Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. (CSE) Scheme - 2024

Course Code: CCS104
Course Title: Database Management Systems

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45 (L)+30 (P)= 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the concepts of database systems, data modeling and relational database to design Entity-Relationship (ER) diagrams and map them to relational schemas.
2	Examine functional dependencies and normalization techniques to improve database schema quality and minimize redundancy.
3	Use SQL commands to define, manipulate, and query relational databases including complex SQL queries and PL/SQL constructs.
4	Understand the data storage structure and transaction management in DBMS.
5	Make use of NoSQL database to store, retrieve, and manipulate data.
6	Design and develop relational databases to address real-world application requirements.

Contents

Part-A

Unit-1 Database Environment and Development Process **4 (L) hrs**

Basic Concepts and Definitions, Traditional File Processing Systems, The Database Approach-Data Models, Relational Databases, Database Management Systems, Advantages of the Database Approach; Components of the Database Environment. The Database Development Process-Systems Development Life Cycle, Three-Schema Architecture for Database Development, Managing the People involved in Database Development.

Unit-2 Relational Model and Database Design using the E-R Model **6 (L) hrs**

Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages- The Relational Algebra. Overview of the Design Process, The Entity-Relationship

Model, Complex Attributes, Mapping Cardinalities, Primary Key, Removing Redundant Attributes in Entity Sets, Reducing E-R diagrams to Relational Schemas, Extended E-R features, Entity-Relationship Design Issues, Alternative Notations for Modeling Data, Other Aspects of Database Design.

Unit-3 Structured Query Languages (SQL) 8 (L) hrs

Overview of the SQL Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub-queries, Modification of the Database, Intermediate SQL-Join Expressions, Views, Transactions, Integrity Constraints, SQL Data types and Schemas, Index Definition in SQL, Authorization. Advanced SQL - Accessing SQL from Programming Language, Functions and Procedures.

Part-B

Unit-4 Normalization 6 (L) hrs

The purpose of Normalization, Data redundancy and update anomalies, Functional Dependencies-Characteristics of Functional Dependencies, Identifying Functional Dependencies, Identifying the Primary Key for a Relation. The Process of Normalization- First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF). Advanced Normalization- More on Functional Dependencies - Inference Rules for Functional Dependencies, Minimal Sets of Functional Dependencies. Boyce–Codd Normal Form (BCNF) - Definition of BCNF. Fourth Normal Form (4NF) - Multi-Valued Dependency, Definition of Fourth Normal Form. Fifth Normal Form (5NF)-Lossless-Join Dependency, Definition of Fifth Normal Form

Unit-5 Data Storage Structures 3 (L) hrs

Database Storage Architecture, File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer, Column-Oriented Storage, Storage Organization in Main Memory Databases. Indexing-Basic Concepts, Ordered Indices, B^+ Tree Index Files, Hash Indices.

Unit-6 Transaction Management 10 (L) hrs

Transactions-Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability. Concurrency Control-Lock-Based Protocols, Deadlock handling, Multiple Granularity, Insert Operations, Read operations and Predicate Reads, Timestamp-Based Protocols, Validation-Based Protocols. Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm-Log Based Recovery and Shadow Paging.

Unit-7 Advanced Databases 8 (L) hrs

NoSQL Databases-Introduction to NoSQL Systems, The CAP Theorem, Document-Based NoSQL Systems and MongoDB, NoSQL Key-Value Stores, Column-Based or Wide Column NoSQL Systems, NoSQL Graph Databases and Neo4j. Other Advanced Databases- Introduction of Cloud

Databases, Spatial and Geographic information system (GIS) Databases and their applications.

Laboratory Work:

Students will create ER Diagrams using any tool, perform operations of relational algebra in RelaX tool, perform SQL commands to demonstrate the usage of DDL, DML, joining of tables, grouping of data, PL/SQL constructs. They will also implement CRUD operations of NOSQL Databases.

Following is only the suggested list of Practical's. Instructor may frame additional Practical's relevant to the course contents.

