive"}). What is the precise consequence if no documents match the criteria? **(K4)**
   a) The operation throws a critical runtime database exception
   b) The entire collection is cleared as a safety fallback
   c) The command executes successfully returning a deleted count of 0
   d) The MongoDB server automatically restarts the collection session
10. Critique the design of a GUI application where a long-running computation is bound directly to a Tkinter Button command without threading. What is the primary architectural flaw? **(K5)**
    a) The button will automatically duplicate itself
    b) The UI main loop freezes, making the interface completely unresponsive
    c) The background computation will execute twice
    d) Tkinter converts the application automatically into a web page
11. Deduce the primary performance benefit of implementing a Recursive function with a base case over a traditional loop for processing nested mathematical expressions. **(K5)**
    a) It consumes significantly less stack memory
    b) It simplifies the tracking of state across deeply branch-dependent structures
    c) It guarantees execution in $O(1)$ constant time complexity
    d) It eliminates the need for any internal variable scope
12. Suppose you are assessing a MongoDB script designed to modify document traits. Assess which deployment strategy is ideal to update a single user's email without overwriting their entire profile record. **(K5)**
    a) db.users.update_one({"id": 1}, {"email": "new@email.com"})
    b) db.users.replace_one({"id": 1}, {"email": "new@email.com"})
    c) db.users.update_one({"id": 1}, {"$set": {"email": "new@email.com"}})
    d) db.users.insert_one({"email": "new@email.com"})
13. Design a minimal Python statement structure using functional programming tools (filter and lambda) that constructs a new list containing only even values extracted from an initial list called numbers. **(K6)**
    a) list(filter(lambda x: x % 2 == 0, numbers))
    b) filter(lambda x: x / 2 == 0, numbers)
    c) list(map(lambda x: x % 2 == 0, numbers))
    d) [lambda x: x % 2 == 0 for x in numbers]

14. Formulate the correct configuration code sequence to establish a functioning vertical Scrollbar attached perfectly to a Text widget layout in a Python GUI environment. **(K6)**
    a) Bind scrollbar to text pack without cross-linking commands
    b) Set text['yscrollcommand'] = scrollbar.set and scrollbar['command'] = text.yview
    c) Set text['command'] = scrollbar.yview and scrollbar['yscrollcommand'] = text.set
    d) Define both objects into separate frames without layout managers
15. Formulate a dynamic Python structure to generate custom instances of exceptions. How do you properly define a user-defined exception named ValueTooLowError? **(K6)**
    a) class ValueTooLowError:
    b) def ValueTooLowError(Exception):
    c) class ValueTooLowError(Exception): pass
    d) ValueTooLowError = new Exception()

PART – B (5 × 4 = 20 Marks)
Answer ALL the questions, choosing EITHER (a) OR (b).

16. a) Define Python identifiers. State the fundamental syntax rules used to name variables. **(K1)**
    OR
    b) Enumerate the built-in numeric data types supported in Python with clear examples for each. **(K1)**
17. a) Explain how formal arguments and variable-length arguments (*args and kwargs) are processed during a function call. **(K2)**
    OR
    b) Demonstrate the application of Python sets. Provide a small code snippet showing union, intersection, and difference operations. **(K3)**
18. a) Analyze the mechanism of namespaces in Python. Distinguish between local, global, and built-in namespaces when an import happens. **(K4)**
    OR
    b) Break down the handling of runtime anomalies using try, except, and finally blocks. Trace the flow when an exception arises. **(K4)**
19. a) Compare the UI design roles of a Frame widget versus a standalone layout container. Evaluate how nesting widgets in a frame optimizes application layouts. **(K5)**
    OR
    b) Assess the operational differences between using a Label widget and an Entry widget when validating direct alphanumeric user inputs. **(K5)**
20. a) Formulate a Python function that hooks up to a local MongoDB system, targets a collection, and executes an operation to alter matching attributes. **(K6)**
    OR
    b) Construct a custom Python script that performs a complete DELETE routine on a specific MongoDB target table/collection based on user inputs. **(K6)**

PART – C (5 × 8 = 40 Marks)
Answer ALL the questions, choosing EITHER (a) OR (b).

21. a) Write a comprehensive essay explaining standard type operators and built-in functions available for processing Python objects. **(K1)**
    OR
    b) Give a detailed account of structural control flow in Python. Describe conditional constructs and loop systems (for and while) with syntax and flowcharts. **(K1)**
22. a) Differentiate between mapping types (Dictionaries) and sequence types (Lists/Tuples). Explain their built-in operations, mutability factors, and internal storage features. **(K2)**
    OR
    b) Implement a complete, modular Python program that utilizes recursion to calculate the Fibonacci sequence up to N terms. Trace its execution stack for N=5. **(K3)**
23. a) Analyze the main pillars of Object-Oriented Programming (Encapsulation, Inheritance, and Polymorphism) within Python. Provide a clear code architecture illustrating these behaviors. **(K4)**
    OR
    b) Investigate the module import mechanism in Python. Analyze what happens internally when using import module versus from module import item, highlighting impacts on memory and names. **(K4)**
24. a) Critique the visual layout below. Appraise how to combine Menus, List Boxes, Buttons, and Scroll Bars to build an efficient, accessible user system. **(K5)**
    OR
    b) Appraise the utility of interactive selection tools (Check Buttons, Radio Buttons, and Scale sliders). Justify their placement configurations inside desktop database front-ends. **(K5)**
25. a) Devise a fully working Python program that establishes a live connection with a MongoDB instance, builds a collection, and runs sequential INSERT and READ CRUD workflows. **(K6)**
    OR
    b) Synthesize an end-to-end Python script that integrates a Tkinter Graphical User Interface with a backend MongoDB database to register new user profiles via input entries. **(K6)**

11.ENTIRE PROGRAMME STRUCTURE

FIRST YEAR

Semester-I

Specification	Courses	Credits	No. of Hours
Core – I	Mathematical Foundation for Information Technology	4	4
Core – II	Python Programming	4	4
Core – III	Java with Networking	4	4
Core – IV [LAB]	Python Programming – Practical	3	5
Core – V [LAB]	Java with Networking– Practical	3	5
Elective – I	Distributed Operating System / Green Computing / Human Computer Interaction	3	4
Elective – II	Data Communication & Networking / Block Chain Technology / Internet of Things and its Applications	3	4
		24	**30**

Semester-II

Specification	Courses	Credits	No. of Hours
Core – VI	Relational Database Management System	4	4
Core – VII	Data Structures and Algorithms	4	4
Core – VIII [LAB]	RDBMS - Practical	3	5
Core – IX [LAB]	Data Structures and Algorithms - Practical	3	5
Elective – III	Compiler Design / Intelligent Systems / Distributed and Cloud Computing	3	4
Elective – IV	Software Project Management / Software Testing / Object Oriented Analysis and Design	3	4
Skill Enhancement Course – I	Open Source Technologies	3	4
		23	**30**

SECOND YEAR

Semester – III

Specification	Courses	Credits	No. of Hours
Core – X	R Programming	4	4
Core – XI	Research Methodology	4	4
Core – X1I	Wireless Networks and Mobile Computing	4	4
Core – XIII [LAB]	Data Analytics using R - Practical	3	5
Core – XIV [LAB]	Mini Project	3	5
Elective – V	Cryptography & Network Security / Big Data Analytics / Robotics and its Applications	3	4
Skill Enhancement Course – II	Soft Computing	3	4
	Internship	2	-
		26	**30**

Semester-IV

Specification	Courses	Credits	No. of Hours
Core – XV	Project with Viva Voce	16	30
	Extension Activity	1	-
		17	**30**

Total Credits : 90

Project : Individual Project report should be submitted at the end of IV semester for external evaluation. Internal – 50 Marks, External – 50 Marks (Total 100 Marks). The internal marks should be given based on the presentation of three reviews(0^{th} review -10 Marks, 1^{st} review – 10 Marks, 2^{nd} review – 10 Marks) and the performance assessment of the guide (Project completion in time 10 Marks and Report 10 Marks).

12. COURSE – PSO MAPPING

Title of the course	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total score
Mathematical Foundation for Information Technology	1	3	3	1	0	2	1	11
Python Programming	1	3	2	2	0	3	1	12
Java with Networking	1	3	2	2	0	3	1	12
Python Programming – Practical	1	3	2	2	0	3	1	12
Java with Networking– Practical	1	3	2	2	0	3	1	12
Distributed Operating System	1	3	3	2	0	3	1	13
Green Computing	2	3	2	2	3	3	1	16
Human Computer Interaction	1	3	3	1	3	2	0	13
Data Communication & Networking	1	3	3	2	1	3	0	13
Block Chain Technology	1	3	3	2	3	3	1	16
Internet of Things and its Applications	1	3	2	1	1	3	0	11
Relational Database Management System	1	3	2	1	1	3	0	11
Data Structures and Algorithms	1	3	3	1	0	3	0	11
RDBMS - Practical	0	2	1	1	1	3	0	8
Data Structures and Algorithms - Practical	0	2	1	1	0	3	0	7
Compiler Design	1	3	3	1	0	3	0	11
Intelligent Systems	1	3	3	1	0	3	0	11
Robotics and its Applications	1	3	2	1	2	3	0	12
Software Project Management	2	3	2	2	2	3	3	17
Software Testing	1	3	2	2	1	3	2	14
Object Oriented Analysis and Design	1	3	2	1	0	3	1	11
Open Source Technologies	1	2	1	1	1	3	0	9
R Programming	1	3	3	1	0	3	0	11
Research Methodology	2	3	3	2	3	3	0	16

Wireless Networks and Mobile Computing	1	3	2	1	1	3	0	11
Data Analytics using R - Practical	1	3	2	1	0	3	0	10
Mini Project	2	3	2	2	1	3	2	15
Cryptography & Network Security	1	3	3	1	2	3	0	13
Big Data Analytics	1	3	3	1	1	3	0	12
Distributed and Cloud Computing	1	3	2	1	0	3	0	10
Soft Computing	1	3	3	1	1	3	0	12
Internship	2	3	2	3	2	3	3	18
Project with Viva Voce	3	3	3	3	2	3	3	20
Extension Activity	2	2	2	3	3	2	2	16
Total score of all courses contributing to PSO	40	98	79	52	35	99	24	427

Each Course has to address a minimum of 4 PSOs

Level of contribution of the Course towards attaining PSOs

0 – No Contribution 1 – Low Level 2 – Medium Level 3 – High Level

13. DETAILED SYLLABUS

Title of the Course	**MATHEMATICAL FOUNDATION FOR INFORMATION TECHNOLOGY**									
Category	CORE			**Paper Number**			CORE I			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	I	4	4	25	75	100
Course Outline	**UNIT I : MATRIX ALGEBRA** Matrices - Rank of a matrix - Solving system of equations - Eigenvalues and Eigenvectors - Cayley - Hamilton theorem - Inverse of a matrix.									
	UNIT II : BASIC SET THEORY Basic definitions - Venn diagrams and set operations - Laws of set theory -. Relations - Properties of relations - Matrices of relations - Closure operations on relations - Functions - Injective, subjective and objective functions-Hermitian and Unitary operators/matrices.									
	UNIT – III : COMBINATORICS Review of Permutation and Combination - Mathematical Induction - Pigeon hole principle - Principle of Inclusion and Exclusion									

	UNIT IV : MATHEMATICAL LOGIC Propositions and logical operators -Truth table - Propositions generated by a set - Equivalence and implication -Basic laws - Some more connectives - Functionally complete set of connectives - Normal forms - Proofs in propositional calculus – Predicate calculus
	UNIT V : GRAPH THEORY: Graphs: An Introduction, Special Graphs, Subgraph, Degree of a Vertex – The Concept, Given a Degree Sequence –How to Draw the Graph? Adjacency Matrices, Incidence Matrices, Isomorphism of Graphs, Paths and Circuits, Euler Paths, Hamiltonian Circuit, the Travelling Salesman Problem, Shortest Path Problem
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB /NET / UGC – CSIR / GATE / TNPSC/others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. J.P Trembley, R. Manohar, "Discrete Mathematical structures with applications to Computer Science", Tata McGrawHill publications, 2017 2. Seymour Lipschutz, Marc Lipson, "Discrete Mathematics", Revised Third Edition, Schaum's Outline Series, Tata McGraw Hill Publications, 2002. 3. John Vince, "Foundation Mathematics for Computer Science, A Visual Approach", Springer, 2015. 4. Jayant Ganguly, "Mathematical Foundations for Computer Science Engineers", PHI, 2011
Reference Books	1. K. Trivedi, "Probability and Statistics with Reliability, Queuing, and Computer ScienceApplications", Wiley, 2016. 2. M. Mitzenmacher and E. Upfal, "Probability and Computing: Randomized Algorithms andProbabilistic Analysis", Cambridge University Press, 2005. 3. Alan Tucker, "Applied Combinatorics", 6th Edition, Wiley 2012.
Website and e-Learning Source	https://nptel.ac.in/courses/106/106/106106183/ https://nptel.ac.in/courses/111/105/111105035/ https://nptel.ac.in/courses/111/102/111102133/ https://nptel.ac.in/courses/106/103/106103015/

CO	Bloom's Level	Course Outcome Statement
CO1	**K1 & K2**	**Recall and Explain:** Define matrix rank, Cayley-Hamilton theorem, basic set operations, types of functions, Pigeon hole principle, propositional connectives, and basic graph definitions (degrees, subgraphs).
CO2	**K3**	**Apply:** Compute the inverse of a matrix, solve system of equations, find closures of relations, apply Mathematical Induction and the Principle of Inclusion-Exclusion, and construct truth tables.

CO3	**K4**	**Analyze:** Determine eigenvalues/eigenvectors, analyze whether matrices are Hermitian/Unitary, simplify logical statements using normal forms, and analyze graphs for Euler/Hamiltonian circuits and isomorphism.
CO4	**K5 & K6**	**Evaluate & Create:** Evaluate and formulate solutions for complex networking/routing scenarios using the Shortest Path and Travelling Salesman algorithms, and assess the validity of proofs in predicate calculus.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	1	1	1	1
CO2	2	2	3	2	1	2	1
CO3	2	3	2	2	1	2	1
CO4	3	3	3	3	2	2	2
Total Score	9	9	9	8	5	7	5

CO-PSO Mapping

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	2	1	2	1
CO2	2	3	2	2	1	3	2
CO3	3	3	3	2	1	2	2
CO4	3	3	3	3	2	3	3
Total Score	10	11	9	9	5	10	8

Title of the Course	**PYTHON PROGRAMMING**									
Category	CORE			**Paper Number**			CORE II			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	I	4	4	25	75	100
Course Outline	**UNIT-I : Core Python:** Introduction - Python Basics: Comments -Statements and syntax - variable Assignment - Identifiers - **Python objects :** Built-in-types - Internal types - Standard Type operators - Standard type Built-in-functions. **Numbers :** Introduction to Numbers - Integers - Floating point numbers - Complex numbers - Operators - Built-in and factory functions –Conditionals and Loops **-Sequences :** Strings, Lists and Tuples									
	UNIT-II : Mapping and set types.- **Functions and functional programming**: Introduction - Calling functions - Creating functions - passing functions - Formal arguments - Variable - Length Arguments - Functional Programming - Variable Scope – Recursion									

	UNIT-III : Modules: Modules and Files – name spaces - Importing Modules - Features - Built-in functions. Object Oriented Programming: Introduction - Object Oriented Programming – Encapsulation - Inheritance –Polymorphism - Errors and Exceptions: Introduction – Exceptions in Python.
	UNIT-IV : GUI Programming: Introduction – **Using Widgets**: Core widgets- Generic widget properties – Labels – Buttons – Radio Buttons – Check Buttons – Text – Entry – List Boxes – Menus –Frame – Scroll Bars – Scale
	UNIT-V: Database Programming: Connecting to a database using MongoDB - Creating Tables - INSERT-UPDATE - DELETE - READ operations.
Reference Books	1. Mark Lutz, (2013), "Learning Python Powerful Object Oriented Programming", O"reillyMedia, 5 th Edition. 2. Timothy A. Budd, (2011), "Exploring Python", Tata MCGraw Hill Education PrivateLimited, First Edition. 3. Allen Downey, Jeffrey Elkner, Chris Meyers, (2012), "How to think like a computerscientist: learning with Python"
Website and e-Learning Source	1. http://interactivepython.org/courselib/static/pythonds 2. http://www.ibiblio.org/g2swap/byteofpython/read/ 3. http://www.diveintopython3.net/ 4. http://docs.python.org/3/tutorial/index.html

CO	Bloom's Level	Course Outcome Statement
CO1	**K1 & K2**	**Recall and Explain:** Understand Python variables, numbers, strings, lists, tuples, dictionaries, set types, module namespaces, OOP concepts, core Tkinter/GUI widgets, and MongoDB connection basics.
CO2	**K3**	**Apply:** Implement flow control (loops and conditionals), pass variable-length arguments to functions, deploy recursive techniques, import/create modules, and build simple interfaces with buttons and labels.
CO3	**K4**	**Analyze:** Differentiate structural components of an OOP application, analyze scope chains, and diagnose/handle runtime errors using try-except blocks.
CO4	**K5 & K6**	**Evaluate & Create:** Appraise factory functions, build complex data structures, and create multi-layered database applications capable of full CRUD (Create, Read, Update, Delete) execution via a GUI.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	2	1	1	2
CO4	3	3	3	3	2	3	3
Total Score	10	9	9	9	5	8	8

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	2	1	3	1
CO2	2	3	2	2	1	3	2
CO3	2	3	3	2	1	2	2
CO4	3	3	3	2	2	3	3
Total Score	9	11	9	8	5	11	8

Title of the Course					**JAVA WITH NETWORKING**					
Category		CORE		**Paper Number**		CORE III				
Course Code							**Inst.**	**Marks**		
	L	**T**	**P**	**Year**	**Semester**	**Credits**	**Hours**	**CIA**	**External**	**Total**
	4	0	0	I	I	4	4	25	75	100

Course Outline

UNIT-I :
The Genesis of Java: Java‟s Magic, The Java Buzzwords-An Overview of Java - Data types, Variables, Arrays-Operators-Control Statements- Introducing Classes – A Close Look at Methods and Classes-Inheritance

UNIT-II :
String Handling Functions – Collections Framework: Collection Classes, String Tokenzier, Date, Calendar - Abstract Classes - Packages and Interfaces: Packages – Access Protection Importing Packages – Interfaces

UNIT-III :
Exception Handling: Exception types – Creating your own exceptions -Multithreaded Programming: Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Inter-thread Communication, Suspending, Resuming and Stopping Threads – JDBC

UNIT-IV :
The Applet Class-Event Handling – Introducing the AWT: Working with windows, graphics and Text, Using AWT Controls, Layout Managers and Controls - Developing Java Server Pages

UNIT-V:
Developing Servlets -Structuring Web application with the MVC pattern – Sessions and Cookies - Using JSP tags with JavaBeans

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Herbert Schildt, (2004), "Java 2: The Complete Reference", Fifth Edition,Tata McGraw Hill,New Delhi. 2. Joel Murach, (2008), "Andrea Steelman,,Murach"s Java Servlets and JSP", Second Edition,Shroff Publishers
Reference Books	1. Matthew Mac Donald, (2002), "ASP.NET : The Complete Reference", MC Graw Hill. 1. VladaMatena, (2003), "Applying Enterprise JavaBeans", Second Edition, Addison Wesley. 2. Cay S Horstmann& Gary Cornell, Core Java Vol II Advanced Features, Eighth Edition,Addison Wesley. 3. Bruce W Perry (2004), Java Servlets & JSP Cook Book, Second edition, O"reilly Media.
Website and e-Learning Source	1. http://netbeans.org/kb/docs/javaee/javaee-intro.html 2. http://www.jsptube.com/ 3. http://articles.sitepoint.com/article/java-servlets-1 4. http://www.java-tips.org/java-tutorials/tutorials/introduction-to-java-servlets-with-netbeans.html 5. http://download.oracle.com/javase/tutorial/javabeans/index.html

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	**Recall and Explain:** Detail the Java buzzwords, class structures, standard collection frameworks, string handling structures, Thread attributes, Applet/AWT controls, and fundamental servlet lifecycle methods.
CO2	K3	**Apply:** Build simple application workflows using primitive operators, encapsulate modular functionality via packages/interfaces, write custom exception try-catch blocks, and position GUI elements using layout managers.
CO3	K4	**Analyze:** Deconstruct complex code relationships utilizing hierarchical abstract inheritance, test multi-threaded code paths for proper synchronization, and trace state transfers between client-side cookies and server-side sessions.
CO4	K5 & K6	**Evaluate & Create:** Assemble interactive web-based software architectures adhering to Model-View-Controller patterns that fetch relational database content utilizing Java Database Connectivity.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	1	1	2	1
CO2	2	2	2	2	1	2	1
CO3	2	3	2	2	1	2	1
CO4	3	3	3	3	2	3	2
Total Score	9	9	8	8	5	9	5

CO-PSO Mapping

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	2	1	3	1
CO2	2	3	2	2	1	3	2
CO3	3	3	3	2	1	2	2
CO4	3	3	3	3	2	3	3
Total Score	10	11	9	9	5	11	8