Experiment No.	Experiment Title
1.	Design ER diagrams for specific problems using any open source tool.
2.	Write queries for Relational Algebra in RelaX tool.
3.	Write SQL queries for Data Definition Languages for creating and managing tables (create, drop, truncate, alter and rename), DEFAULT option, referencing another user's table.
4.	Write SQL queries for Data Manipulation Languages for manipulating data in tables (select, insert, update and delete commands).
5.	Write SQL queries to implement Basic SQL select statements using arithmetic operators, logical operators, comparison operators, operators' precedence, eliminating duplicate rows, using column aliases.
6.	Write SQL queries for Character functions - case manipulation and character manipulation functions; number functions, date functions; using arithmetic operators with dates; date functions, conversion functions.
7.	Write SQL queries for extracting data from more than one table (Cartesian product, equi-Join, non-equi-join, outer join)
8.	Write SQL queries for aggregating, sorting data, using various clauses (group by, having and order by).
9.	Write SQL queries for subqueries, nested queries (single-row subqueries; multiple-row subqueries; using group function in a subquery; HAVING clause with subqueries; usage of operators in multiple-row subqueries)
10.	Write SQL queries to create views and also apply different operations on views.
11.	Write programs to access SQL from programming language using basic PL/SQL constructs.
12.	Write PL/SQL programs to illustrate the concept of functions and procedures.
13.	Apply Normalization Techniques up to third Normal Form(3NF) to a Given Relation: **i.** Identify the **repeating groups** and remove them to convert the table into **First Normal Form (1NF).** ii. Identify **partial dependencies** and convert the table into **Second Normal Form (2NF)**.

	iii. Identify **transitive dependencies** and convert the table into **Third Normal Form (3NF).** iv. Implement the normalized tables using **SQL CREATE TABLE** statements. v. Insert sample data into normalized tables using **SQL INSERT**. vi. Demonstrate data retrieval using **SQL SELECT** with JOIN.
13.	NoSQL Databases-Installation of MongoDB, CRUD operations of NoSQL Databases with Python/Java.
14.	Mini Project By using standard database design rules, database has to be designed for a specific assigned problem to a group of two to three students. ER diagram related to project with an open source database tools like MySQL workbench, Lucidchart must also be prepared. The group of students must submit a project report of 8 to 10 pages (approximately) and the team will have to demonstrate as well as have to give a presentation of the same.

Text Books

1. Abraham Silberschatz, S. Sudarshan, Henry F. Korth, "Database System Concepts", 7th Edition, Tata McGraw - Hill Education, 2020.
2. Shamkant B. Navathe, Ramez Elmasri, "Fundamentals of Database Systems", 7th Edition, Pearson, 2016.
3. Jeffrey A. Hoffer, V. Ramesh and Heikki Topi, "Modern Database Management", 12th Edition, Pearson, 2016.

Reference Books

1. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", 4th Edition, BPB Publications, 2009.
2. Sadalage, P. & Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 1st Edition, Wiley Publications 2019.

Online Learning Material

1. https://scs.dypvp.edu.in/documents/e-books/DMBS/database-management-systems-raghu-ramakrishnan.pdf Accessed on May 13, 2025
2. http://infolab.stanford.edu/~ullman/dscb.html Accessed on May 13, 2025
3. https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/162-Introduction-to-Database-Management-System-Satinder-Bal-Gupta-Aditya-Mittal-Edisi-2-2017.pdf Accessed on May 13, 2025
4. https://circuitmix.com/free-download-fundamentals-of-database-management-systems-ebook/ Accessed on May 13, 2025
5. https://freevideolectures.com/course/2668/database-management-system

Accessed on May 13, 2025

6. https://www.studytonight.com/dbms/er-to-relational-model.php Accessed on May 13, 2025
7. https://www.studytonight.com/dbms/database-normalization.php Accessed on May 13, 2025

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Database Management System	Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc21_ee 39/preview
2	Database Management System	Prof. Partha Pratim Das	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc19_cs46/preview
3	Introduction to Database Systems	Prof. Sreenivasa Kumar	IIT Madras	https://onlinecourses.nptel.ac.in/noc25_cs40/preview

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B.Tech. (CSE) Scheme - 2024

Course Code: CCS105
Course Title: Operating System

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45 (L) + 30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the components of operating systems and design issues associated with it.
2	Apply the knowledge of various process management concepts for process synchronization.
3	Illustrate the concept of scheduling algorithms to work in multitasking environment.
4	Analyze the algorithms for deadlock management, file management and memory management.
5	Evaluate file system structures and implement file handling, directory structures, and disk scheduling algorithms.