Title of the Course			**PYTHON PROGRAMMING - PRACTICAL**						
Category		CORE	**Paper Number**			CORE IV			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	0	0	5	I	I	3	5	50	50	100

Course Outline	1. Python Basic programs 2. Control Structures 3. Lists 4. Functions and Recursions 5. Modules 6. String Processing 7. Dictionaries and Sets 8. Classes and Objects 9. Polymorphism 10. Inheritance 11. GUI Application 12. Working with Database
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text	Wesley J. Chun, (2007), "Core Python Programming", Pearson Education, Second Edition –
Reference Books	1. Mark Lutz, (2013), "Learning Python Powerful Object Oriented Programming", O"reillyMedia, 5 th Edition. 2. Timothy A. Budd, (2011), "Exploring Python", Tata MCGraw Hill Education PrivateLimited, First Edition. 3. Allen Downey, Jeffrey Elkner, Chris Meyers, (2012), "How to think like a computerscientist: learning with Python"
Website and e-Learning Source	1. http://interactivepython.org/courselib/static/pythonds 2. http://www.ibiblio.org/g2swap/byteofpython/read/ 3. http://www.diveintopython3.net 4. http://docs.python.org/3/tutorial/index.html

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	**Recall and explain** fundamental Python concepts, including basic programming syntax, control structures, collection types (lists, dictionaries, sets), functions, modules, string processing, and the core tenets of object-oriented programming.
CO2	K3	**Apply** Python programming constructs to develop modular scripts, utilizing iterative structures, recursive functions, custom modules, and sequence manipulation techniques to solve computational problems.
CO3	K4	**Analyze** and deconstruct complex software requirements to design structured object-oriented solutions implementing class hierarchies, inheritance, and polymorphic relationships.
CO4	K5 & K6	**Evaluate** program execution pathways and **create** full-stack desktop software architectures by integrating interactive Graphical User Interfaces (GUIs) with robust database connectivity.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	2	1	2	1
CO2	2	2	2	2	1	2	2
CO3	3	3	2	2	1	2	2
CO4	3	3	3	3	2	3	3
Total Score	10	9	8	9	5	9	8

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	2	1	3	1
CO2	2	3	2	2	1	3	2
CO3	2	3	3	2	1	2	2

CO4	3	3	3	2	2	3	3
Total Score	9	11	10	8	5	11	8

Title of the Course		JAVA WITH NETWORKING – PRACTICAL							
Category		CORE		**Paper Number**		CORE V			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	0	0	5	I	I	3	5	50	50	100

Course Outline

1. Write a program to create a JTable.
2. Convert an image in RGB to a grayscale image.
3. Count number of access times of the servlet page.
4. Write a program to display a string in frame window with pink color as background.
5. Create chat application using either TCP or UDP protocol.
6. Implement TCP Server for transferring files using Socket and Server Socket.
7. Implement Student information system using JDBC and RMI.
8. Create Servlet file and study web descriptor file.
9. Write a program to design simple calculator with the use of Grid Layout.
10. Create login form and perform state management using Cookies, HTTP Session and URL Rewriting.
11. Write an Applet which will lay two sound notes in a sequence continuously use the play () methods available in the applet class and the methods in the audio clip interface.
12. Write a program to demonstrate the use of InetAddress class and its factor methods.
13. Create Servlet file which contains following functions:
    1. Connect 2. Create Database 3. Create Table
    4. Insert Records into respective tables
    5. Update records of particular table in database
    6. Delete Records from table.
    7. Delete table and also database
14. Develop Simple Servlet Question Answer Application using Database
15. Develop simple shopping cart application using EJB [Stateful Session Bean].

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Java the Complete Reference, ninth edition by Herbert Schild, Publisher: McGraw Hills

Reference Books	**1.** Head First EJB 3.0 by Kathy Sierra, Bert Bates, Publisher: O'Reilly Media **2.** Head First Servlets and JSP by Bryan Basham, Kathy Sierra & Bert Bates, Publisher: O'Reilly Media **3.** Just Hibernate, A Lightweight Introduction to the Hibernate Framework by Madhusudhan Konda, Publisher: O'Reilly Media **4.** Programming Jakarta Struts, 2nd Edition by Chuck Cavaness, Publisher: O'Reilly Media
Website and e-Learning Source	https://nptel.ac.in/courses/106/105/106105191/ https://onlinecourses.nptel.ac.in/noc19_cs84/preview

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	**Recall and explain** the architecture of Java web components, servlet lifecycle methods, deployment descriptors, network programming concepts (TCP/UDP, InetAddress), RMI registry, AWT/Swing GUI hierarchies, and Enterprise JavaBeans (EJB) structures.
CO2	K3	**Apply** Java networking, GUI, and web APIs to build applications, including configuring layout managers, rendering images in grayscale, invoking audio playback, performing basic socket communication, and managing database connections.
CO3	K4	**Analyze** execution workflows and data transmission pathways to trace state management techniques (Cookies, HTTP Session, URL Rewriting), track page hit metrics, deconstruct RMI middleware configurations, and examine TCP file transfer protocols.
CO4	K5 & K6	**Evaluate** multi-tier architectures and **create** full-featured, secure enterprise applications such as desktop chat engines, question-answer engines, student information systems, and transactional shopping carts using JDBC, Servlets, and Stateful Session EJBs.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	2	1	2	1
CO2	2	2	2	2	1	2	2
CO3	3	3	2	2	1	2	2
CO4	3	3	3	3	2	3	3
Total Score	10	9	8	9	5	9	8

CO-PSO Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	2	1	3	1
CO2	2	3	2	2	1	3	2
CO3	2	3	3	2	1	2	2
CO4	3	3	3	2	2	3	3

Total Score	9	11	10	8	5	11	8

Title of the Course					DISTRIBUTED OPERATING SYSTEM					
Category		Elective		**Paper Number**			ELECTIVE I A			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	I	3	4	25	75	100

Course Outline

UNIT – I

Fundamentals: What is Distributed Operating System? – Evolution of Distributed Computing System – Distributed Computing System Models – Why are Distributed Computing Systems gaining popularity? – What is a Distributed Computing System? – Issues in Designing Distributed Computing System – Introduction to Distributed Computing Environment (DCE). Computer Networks: Introduction– Network Types – LAN Technologies–WAN Technologies– Communication Protocols – Internetworking – ATM Technology.

UNIT - II

Message Passing: Introduction –Desirable features of Good Message Passing System – Issues in IPC Message Passing – Synchronization – Buffering – Multi datagram Messages – Encoding and Decoding of Message Data– Process Addressing – Failure Handling – Group Communication

UNIT - III

Remote Procedure Calls : Introduction– The RPC Model – Transparency of RPC– Implementing RPC mechanism–Stub Generation–RPC Messages–Marshaling Arguments and Results– Server Management– Parameter Passing Semantic–Call Semantics– Communication Protocol for RPC's – Complicated RPC's –Client Server Binding–Exception Handling–Security–Some Special Types of RPC's –RPC in Heterogeneous Environments – Light weight RPC. Distributed Shared Memory: Introduction – General Architecture of DSM Systems – Design and Implementation Issues of DSM – Granularity – Structure of Shared Memory – Consistency Models – Replacement Strategy – Thrashing–Other Approaches to DSM– Heterogeneous DSM –Advantages of DSM.

UNIT – IV

Synchronization: Introduction – Clock Synchronization – Event Ordering – Mutual Exclusion – Deadlock – Election Algorithms. Process Management: Introduction-Process Migration– Threads.

UNIT – V

Distributed File System: Introduction – Desirable features of a Good Distributed File System– File Models – File Accessing Models – File

	Sharing Semantics – File Caching Schemes – File Replication – Fault Tolerance – Atomic Transactions – Design Principles.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Full details about the operating system and its usage in the computers
Recommended Text	1. Pradeep K Sinha,"Distributed Operating Systems", PHI Learning, 2012. 2. Andrew S Tanenbaum, "Distributed Operating Systems", First Edition, PHI 2002
Reference Books	1. George Coulouris, Gordon Blair, Jean Dollimore, Tim Kindberg, "Distributed Systems - Concepts and Design", Fifth Edition Pearson 2017. 2. Manish Varshney, Shanoo Agarwal, "Concepts Of Distributed System", CBS Publisher and Distributors, 2016.

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	**Recall and explain** the fundamental concepts of Distributed Operating Systems, hardware/networking technologies, message-passing IPC mechanisms, RPC architectures, Distributed Shared Memory (DSM) topologies, synchronization protocols, process/thread models, and distributed file systems.
CO2	K3	**Apply** core distributed algorithms, message synchronization methods, argument marshaling, client-server binding protocols, thread execution pathways, and file caching schemes to simulate reliable communication and resource management in a network environment.
CO3	K4	**Analyze** design complexities across distinct modules to debug synchronization issues, identify system-level deadlocks, contrast shared memory consistency models, trace process migration workflows, and evaluate file replication semantics for system consistency.
CO4	K5 & K6	**Evaluate** the critical trade-offs between system performance and structural fault tolerance, and **formulate** holistic architecture solutions for secure, scalable distributed networks utilizing optimal clock synchronization, leader election, and atomic file transaction designs.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	2	1	2	1
CO2	2	2	2	2	1	2	2
CO3	3	3	2	2	1	2	2
CO4	3	3	3	3	2	3	3

Total Score	10	9	8	9	5	9	8

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	2	1	3	1
CO2	2	3	2	2	1	3	2
CO3	2	3	3	2	1	2	2
CO4	3	3	3	2	2	3	3
Total Score	9	11	10	8	5	11	8

Title of theCourse	**GREEN COMPUTING**								
Category	Elective		**Paper Number**		ELECTIVE I B				
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	4	0	0	I	I	3	4	25	75	100
Course Outline										
	UNIT I: Green Computing and Saving Money: Key Concepts –Getting Focused on Money- Saving Efforts – Implementing Energy Efficiency – Changing How Current Devices Are Used – Moving to Cloud Services – Digitizing Non-IT Functions – Greening Your Energy-Saving Moves – Some Big Thinking About Money- Saving Efforts. Green Computing and the Environment: Key Concepts –Environmental Drivers for Green Computing –Green Agenda– Key Roots of Environmentalism – Environmentalism and IT – The New Imperative of Climate Change – A Brief History of the Climate and Climate Change – The 2°C Warming "Limit" – Climate Change and IT –Next with Climate Change – What It Means to "Go Green"									

	UNIT II: A New Vision of Computing: Key Concepts – Cloud Computing Emerges – The End of the PC Era – Some New- Model IT –Challenges – A Few Examples from a Multinational – How a Company Adopted the iPhone – A Mental Model for IT Simplicity – Why Green Computing Fits the New Model – Disadvantages of Cloud Computing – Managing Disadvantages of Cloud Computing – What to Do Besides Cloud Computing – Efficiency and Cloud Computing – Greenability and Cloud Computing – Responsibility, Usability, and Cloud Computing – The Philosophical Implications of Green Computing – The Zen of Green Computing. Building a Green Device Portfolio : Key Concepts – Introduction
	UNIT III: Green Servers and Data Centers: Key Concepts – Choosing and Creating Green Data Centers – Green Data Centers as a Model –The Last Shall Be First –Data Center Green – Building and Power Supply Considerations – Servers, Storage, and Networking – Data Center Suppliers 59 Saving Energy: Key Concepts – Saving Energy Serves Many Masters – Cost Savings through Energy Savings –Risk Reduction through Energy Savings – Carbon Footprint Reduction through Energy Savings – Improving Your Reputation and Brand – Why Energy Prices Will Stay High –Embodied Energy – Analyzing Your Energy Usage – A Recipe for Energy Savings –Understanding the Unique Energy Needs of IT – Focusing on Solar Power – Saving Energy and the Supply Chain – Energy-Saving Pilot Projects – Selling Energy Savings
	UNIT IV: Reducing Greenhouse Gas Emissions: Key Concepts – Why Greenhouse Gas Emissions Are Important – Sources and Sinks of Greenhouse Gases and Warming –Reducing Emissions I: Embodied Energy – Reducing Emissions II: Daily Energy Use –Reducing Emissions III: Taking Steps to Use Different Sources –Reducing Emissions IV: Supply Chain Success. Reducing Resource Use: Key Concepts – Resource Use Is Important – A Resource Use Checklist – Planned Obsolescence and Resource Use – The Story of Apple and EPEAT – Case Study: Computer Hardware and RSI

	UNIT V: Green Computing by Industry Segment: Key Concepts – Evaluating Greenness – The Newsweek – Green 500 Approach – Looking at Industry Segments – Analyzing Your Own Initiatives, Company, and Sector. The Future: Deep Green Computing: Key Concepts –Green Computing and the Future – Megatrends for Green Computing – An Increasing Need for Sustainability – The Continually Decreasing Cost of Core Computing Capabilities – The Ability of Computing to Do More and More Telepresence Instead of Travel – Telecommuting Instead of Commuting – Toward Deep Green Computing – Platforms for Deep Green Computing – Selling Deep Green Computing.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Green computing, Reducing Greenhouse Gas Emissions, Green Computing by Industry Segment, Green Servers and Data Centers
Recommended Text	Bud E. Smith, Green Computing Tools and Techniques for Saving Energy, Money and Resources, CRC Press, 2014.
Reference Books	1. TobyVelte, Anthony Velte, Robert Elsenpeter, Green IT, McGraw Hill, 2008. 2. AlvinGalea, Michael Schaefer, Mike Ebbers, Green Data Center: Steps for the Journey, Shroff Publishers and Distributers, 2011
Website and e-Learning Source	1. https://blogs.nvidia.com/blog/2022/10/12/what-is-green-computing 2. https://www.techtarget.com/searchdatacenter/definition/green-computing 3. https://www.techopedia.com/definition/14753/green-computing

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	**Recall and Explain:** Describe the fundamental drivers of green computing, environmental agendas, climate change impacts, the shift toward cloud services, and the basic principles of managing a green device portfolio across various organizational structures.
CO2	K3	**Apply:** Implement energy efficiency checklists, apply resource use minimization strategies, and deploy cloud-based or simplified IT models to optimize current hardware deployment and daily energy consumption patterns.
CO3	K4	**Analyze:** Deconstruct data center energy demands, evaluate supply chain efficiencies, analyze institutional carbon footprints, and examine greenhouse gas emission pathways (embodied vs. operational energy) across different industry segments.

CO4	K5 & K6	**Evaluate & Create:** Criticize existing organizational sustainability policies utilizing corporate benchmarks (like EPEAT or the Green 500) and formulate a comprehensive, deep green enterprise infrastructure plan incorporating telepresence, renewable energy options, and long-term sustainability models.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	2	2	1
CO2	2	2	2	2	1	2	2
CO3	2	3	2	2	2	1	1
CO4	3	3	3	3	3	2	3
Total Score	10	9	8	9	8	7	7

CO-PSO Mapping

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	2	2	1	1
CO2	2	3	2	2	2	3	2
CO3	2	3	3	2	2	2	2
CO4	3	3	3	3	3	3	3
Total Score	9	10	10	9	9	9	8

Title of the Course	**HUMAN COMPUTER INTERACTION**									
Category	Elective		**Paper Number**		ELECTIVE IC					
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	I	3	4	25	75	100

Course Outline

UNIT-I :
Foundations: The Human: Introduction-Input-Output Channels-Memory. The Computer: Introduction- Text Entry Devices-Display Devices- Memory. The Interaction: Introduction – Models of Interaction-Frameworks and HCI Ergonomics-Interaction Styles-Elements of the WIMP Interface-Interactivity - The Context of the Interactions

UNIT-II :
Design Process: Design Basics- Introduction - Process- User Focus-Scenarios-Navigation Design- Screen Design and Layout-Interaction and Prototyping. Design Rules-Introduction- Principles to Support Usability-Guidelines-Golden Rules and Heuristics-HCI Patterns

UNIT-III :

	Implementation Support: Introduction - Elements of Windowing Systems - Programming the Application- Using Toolkits-User Interface Management Systems. Evaluation Techniques: What is an Evaluation- Goal of Evaluation- Evaluation Through Expert Analysis-Choosing an Evaluation Method
	UNIT-IV : Universal Design: Introduction - Universal Design Principles-Designing for Diversity. User Support: Introduction-Requirements of User Support-Approaches to User Support-Adaptive Help Systems-Designing User Support Systems
	UNIT-V: Models: Cognitive Models: Introduction-Goals and Task-Linguistic Models-Challenge of Display Based System-Physical and Device Models - Cognitive Architectures
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Alan dix, Janet finlay, Gregory D. Abowd and Russell Beale,(2004),Human Computer Interaction, 3rd edition, Pearson Education
Reference Books	1. John C. Caroll, (2002), Human Computer Interaction in the new millennium, Pearson Education 2. Jenny Preece, Yvonne Rogers, Helen Sharp (2019), Interaction Design: Beyond Human–Computer Interaction,fifth edition, John Wiley & Sons Inc.
Website and e-Learning Source	1. http://courses.iicm.tugraz.at/hci/ 2. http://www.hcibook.com/hcibook/downloads/pdf/exercises.pdf 3. http://www.idemployee.id.tue.nl/g.w.m.rauterberg/lectures.html 4. http://user.medunigraz.at/andreas.holzinger/holzinger/paperse n/HCI/Workshop/forISSEP%2 02005.pdf 5. http://universaldesign.ie/What-is-Universal-Design/The-7-Principles/ (Unit IV**:** Universal Design Principles)

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	**Recall and Explain:** Describe human input-output channels, computer display and memory mechanics, interactive styles, WIMP interface elements, usability guidelines, golden rules, windowing system architectures, and the principles of universal design.

CO2	K3	**Apply:** Apply interaction design steps, navigation maps, screen layouts, prototyping strategies, UI toolkits, and adaptive help system frameworks to build user-centered application interface workflows.
CO3	K4	**Analyze:** Deconstruct interaction contexts using cognitive, task, and linguistic models, analyze interface usability through expert analytical evaluations, and examine user feedback patterns across diverse user requirements.
CO4	K5 & K6	**Evaluate & Create:** Critically evaluate interactive systems against established software ergonomics, design heuristics, and accessibility standards to architect integrated, universally usable interface management systems.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	2	2	1
CO2	2	2	2	2	1	2	2
CO3	2	3	2	2	1	2	1
CO4	3	3	3	3	3	2	2
Total Score	10	9	8	9	7	8	6

CO-PSO Mapping

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	2	2	1	1
CO2	2	3	2	2	2	3	2
CO3	2	3	3	2	2	2	2
CO4	3	3	3	3	3	3	3
Total Score	9	10	10	9	9	9	8

Title of the Course			**DATA COMMUNICATION AND NETWORKING**						
Category		Elective		**Paper Number**		ELECTIVE II A			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	4	0	0	I	I	3	4	25	75	100
Course Outline	**UNIT-I :** Uses of Computer Networks – Network Hardware – Line Configuration – Topology – Transmission Modes – **Reference Models:** OSI Reference Model – TCP/IP Reference Model –**Physical Layer:** Guided Transmission Media – Wireless Transmission – Communication Satellites – **Public Switched Telephone Network**: Local Loop – Multiplexing – Switching								

	UNIT-II : **Data Link Layer:** Design Issues - Error Detection and Correction - **Network Layer :** Design Issues – **Routing Algorithms** : Shortest Path Routing – Distance Vector Routing – Link State Routing – Broadcast Routing – Multicast Routing – Congestion Control
	UNIT-III : **Network Layer in the Internet:** IP Addresses –**Transport Layer:** Elements of Transport Protocols: Addressing – Connection Establishment – Connection Release – **Application Layer:** Domain Name System – **Email:** Architecture and Services
	UNIT-IV : **Network Security:** Introduction to Cryptography - Symmetric - Key Cryptography - Asymmetric- key Cryptography – Security Services: Message Confidentiality - Message Integrity – Message Authentication - Digital Signature - Entity Authentication – **Security in the Internet:** IPSecurity - SSL/TLS: SSL services - SSL Protocols - Firewalls
	UNIT-V: Security for Wireless Networks: Introduction – Protecting the wireless networks – Physical Security – Authentication and access control- Smartphone Security: Security Threats - Steps to smartphone security –Websites and Web application Security: Definition – Available Technologies - Threats – Strategies. Case Study: To study recent Wi -Fi and Smartphone technologies
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text J	1. Andrew S.Tanenbaum, David J. Wetherall (2010), Computer Networks, Prentice Hall of India, V Edition. (Unit I - Unit - III) Unit I – Chapter 1,2 Unit II – Chapter 3,5 Unit III – Chapter 5,6,7 2. Behrouz A. Forouzan, (2016), Data Communications and Networking, Tata McGraw-Hill Publishing Company Limited, IV Edition. (Unit IV) Unit IV - Chapter 30, 31, 32
References Books	1. Charle P. Shari Lawrence P fleeger, Security in Computing, 3rd Edition, Pearson Education. 2. James F. Kurose, Keith W Ross (2005), Computer Networking, 3rd Edition, Addison Wesley,. 3. William Stallings(2006), Cryptography and Network Security: Principles and Practice, 3rd Edition, PHI.