Contents

Part-A

Unit-1 Introduction **6(L) hrs**

Concept of Operating Systems, Generations of Operating systems, Types and structures of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, System Programs, System boot, Basics of OS security, user authentication.

Unit-2 Process management and scheduling algorithms **10(L) hrs**

Concept of processes and threads, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread - Definition, Various states and types, Benefits of threads, Multithreading Models. Process Scheduling - Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria, Scheduling algorithms, Multiprocessor scheduling.

Unit-3 Process Synchronization **5(L) hrs**

Inter-process Communication-Shared memory, message passing. Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution- Test and Set instruction, Software solution- Strict Alternation, Peterson's Solution. The Producer/Consumer Problem, Semaphore.

Case study 1: **2(L) hrs**

Implementation of Unix based operating systems and windows based operating Systems.

Part-B

Unit-4 Deadlocks **4(L) hrs**

Introduction to deadlocks, Conditions for deadlock, Resource allocation graphs, Deadlock prevention and avoidance, Deadlock detection and recovery.

Unit-5 Memory Management **10(L) hrs**

Basic concept, Logical and Physical address map, Swapping, Memory allocation - Contiguous Memory allocation, Fixed and variable partition, Internal and External fragmentation and Compaction, overlay, Paging - Structure of the Page Table, Allocation of Frames, Segmentation. Virtual Memory Management - Demand Paging, Page Replacement algorithms, Thrashing.

Unit-6 File and storage Management **6(L) hrs**

Concept of File, Access methods, File types, File operation, Directory structure, Allocation methods (contiguous, linked, and indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table). Secondary Storage: Disk structure, Disk scheduling algorithms.

Case study 2: **2(L) hrs**

Implementation of Mobile Operating systems and Robotics Operating systems.

Laboratory Work: Install and practice Linux/Unix commands, basic shell scripting. Simulate CPU scheduling, Disk Scheduling, Process synchronization, deadlock, Memory Management techniques, page replacement policies, file management techniques using either C or C++.

Following is only the suggested list of Practical's. Instructor may frame additional Practical's relevant to the course contents

Experiment No.	Experiment Title
1	**Operating System Installation and Virtualization:** a) Installation of Linux operating systems. b) Setting up and managing virtual operating systems using Virtual Box.

2	**System Architecture and Types of OS:** a) Study of single-user, multi-user, network operating systems. b) Exploring system boot processes and OS initialization
3	**Linux System Administration:** a) Study of Linux system architecture, booting process, and kernel. b) Exploring system services, logs, and process management.
4	**Linux Commands and Scripting:** a) Executing essential Linux commands for file handling, disk management, and networking. b) Working with permissions, process control, and system monitoring.
5	**Shell Scripting & Automation:** a) Basics of shell scripting (Bash, Zsh). b) Writing scripts with conditional statements, loops, and functions. c) Automating system tasks such as backups, log management, and user creation.
6	**CPU Scheduling Algorithms:** Implement and analyze First Come First Serve (FCFS), Shortest Job First (SJF), Round Robin (RR), and Priority Scheduling and also Compute turnaround time and waiting time.
7	**Process Synchronization & Deadlocks:** a) Simulation of Producer-Consumer problem using semaphores. b) Implementation of Banker's Algorithm for deadlock avoidance.
8	**Memory Management Techniques:** Implement and compare Worst-Fit, Best-Fit, First-Fit. Also, Simulate paging and segmentation techniques.
9	**Page Replacement Policies:** Implementation of FIFO (First In First Out), LRU (Least Recently Used), Optimal Page Replacement.
10	**Disk Scheduling Algorithms:** - Simulation of FCFS (First Come First Serve), SCAN, C-SCAN
11	**File Management Techniques:** - Simulation of file allocation strategies (Sequential, Indexed, Linked)

Text Books

1. A Silberschatz and Peter B. Galvin, "Operating System Concepts", 10th edition, Addison Wesley, 2019.
2. GaryNutt, "Operating Systems Concepts", 3rd edition, Pearson Education Inc. 2004.