Website and e-Learning Source	1. http://wndw.net/pdf/wndw3-en/ch09-security-for-wireless-networks.pdf (Unit V- Wireless Networks Security) 2. https://www.fcc.gov/sites/default/files/smartphone_master_document.pdf (Unit V- Steps to smartphone security) 3. https://www.csoonline.com/article/3241727/mobile-security/6-mobile-security-threats-you- should-take-seriously-in-2019.html (Unit V – SmartPhone Security Threats) 4. https://kgk.uni-obuda.hu/sites/default/files/12_Kadena.pdf (Unit V – SmartPhone Security Threats) 5. https://www.goodfirms.co/glossary/web-security/ (Unit V – Web Security)

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamentals of computer networks, including network hardware, transmission media, network topologies, OSI and TCP/IP reference models, switching techniques, and basic cryptographic concepts.
CO2	K3	Apply networking concepts and protocols to configure routing techniques, error detection and correction methods, transport layer operations, DNS services, email architecture, and wireless network protection mechanisms.
CO3	K4	Analyze network layer operations, routing algorithms, congestion control methods, transport protocols, authentication mechanisms, SSL/TLS protocols, firewall operations, and security threats in wireless and web applications.
CO4	K5 & K6	Evaluate network security architectures and create secure communication solutions by integrating cryptographic techniques, IP security services, wireless security strategies, smartphone security practices, and modern web application protection mechanisms.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	2	1	2	1
CO4	3	3	3	3	2	2	2
Total Score	10	9	9	9	5	8	6

CO-PSO Mapping

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	2	2	1	1
CO2	2	3	2	2	2	3	2

CO3	2	3	3	2	2	2	2
CO4	3	3	3	3	3	3	3
Total Score	9	10	10	9	9	9	8

Title of the Course	**BLOCK CHAIN TECHNOLOGY**								
Category	Elective		**Paper Number**			ELECTIVE II B			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	4	0	0	I	I	3	4	25	75	100
Course Outline	**UNIT - I** History: Digital Money to Distributed Ledgers -Design Primitives: Protocols, Security, Consensus, Permissions, Privacy- : Block chain Architecture and Design-Basic crypto primitives: Hash, Signature- Hash chain to Block chain-Basic consensus mechanisms.								
	UNIT - II Requirements for the consensus protocols-Proof of Work (PoW)-Scalability aspects of Block chain consensus protocols**:** Permissioned Block chains-Design goals-Consensus protocols for Permissioned Block chains.								
	UNIT – III Decomposing the consensus process-Hyper ledger fabric components-Chain code Design and Implementation: Hyper ledger Fabric II:-Beyond Chain code: fabric SDK and Front End-Hyper ledger composer tool.								
	UNIT – IV Block chain in Financial Software and Systems (FSS): -Settlements, -KYC, -Capital markets-Insurance- Block chain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting								
	UNIT - V Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system / social welfare systems: Block chain Cryptography: Privacy and Security on Block chain								
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)								
Skills acquired from this course	Get the ideas to test the different software								

Recommended Text	1. Mark Gates, "*Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money*", Wise Fox Publishing and Mark Gates 2017. 2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "*Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer*", 2018. 3. Bahga, Vijay Madisetti, "*Block chain Applications: A Hands-On Approach*", Arshdeep Bahga, Vijay Madisetti publishers 2017.
Reference Texts	1. Andreas Antonopoulos, "*Mastering Bitcoin: Unlocking Digital Crypto currencies*", O'Reilly Media, Inc. 2014. 2. Melanie Swa, "*Block chain* ",O'Reilly Media 2014.
Web References	1. NPTEL & MOOC courses titled blockchain technology 2. blockgeeks.comguide/what-is-block-chain-technology https://nptel.ac.in/courses/106105184/

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamentals of blockchain technology, including distributed ledgers, blockchain architecture, cryptographic primitives, consensus mechanisms, permission models, privacy concepts, and Hyperledger Fabric components.
CO2	K3	Apply blockchain concepts and consensus protocols to implement Proof of Work mechanisms, permissioned blockchain models, chaincode development, Hyperledger Fabric SDK integration, and blockchain-based application workflows.
CO3	K4	Analyze the scalability, security, and consensus processes of blockchain systems, including decomposition of consensus mechanisms, permissioned blockchain protocols, smart contract implementation, and blockchain applications in finance and supply chain management.
CO4	K5 & K6	Evaluate blockchain-based solutions and create secure decentralized applications for government, financial, and supply chain systems by integrating cryptographic security, privacy mechanisms, digital identity management, and distributed record-keeping frameworks.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	2	1	2	1
CO4	3	3	3	3	2	2	2
Total Score	10	9	9	9	5	8	6

CO-PSO Mapping

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	2	2	1	1
CO2	2	3	2	2	2	3	2
CO3	2	3	3	2	2	2	2
CO4	3	3	3	3	3	3	3
Total Score	9	10	10	9	9	9	8

Title of the Course	**INTERNET OF THINGS AND ITS APPLICATIONS**								
Category	Elective		**Paper Number**		ELECTIVE II C				
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	4	0	0	I	I	3	4	25	75	100

Course Outline

UNIT-I :
Introduction to IoT - Introduction to Internet of Things: Introduction-Physical Design of IoT- Logical Design of IoT- IoT Enabling Technologies - IoT Levels & Deployment Templates

UNIT-II :
Domain Specific IoT: Introduction-Home Automation-Cities-Environment-Energy-Retail- Logistics-Agriculture-Industry-Health & Lifestyle. IoT and M2M: Introduction - M2M- Difference between IoT and M2M - SDN and NFV for IoT.

UNIT-III :
M2M to IoT- An Architectural Overview: Building an Architecture-Main design principles and needed capabilities-An IoT Architecture Outline-Standard Considerations. M2M and IoT Technology Fundamentals: Devices and Gateways-Local and wide area Networking-Data Management.

UNIT-IV :
IoT Architecture - Architecture Reference Model: Introduction-Reference Model and Architecture- IoT Reference Model: IoT Domain Model-Information Model-Functional Model- Communication Model-Safety, Privacy, Trust, Security Model IoT.

UNIT-V:
Implementation Examples: The Smart Grid-Introduction-Smart Metering-Smart House-Smart energy city. Case Study: Commercial Building automation today and in the future.

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach, Universities Press, 2015 (Unit I and II) 2. Jan Holler, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014 (Unit III, IV and V).
Reference Books	1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017 2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011.
Website and e-Learning Source	1. https://www.tutorialspoint.com/internet_of_things/ 2. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/ 3. https://www.slideshare.net/khusuma/domain-specific-iot(Unit-II) 4. https://www.slideshare.net/PascalBodin/an-introduction-to-m2m-iot-technologies(Unit -III) 5. https://www.smartgrid.gov/the_smart_grid/smart_grid.html

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamentals of Internet of Things (IoT), including IoT architecture, physical and logical design, enabling technologies, deployment models, M2M communication concepts, and IoT reference models.
CO2	K3	Apply IoT and M2M technologies to develop domain-specific IoT applications in areas such as home automation, smart cities, healthcare, agriculture, retail, logistics, and industrial systems using networking and data management techniques.
CO3	K4	Analyze IoT architectures, communication models, networking frameworks, gateways, security mechanisms, and data management processes to evaluate interoperability, scalability, and system

		integration requirements in IoT environments.
CO4	K5 & K6	Evaluate IoT solutions and create smart interconnected systems for energy management, smart metering, smart homes, smart cities, and commercial building automation by integrating IoT architectures, security models, and communication technologies.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	3	1	3	2
CO3	2	3	3	2	1	2	1
CO4	3	3	3	3	2	3	3
Total Score	10	9	10	10	5	10	7

CO-PSO Mapping

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	2	1	3	1
CO2	2	3	2	2	1	3	2
CO3	2	3	3	2	2	3	2
CO4	3	3	3	2	2	3	3
Total Score	9	11	9	8	6	12	8

Title of the Course	**RELATIONAL DATABASE MANAGEMENT SYSTEM**									
Category	CORE		**Paper Number**		CORE VI					
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	II	4	4	25	75	100
Course Outline	**UNIT-I : Introduction**: Database System Applications-Purpose of Database Systems-View of Data- Database Users and Administrators. **Relational Database**: Structure of Relational Databases- Databases Schema- Keys-Schema Diagrams-**Formal Relational Query Languages**: Relational Algebra-Tuple Relational Calculus									

	UNIT-II : Database Design: Overview of Design Process-The Entity Relationship Model-Constraints- Removing Redundant Attributes in Entity Sets-Entity-Relationship Diagrams-Reduction to Relational Schemas - Extended E-R features -Alternative Notations for Modeling Data**. Relational Database Design:** Features of Good Relational Design-Functional Dependency-**Normalization**: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF- Functional Dependency Theory
	UNIT-III : Transaction Management: Transaction Concept-Simple Transaction Model-Storage Structure- Transaction Atomicity and Durability-Transaction Isolation - Serializability. **Concurrency Control:** Lock Based Protocols-Locks-Granting of Locks-Two Phase Locking Protocol-Time Stamp Based Protocol - **Recovery System:** Failure Classification-**Recovery and Atomicity**: Log Records – Database Modification-Concurrency Control and Recovery-Recovery Algorithm
	UNIT-IV : Distributed Database: Homogeneous and Heterogeneous Databases-Distributed Data storage- Distributed Transactions-Commit Protocols-Concurrency Control in Distributed Databases- Distributed Query Processing. Case study: MongoDB
	UNIT-V: SQL - Table Fundamentals - Viewing Data - Inserting -Deleting - Updating - Modifying - Constraints - Functions – Grouping - Subqueries - Joins – Views. **PL/SQL**: Introduction - PL/SQL Block -Data Types And Variables - Control Structure -Cursors - PL/SQL Security - Locks. PL/SQL Database Objects: Exception Handling-Packages - Procedures and Functions - Database Triggers
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamental concepts of database systems, relational databases, database design principles, transaction management, distributed databases, SQL, and PL/SQL structures and commands.
CO2	K3	Apply relational database concepts, normalization techniques, transaction managem distributed database operations, and SQL/PL/SQL commands to solve database-rel
CO3	K4	Analyze database design models, functional dependencies, normalization processes, concurrency control mechanisms, recovery techniques, distributed database architectures, and SQL query structures for efficient database implementation.

CO4	K5 & K6	Evaluate and design database solutions using advanced normalization, transaction processing, distributed database techniques, SQL/PL/SQL programming, procedures, functions, triggers, and security mechanisms for real-world applications.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	2	3	3
Total Score	10	9	9	10	5	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	1	3	1
CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	2	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	11	11	10	6	12	8

Title of the Course	DATA STRUCTURES AND ALGORITHMS								
Category	CORE		Paper Number		CORE VII				
Course Code	L	T	P	Year	Semester	Credits	Inst. Hours	Marks		
								CIA	External	Total
	4	0	0	I	II	4	4	25	75	100
Course Outline	**UNIT-I :** **Primary Data Structures**, Time and Space Complexity Analysis Sorting – Quick and Heap Sort, Radix Sort, AVL trees, Graph Traversals Asymptotic notations, conditional asymptotic notations, Amortized analysis, NP complete and NP hard Time and Space complexity analysis by solving recurrence equations								
	UNIT-II : **Optimization Data structures** Search Trees, building Optimal search trees, Height balanced and Weight balanced trees B –trees, Red Black Trees and Splay trees								

	UNIT-III : Data Structures for sets of Intervals Interval Trees - Segment Trees, Trees for Weighted Intervals, Higher dimensional Segment Trees. Range Counting and Semi group model. K-d trees, Orthogonal Range trees, Leftist heap, Skew heap, Binomial heap and Fibonacci heaps.
	UNIT-IV : Data structures for Strings & Transformations Dynamic Structures, Persistent Structures, Tries, Compressed Tries, Suffix Trees and Suffix Arrays
	UNIT-V: Advanced Algorithm Design Dynamic Programming - Rod Cutting, Matrix chain multiplication, Longest Common Subsequence .Greedy Algorithms – Activity selection problem, Matroids and Greedy methods

Extended	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC/ others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms: Third Edition", The MIT Press, 2014.
Reference Books	1. Thomas H.Cormen, "Algorithms Unlocked", The MIT Press, 2013 2. Peter Brass, "Advanced Data Structures", Cambridge University Press, 2014
Website and e-Learning Source	https://goalkicker.com/AlgorithmsBook/ https://nptel.ac.in/courses/106/102/106102064/ https://nptel.ac.in/courses/106/102/106102064/.

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain advanced data structures and algorithmic concepts, including complexity analysis, asymptotic notations, sorting techniques, graph traversals, balanced trees, heaps, interval trees, tries, suffix structures, and dynamic programming principles.
CO2	K3	Apply advanced data structures and algorithm design techniques to solve computational problems using balanced trees, heaps, interval structures, string processing methods, greedy algorithms, and dynamic programming approaches.
CO3	K4	Analyze the efficiency and performance of advanced algorithms and data structures through recurrence relations, amortized analysis, NP-completeness concepts, optimization techniques, and range-query processing methods.

CO4	K5 & K6	Evaluate algorithmic strategies and create optimized computational solutions using advanced tree structures, persistent data structures, dynamic programming models, and greedy methods for complex problem-solving applications.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	2	3	1	3	1
CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	1	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	12	11	10	5	12	8

Title of the Course	RDBMS PRACTICAL								
Category	CORE		**Paper Number**		CORE VIII				
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	0	0	5	I	II	3	5	50	50	100
Course Outline	1. DDL Commands 2. DML Commands 3. DCL Commands 4. Usage of Sub Queries in DML and Create-SQL 5. Solving queries using built-in functions 6. Simple programs in PL/SQL block 7. Exception Handling in PL/SQL 8. Programs using Implicit Cursors 9. Programs using Explicit Cursors 10. Procedures & User-defined functions 11. Creation of Triggers									

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Ivan Bayross, SQL, PL/SQL The Programming Language of ORACLE, Fourth edition, BPBPublications
Reference Books	RamezElmasri, Shamkant B. Navathe (2014), "Database Systems", Sixth edition, PearsonEducation, New Delhi
Website and e-Learning Source	1. http://awtrey.com/tutorials/dbeweb/database.php 2. http://www.slideshare.net/SalamaAlbusaidi/emerging-database-technology-multimedia- database. 3. http://www.tutorialspoint.com/dbms/index.htm 4. http://www.tutorialspoint.com/plsql/index.htm

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamentals of relational database management systems, including DDL, DML, DCL commands, SQL queries, built-in functions, PL/SQL blocks, cursors, procedures, functions, and triggers.
CO2	K3	Apply SQL and PL/SQL programming techniques to perform database creation, data manipulation, subquery execution, exception handling, and cursor-based operations in relational database environments.
CO3	K4	Analyze database operations and PL/SQL program execution by examining query structures, cursor mechanisms, exception handling procedures, and trigger-based event processing for efficient database management.
CO4	K5 & K6	Evaluate database programming strategies and create robust database applications u PL/SQL constructs, user-defined procedures, functions, triggers, and secure transac techniques.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	1	3	1
CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	1	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	11	11	10	5	12	8

Title of the Course				**DATA STRUCTURES AND ALGORITHMS - PRACTICAL**						
Category		CORE		**Paper Number**		CORE IX				
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	0	0	5	I	II	3	5	50	50	100
Course Outline	1. Implementation of Merge sort and quick sort Algorithms 2. Implementation of Binary Search Tree 3. Red Black Tree Implementation 4. Implementation of Heap Implementation 5. Implementation of Fibonacci Heap Implementation 6. Implementation of Graph Traversals 7. Implementation of Spanning Tree Implementation 8. Shortest path Algorithms(Dijkstra's, Bellman Ford Algorithms) 9. Implementation of Matrix Chain Multiplication 10. Activity selection and Huffman coding Implementation									
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)									
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill									
Recommended Text	Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms: Third Edition", The MIT Press, 2014.									
Reference Books	Peter Brass, "Advanced Data Structures", Cambridge University Press, 2014									
Website and e-Learning Source	1. https://goalkicker.com/AlgorithmsBook/ 2. http://algs4.cs.princeton.edu/home/ 3. techread.dev/en/books/about/algori...									

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain fundamental algorithm design and data structure concepts, inclu algorithms, search trees, heaps, graph traversals, shortest path algorithms, dynamic and greedy techniques.
CO2	K3	Apply algorithmic techniques to implement sorting methods, binary search trees, ba heap structures, graph traversal algorithms, shortest path algorithms, and optimizati
CO3	K4	Analyze algorithm performance and computational efficiency by evaluating time complexity, space complexity, data structure behavior, and correctness of graph, tree, and dynamic programming algorithms.
CO4	K5 & K6	Evaluate algorithmic strategies and create optimized solutions by implementing advanced data structures and algorithms such as Red-Black Trees, Fibonacci Heaps, spanning trees, Huffman coding, and dynamic programming models.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	2	3	1	3	1
CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	1	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	12	11	10	5	12	8

Title of the Course	COMPILER DESIGN									
Category	Elective		**Paper Number**		ELECTIVE III A					
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	II	3	4	25	75	100

Course Outline

UNIT-I :

Compilers & Translators, Need of Translators, Structure of a Compiler, Phases, Lexical Analysis, Syntax Analysis, Intermediate Code Generation, Code Optimization, Code Generation, Book Keeping, A Symbol Table in brief, Semantic Analysis, L-value, r-values, Error Handling

UNIT-II :

Rules of Lexical Analyser, Need for Lexical Analysis, Input Buffering, Preliminary Scanning, A simple Approach to the Design of Lexical Analysers, Transition Diagrams, Regular Expression, String & Languages, Finite Automata, Non-deterministic Automata, Deterministic Automata, From regular Expression to Finite Automata, Context free Grammars, Derivations & Parse Trees, Parsers, Shift Reduce Parsing, Operator-Precedence Parsing

UNIT-III :

Symbol Table Management, Contents of a Symbol Table, Names & Symbol table records, reusing of symbol table spaces, array names, Indirection in Symbol Table entries, Data Structures for Symbol Tables, List, Self Organizing Lists, Search Trees, Hash Tables, Errors, Reporting Errors, Sources of Errors Syntactic Errors, Semantic Errors, Dynamic Errors, Lexical Phase Errors, Minimum Distance Matching, Syntactic Phase Error, Time of Detection, Ponic mode, Case study on Lex and Yacc

UNIT-IV :

Principal Sources of Optimization, Inner Loops, Language Implementation Details Inaccessible to the User. Further Optimization, Algorithm Optimization, Loop Optimization , Code Motion, Induction Variables, Reduction in Strength, Basic Blocks, Flow Graphs, DAG Representation of Basic Blocks, Value Numbers & Algebraic Laws, Global Data Flow Analysis, Memory Management Strategies , Fetch Strategy, Placement Strategies, Replacement Strategies, Address Binding, Compile Time, Load Time, Execution Time, Static Loading, Dynamic Loading, Dynamic Linking

UNIT-V:

Problems in Code Generation, a Simple Code Generator, Next-Use Information, Register Descriptors, Address Descriptors, Code Generation Algorithm, Register Allocation & Assignment, Global Register Allocation, Usage Counts, Register Assignment for Outer Loops, Register Allocation by Graph Coloring, Code Generation from DAG's, Peep-Hole Optimization, Redundant Loads & Stores, Un-Reachable Code, Multiple Jumps, Algebraic Simplifications, Use of Machine Idioms

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Compilers: Principles, Techniques & Tools, Second Edition by A. V. Aho, Monicas. Lam, Ravi Sethi, J. D. Ullman
Reference Books	1. Dhamdhere D.M., "Compiler Construction: Theory and Practice", McMillan India Ltd., 1983 2. Holub Allen, "Compiler Design in C", Prentice Hall of India, 1990
Website and e-Learning Source	1. https://www.geeksforgeeks.org/compiler-design-tutorials/ 2. https://www.tutorialspoint.com/compiler_design/ 3. https://www.javatpoint.com/compiler-tutorial 4. https://onlinecourses.nptel.ac.in/noc19_cs01/preview 5. http://ecomputernotes.com/compiler-design

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamentals of compiler design, including structure of compilers, phases of compilation, lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization, and error handling concepts.
CO2	K3	Apply compiler construction techniques such as lexical analysis using finite automata, parsing techniques, grammar processing, symbol table management, syntax-directed translation, and basic code generation methods.
CO3	K4	Analyze compiler processes including parsing, syntax and semantic error detection, symbol table organization, optimization techniques, data flow analysis, and memory management strategies to evaluate program translation efficiency.
CO4	K5 & K6	Evaluate compiler optimization strategies and create efficient code generation mech register allocation techniques, DAG-based optimization, loop optimization, peepho and advanced code generation algorithms.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2

CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	1	3	1
CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	1	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	11	11	10	5	12	8

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">INTELLIGENT SYSTEMS</td></tr>
<tr><td colspan="2">Category</td><td colspan="3">Elective</td><td colspan="2">Paper Number</td><td colspan="3">ELECTIVE III B</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">L</td><td rowspan="2">T</td><td rowspan="2">P</td><td rowspan="2">Year</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td rowspan="2">Inst. Hours</td><td colspan="3">Marks</td></tr>
<tr><td>CIA</td><td>External</td><td>Total</td></tr>
<tr><td></td><td>4</td><td>0</td><td>0</td><td>I</td><td>II</td><td>3</td><td>4</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Course Outline</td><td colspan="9">UNIT-I :
Artificial Intelligence: AI problems-AI technique-Problem Search:- Production Systems – Problem Characteristics –Production system characteristics- Heuristic Search techniques: Generate and Test – Hill Climbing – Constraint Satisfaction, Means-end analysis
UNIT-II :
Knowledge representation issues: Representations and mappings – Approaches to Knowledge representations –-Frame problem –. Using Predicate Logic: Representing simple facts in logic -Representing Instance and ISA relationships – Computable functions and predicates – Resolution
UNIT-III :
Representing knowledge using rules: Procedural Vs Declarative knowledge – Logic programming – Forward Vs Backward reasoning – Matching – Control knowledge. Knowledge representation summary: Syntactic and Semantic spectrum of representation-Logic and slot – and-filler structures-Other representational techniques</td></tr>
</table>

	UNIT-IV : Rule-based expert systems: Introduction- Rules as a knowledge representation technique- players- Structure- Forward chaining and backward chaining inference techniques- Fuzzy expert systems: Introduction- Fuzzy sets- Linguistic variables and hedges-Operations - Fuzzy rules- - Building a fuzzy expert system
	UNIT-V: Artificial neural networks: Neuron- perceptron- Multilayer neural networks- - The Hopfield network- Robotics: Introduction-Robot hardware-Perception-Moving-Robotic software architecture.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Elaine rich and Kelvin Knight, "Artificial Intelligence ", Tata McGraw hill Publication, 3ndEdition, 2009. [Unit – I,II,III] 2. Artificial Intelligence: A Guide to Intelligent Systems, 3rd edition, Michael Negnevitsky, Addison Wesley, 2011.[Unit IV-Chapter 1,2,4,V-Chapter 6] 3. Artificial Intelligence a modern Approach "– Stuart Russell & Peter Norvig, 3rd Edition Pearson Education[Unit V-Chapter 25-Robotics]
Reference Books	1. "Artificial Intelligence a modern Approach "– Stuart Russell & Peter Norvig, 3rd Edition, Pearson Education. 2. "Artificial Intelligence ", George F Luger , 4thEdition , Pearsons Education Publ, 2002. 3. "Foundations of Artificial Intelligent And Expert Systems", V S Janaki Raman, KSarukesi, P Gopalakrishnan, Macmillan India Limited
Website and e-Learning Source	1. https://www.techopedia.com/definition/190/artificial-intelligence-ai 2. https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligent_systems.htm 3. https://data-flair.training/blogs/heuristic-search-ai/ 4. http://teaching.csse.uwa.edu.au/units/CITS7212/Lectures/Students/Fuzzy.pdf 5. http://engineering.nyu.edu/mechatronics/smart/pdf/Intro2Robotics.pdf

CO	Bloom's Level	Course Outcome Statement

CO1	K1 & K2	Recall and explain the fundamentals of Artificial Intelligence, including problem-solving techniques, search strategies, production systems, heuristic search methods, and basic knowledge representation concepts.
CO2	K3	Apply AI concepts such as logical reasoning, predicate logic, rule-based systems, knowledge representation techniques, and search algorithms to solve structured AI problems.
CO3	K4	Analyze AI systems and knowledge representation approaches, including inference mechanisms, rule-based reasoning, fuzzy logic systems, and semantic representation structures to evaluate problem-solving strategies.
CO4	K5 & K6	Evaluate AI methodologies and create intelligent systems using expert systems, fuzzy logic, neural networks, and robotic architectures for real-world problem-solving applications.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	1	3	1
CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	2	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	11	11	10	6	12	8

Title of the Course	Distributed and Cloud Computing									
Category	Elective	Paper Number		ELECTIVE III C						
Course Code	L	T	P	Year	Semester	Credits	Inst. Hours	Marks		
								CIA	External	Total
	4	0	0	I	II	3	4	25	75	100

Course Outline	**UNIT-I :** **Distributed Communication** Introduction to Distributed Systems – Characterization of Distributed Systems – Distributed Architectural Models –Remote Invocation – Request-Reply Protocols – Remote Procedure Call –Remote Method Invocation – Group Communication – Coordination in Group Communication– Ordered Multicast – Time Ordering – Physical Clock Synchronization – Logical Time and Logical Clocks.
	UNIT-II : **Distributed Resource Management** Global States– Distributed Mutual Exclusion – Election Algorithms – Distributed Deadlock – Distributed File System Architecture – HDFS – Map Reduce.
	UNIT-III : **Introduction to Cloud** Cloud Computing Overview – Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service , Broad network access , Location independent resource pooling , Rapid elasticity , Measured service. Architectural influences – High- performance Computing, Utility and Enterprise Grid Computing, Autonomic Computing, Service Consolidation, Horizontal scaling, Web services, High scalability Architecture. Cloud Benefits – Cloud Deployment Model: Public Clouds – Private Clouds – Community Clouds - Hybrid Clouds - Advantages of Cloud Computing.
	UNIT-IV : **Virtualization Techniques** Introduction to Virtual Machines, Emulation :Interpretation and Binary Translation, Process Virtual machines and System Virtual machines Virtualization : Virtualization and cloud computing - Need of virtualization – limitations – Types of Hardware Virtualization: Full Virtualization – Para Virtualization – Case Studies : Xen,VMware – Desktop Virtualization – Network Virtualization.
	UNIT-V: **Cloud Resources Management And Issues** Cloud architecture: Cloud delivery model, Cloud Storage Architectures, Software as a Service (SaaS): SaaS service providers – Google App Engine, Salesforce.com and google platfrom – Benefits – Operational benefits - Economic benefits – Evaluating SaaS – Platform as a Service (PaaS): PaaS service providers – Right Scale – Salesforce.com – Rackspace – Force.com – Services and Benefits – Infrastructure-as-a -Service (IaaS): IaaS Service Providers – Amazon EC2 – GoGrid.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text	George Coulouris, Jean Dollimore, Tim Kindberg, Distributed Systems Concepts and Design, Fifth Edition, Pearson Education Asia, 2012.
Reference Texts	1. Distributed Systems - Principles and Paradigms, Andrew S. Tanenbaum,Maarten Van Steen, Second Edition, Pearson Prentice Hall, 2006. 2. MukeshSinghal, Advanced Concepts In Operating Systems, McGraw Hill Series in Computer Science, 1994. 3. Cloud Computing A Practical Approach - Anthony T.Velte, Toby J. Velte, Robert Elsenpeter Tata-McGraw- Hill , New Delhi – 2010.
Website and e-Learning Source	https://nptel.ac.in/courses/106/104/106104182/ https://onlinecourses.nptel.ac.in/noc21_cs15/preview

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Explain the fundamentals of distributed systems, distributed communication mechanisms, resource management techniques, cloud computing concepts, virtualization technologies, and cloud service models.
CO2	K3	Apply distributed computing algorithms, cloud deployment models, virtualization methods, and cloud service architectures to solve computing and resource management problems.
CO3	K4	Analyze distributed system coordination, synchronization, deadlock handling, virtualization techniques, and cloud resource management architectures for performance and scalability.
CO4	K5 & K6	Evaluate and design suitable distributed and cloud computing solutions using virtualization, SaaS, PaaS, and IaaS models for real-world computing environments.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	-	2	1	2	1
CO2	2	2	3	2	-	2	1
CO3	2	3	3	3	-	2	-
CO4	3	3	3	3	2	3	2
Total Score	10	9	9	10	3	9	4

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	1	1	3	1

CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	2	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	11	11	8	6	12	8

Title of the Course				**SOFTWARE PROJECT MANAGEMENT**						
Category		Elective		**Paper Number**			ELECTIVE IVA			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	II	3	4	25	75	100

Course Outline	
	UNIT-I : Introduction to Competencies - Product Development Techniques - Management Skills - Product Development Life Cycle - Software Development Process and models - The SEI CMM - International Organization for Standardization.
	UNIT-II : Managing Domain Processes - Project Selection Models - Project Portfolio Management - Financial Processes - Selecting a Project Team - Goal and Scope of the Software Project -Project Planning - Creating the Work Breakdown Structure - Approaches to Building a WBS - Project Milestones - Work Packages - Building a WBS for Software.
	UNIT-III : Tasks and Activities - Software Size and Reuse Estimating - The SEI CMM - Problems and Risks - Cost Estimation - Effort Measures - COCOMO: A Regression Model - COCOMO II - SLIM: A Mathematical Model - Organizational Planning - Project Roles and Skills Needed.

	UNIT-IV : Project Management Resource Activities - Organizational Form and Structure - Software Development Dependencies - Brainstorming - Scheduling Fundamentals - PERT and CPM - Leveling Resource Assignments - Map the Schedule to a Real Calendar - Critical Chain Scheduling
	UNIT-V: Quality: Requirements – The SEI CMM - Guidelines - Challenges - Quality Function Deployment - Building the Software Quality Assurance - Plan - Software Configuration Management: Principles - Requirements - Planning and Organizing - Tools - Benefits - Legal Issues in Software - Case Study
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Robert T. Futrell, Donald F. Shafer, Linda I. Safer, "Quality Software Project Management", Pearson Education Asia 2002
Reference Books	1. Pankaj Jalote, "Software Project Management in Practice", Addison Wesley 2002. 2. Hughes, "Software Project Management", Tata McGraw Hill 2004, 3rd Edition.
Website and e-Learning Source	1. https://highered.mheducation.com/sites/0077109899/information-center-view/ 2. https://www.tutorialspoint.com/software_engineering/software_project_management.htm 3. https://www.smartsheet.com/content/software-project-management 4. https://www.philadelphia.edu.jo/academics/lalqoran/uploads/SPM_Chapter_1-%202016%204.ppt 5. https://cs.gmu.edu/~kdobolyi/cs421/projectmanagement.ppt

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamentals of software engineering management, including product development life cycle, software development models, process standards (SEI CMM, ISO),

		competencies, and basic project management concepts.
CO2	K3	Apply project management techniques such as project selection, team formation, project planning, work breakdown structure (WBS), scheduling, and resource allocation to manage software projects effectively.
CO3	K4	Analyze software project parameters including cost estimation, effort estimation models (COCOMO, SLIM), risk assessment, scheduling methods (PERT, CPM), and organizational planning to evaluate project feasibility and performance.
CO4	K5 & K6	Evaluate software project management practices and create comprehensive project management solutions including quality assurance plans, configuration management systems, legal compliance strategies, and optimized software development frameworks.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	3	2	2	2
CO2	3	3	2	2	2	2	3
CO3	2	3	3	2	2	2	3
CO4	3	3	3	3	3	3	3
Total Score	11	11	10	10	9	9	11

Title of the Course	**SOFTWARE TESTING**									
Category	Elective		**Paper Number**			ELECTIVE VC				
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**

	4	0	0	I	II	3	4	25	75	100

Course Outline

UNIT – I SOFTWARE QUALITY ASSURANCE

Introduction to Software Quality Engineering : What is software quality – Benefits of software quality – Software development life cycle model – Types of defects – Definitions used in software quality engineering - Software Quality Assurance and Quality Control - Software Configuration Management (SCM).Software Quality Assurance : Benefits of SQA – Role of SQA – SQA people – SQA plan – What is process – Process frame works. Reviews, Inspections and walkthroughs : Management and Technical reviews -Inspections and walkthroughs – Inspection forms and check lists – Rate of Inspection – Inspection metrics- Estimating total number of defects in the software.

UNIT – II TESTING TECHNIQUES

Introduction to Testing : Guiding Principles of testing – Composition of testing team – Essential skills of a tester – Types of Testing – Evaluating the quality of test cases – Techniques for reducing number of test cases – Requirements for effective testing – Test Oracle – Economics of Software testing – Handling defects – Risk in software testing – Requirements traceability matrix. White box (Structural) Testing : Introduction to control flow graph – Control flow testing – Basis path testing – Linear Code Sequence And Jump (LCSAJ) coverage or JJ – path coverage – Loop testing – Data flow testing – Slice-based testing – Pitfalls of white box testing – Tools for white box testing. Integration Testing : Types of Integration testing – Functional Decomposition based Integration – Call graph-based Integration – Path-based Integration – Smoke testing.

UNIT – III FUNCTIONAL & NON-FUNCTIONAL TESTING

Functional Testing : Logic-based Testing – State Transition Testing – Use Case-based Testing – Syntax Testing – Domain Testing – Petry Net-based testing – Tools used in Functional testing.

Non-functional, Acceptance and Regression Testing : Non-functional Testing – Acceptance Testing - Regression Testing.

UNIT – IV INCORPORATING SPECIALIZED TESTING TECHNIQUES

Testing of OO Software and Agile Testing : Basics of OO system – Overview of UML diagram – OO Testing – Quality Metrics for OO Software – Agile Testing. Test Management: Activities in Test Management – Evaluation of Test Effectiveness – Release Management – Tools used in Test management. Cloud Testing: Introduction to Cloud computing – Cloud testing – Testing as a Service(TaaS).

	UNIT – V TEST AUTOMATION & QUALITY METRICS Test Automation : Advantages and disadvantages of test automation – Activities in test Automation - Test Automation Frame work – Tools for Test Automation – Script languages in Test Automation. Metrics for Software Quality : Categories of Software metrics – Metrics program – Types of Metrics – Some Commonly used Software Metrics. Tools for Quality Improvement: Basic Quality Control Tool – Check sheet – Cause and effect Diagram – Pareto Diagram – Histogram – Scatter Plot – Run chart – Control Chart – Orthogonal defect Classification.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Get the ideas to test the different software
Recommended Text	1. Anirban Basu, "Software Quality Assurance, Testing and Metrics", PHI, 2015. 2. Sandeep Desai, Abhishek Srivastava, "Software Testing A Practical Approach", PHI , 2016.
Reference Texts	1. Srinivasan Desikan, Gopalaswamy Ramesh, Software Testing Principles and practices", Pearson, 2012. 2. Aditya P Mathur, "Foundations of Software Testing", Pearson, 2011

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain the fundamentals of software quality assurance, including software quality engineering concepts, SDLC, defect types, SQA and SCM principles, reviews, inspections, walkthroughs, and basic testing concepts.
CO2	K3	Apply software testing techniques including white-box, black-box, integration, functional, and non-functional testing methods, along with test case design, defect handling, and test management tools.
CO3	K4	Analyze software quality processes by evaluating test strategies, inspection metrics, testing effectiveness, risk in testing, OO testing approaches, agile testing methods, and cloud testing frameworks.
CO4	K5 & K6	Evaluate software quality assurance practices and create optimized testing frameworks using test automation, quality metrics, SQA planning, defect classification tools, and continuous quality improvement techniques.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1

CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	3	2	3	2
CO2	3	3	2	2	2	3	2
CO3	2	3	3	2	2	3	3
CO4	3	3	3	3	3	3	3
Total Score	11	11	10	10	9	12	10

Title of the Course			**OBJECT ORIENTED ANALYSIS AND DESIGN**						
Category		Elective	**Paper Number**			ELECTIVE IVC			
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**	
								CIA	**External**	**Total**
	4	0	0	I	II	3	4	25	75	100
Course Outline										
	UNIT-I : Object Basics : Object- oriented Philosophy – Object – Object State, Behaviours and Methods. Encapsulation and Information Hiding – Class Hierarchy – Polymorphism, Aggregation, Object Containment, Meta Classes.									
	UNIT-II : Object Oriented Methodologies: Rumbaugh Object Model, Booch Methodology- Jacobson Methodology, Patterns, Frameworks and Unified Approach.									
	UNIT-III : Object Oriented Analysis: Business Object Analysis– Use Case Driven Approach – Use Case Model. Object Analysis – Noun Phrase Approach – CRC – Identifying Object Relationships and Methods.									
	UNIT-IV :									

	Object Oriented Design: The Design Process – Design Axioms – Corollaries – Design Patterns – Designing Classes. Software Quality: Tests- Testing Strategies – Test Cases – Test Plan – Continuous Testing – Mier‟s Debugging Principles.
	UNIT-V: UML and Programming: Introduction – State and Dynamic Models – UML Diagrams – Class Diagrams – Use Case Diagrams- UML Dynamic Modeling.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Ali Brahami, Object Oriented Systems Development, Tata-McGraw Hill, New Delhi.
Reference Books	1. Martin Fowler, Kendall Scott, UML Distilled- Applying the Standard Object Modeling Language, Addition Wesley. 2. Grady Booch, (1994), Object-oriented Analysis and Design with applications, 2nd Edition, Addition Wesley.
Website and e-Learning Source	1. http://www.slideshare.net/helghareeb/object-oriented-analysis-and-design-12164752 2. http://www.uml-diagrams.org/uml-object-oriented-concepts.html 3. http://www.tutorialspoint.com/object_oriented_analysis_design/index.htm 4. https://www.mppmu.mpg.de/english/kluth_oo_intro.pdf 5. http://www.agilemodeling.com/artifacts/useCaseDiagram.htm

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain object-oriented fundamentals including objects, classes, encapsulation, inheritance, polymorphism, aggregation, object containment, and basic UML concepts.
CO2	K3	Apply object-oriented methodologies and analysis techniques such as Rumbaugh, Booch, Jacobson models, use case modeling, CRC analysis, and object identification methods.

CO3	K4	Analyze object-oriented systems by evaluating relationships, design processes, design axioms, test strategies, debugging principles, and UML-based system modeling.
CO4	K5 & K6	Evaluate object-oriented design approaches and create structured software solutions using design patterns, class design techniques, UML diagrams, and dynamic modeling for real-world applications.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	2	3	2	2	1
CO2	2	3	3	2	2	3	2
CO3	2	3	3	2	2	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	12	11	10	8	11	8

Title of the Course					**OPEN SOURCE TECHNOLOGIES**					
Category		SKILL		**Paper Number**		SKILL I				
Course Code	**L**	**T**	**P**	**Year**	**Semester**	**Credits**	**Inst. Hours**	**Marks**		
								CIA	**External**	**Total**
	4	0	0	I	II	3	4	25	75	100
Course Outline	**UNIT-I :** **PHP:** Introduction – Creating a PHP page – Running PHP page – HTML and PHP – Printing Text – Comment Statements – Working with variables – Storing data in variables - Interpolating strings – Constants - Understanding Internal Datatypes – Operators – Flow Control – Strings: String Functions - Converting to and from strings - Formatting text strings - Working with numbers.									

	UNIT-II : Date and Time - Create an Array - Use an Associative Array - Functions to Work with Arrays -Work with Arrays of Arrays - Create and Use Functions
	UNIT-III : Reading Data in web pages: Handling various controls - PHP Browser-Handling power: Data Validation - File Handling : Opening a file – Reading Text from a file – Closing a file- Working with Databases: Creating , Inserting , Accessing , Updating , Deleting and Sorting Database - Work with Cookies and Sessions
	UNIT-IV : **Ruby:** Getting Started with Ruby – Working with Numbers and Strings – Variables – Constants – Operators – Conditionals and Loops
	UNIT-V: Arrays - Hashes - Methods - Blocks : Classes and Objects : Creating a Class and an Object-Exception Handling – File Handling
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Steven Holzner, (2016), "PHP: The Complete Reference", McGraw Hill Education Private Limited, Indian Edition. (Unit I, II) 2. Rachna Kapur, Mario Briggs, Tapas Saha, Ulisses Costa, Pedro Carvalho, Raul F. Chong, Peter Kohlmann (2010), "Getting Started with Open Source Development", DB2 on Campus Book Series. (Unit III) 3. http://indexof.es/Ruby/Beginning%20Ruby%20On%20Rails.pdf (Unit IV) 4. http://www.cs.uni.edu/~wallingf/teaching/agile-may2010/ruby/programming-ruby.pdf(Unit V)
Reference Books	1. W. Jason Gilmore (2010), "Beginning PHP &MySql", A press. 2. Joel Murach, Ray Harris (2010), "PHP and MySQL", Shroff Publishers & Distributors 3. Larry Ullman (2008), "PHP 6 and MySQL 5", Pearson Education. 4. John Coggeshall (2006), "PHP 5", Pearson Education. 5. Michale C. Glass (2004), "Beginning PHP, Apache, MySQL Web Development", Wiley Dream Tech Press.

Website and e-Learning Source	1. http://www.w3schools.com/php/ 2. http://howtostartprogramming.com/PHP/ 3. http://www.tutorialspoint.com/mysql/

CO	Bloom's Level	Course Outcome Statement
CO1	K1 & K2	Recall and explain fundamental concepts of server-side scripting and programming, including PHP syntax, variables, operators, control structures, strings, arrays, functions, Ruby basics, and object-oriented foundations.
CO2	K3	Apply programming constructs in PHP and Ruby to develop web-based solutions involving arrays, functions, form handling, file operations, cookies, sessions, and database CRUD operations.
CO3	K4	Analyze program execution and web application workflows by examining data validation, file handling processes, database interactions, and object-oriented structures including classes, objects, and exception handling.
CO4	K5 & K6	Evaluate web application architectures and create dynamic, database-driven applications using PHP and Ruby by integrating advanced programming constructs, session management, and structured exception handling.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	2	1
CO2	2	2	3	2	1	2	2
CO3	2	3	2	3	1	3	2
CO4	3	3	3	3	1	3	3
Total Score	10	9	9	10	4	10	8

CO-PSO Mapping

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	1	3	1
CO2	2	3	3	2	1	3	2
CO3	2	3	3	2	2	3	2
CO4	3	3	3	3	2	3	3
Total Score	9	11	11	10	6	12	8