Reference Books

1. Dhamdhere, "Systems Programming & Operating Systems", 2nd edition, Tata McGraw Hill, 1996.

2. Tanenbaum A. S, "Operating System Design & Implementation", 3rd edition, Pearson Education Inc. 2006.
3. Charles Crowley, "Operating System: A Design-oriented Approach", Indian edition, Tata McGraw Hill, 2006.

Online Learning Materials

1. http://dinus.ac.id/repository/docs/ajar/Operating_System.pdf Accessed on May 13, 2025
2. https://youtu.be/mXw9ruZaxzQ Accessed on May 13, 2025
3. https://www.coursera.org/learn/os-pku Accessed on May 13, 2025
4. https://www.coursera.org/learn/operating-system-foundations Accessed on May 13, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Introduction to operating system	Prof. Chester Rebeiro	IIT Madras	https://nptel.ac.in/courses/106106144

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B.Tech. (CSE) Scheme - 2024

Course Code: CCS106
Course Title: Computer Networks

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 15(T) + 30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any) - NIL

Additional Material Allowed in ESE- Scientific Calculator

On completion of the course, the student will have the ability to-

CO#	Course Outcomes
1	Understand the key concepts of data communication to real-world networking scenarios.
2	Apply the concepts of analog and digital signals for transmission of data using efficient bandwidth utilization.
3	Evaluate network performance metrics and algorithms for selecting efficient communication paths.
4	Analyze the design concepts for process to process delivery in end-to-end communication.
5	Assess the functionalities of various network layers and protocols to understand their contribution in computer networks

Contents

Part-A

Unit-1 Introduction **8(L) hrs**

Data Communication Components, Representation of data and data flow, Networks-Network criteria, Physical Structure- Type of connections. Network Type - LAN and WAN. Internet brief History, Protocols- Syntax, Semantics, Timing, Standards and Administration. Networks Models- Protocol Layering, Principle of Protocol Layering, Addressing- Physical Address, Logical Address, Port Address, Specific Address. TCP/IP Protocol suite OSI Model.

Unit-2 Physical Layer **8(L) hrs**

Analog and digital signals, Analog and digital transmission, Data Rate limits- Nyquist formula, Shannon formula. Transmission impairments- Attenuation, Noise, Distortion. Network Performance - Bandwidth, Bit Rate, Throughput, Latency, Propagation Time, Propagation speed. Techniques for Bandwidth utilization- Frequency division, Time division and Wave division Multiplexing. Concepts

of Spread Spectrum. Transmission Media- Guided media- Twisted Pair, Co-axial, Fiber optics with propagation modes, Connectors and its applications. Unguided Media- Radio Wave, Micro Wave, Infra-Red, Ranges, Propagation Methods and its Applications. Switching- Circuit, Message and Packet switching and their comparison.

Unit-3 Data Link Layer **8(L) hrs**

Types of Errors, Detection- Redundancy, Parity, Cyclic Redundancy Check and Checksum. Error Correction- Forward Error Correction- Hamming Code, Burst Error correction. Data Link Control and Protocols- Error control, Flow control. Flow and error control Mechanisms: Stop and Wait ARQ, Go-Back-N ARQ and Selective Repeat ARQ, Piggybacking. Multiple Access Random Access- Concept of Pure ALOHA and Slotted ALOHA. CSMA- Persistent methods, CSMA/CD, CSMA/CA.

Part-B

Unit-4 Network Layer **11(L) hrs**

Logical addressing- Classful and classless, IPv4 and IPv6 Address Format. Network Layer Protocols- ARP, RARP - Concept and Format of ARP Packet. DHCP- Message Format and working operation. IPv4 and IPv6- Header Format and Comparison. Routing algorithms- Concept of Routing Table, Static and Dynamic routing. Unicast Routing- Inter-domain and Intra-domain. Intra-domain- Distance vector routing, Link State Routing- Dijkstra Algorithm. Inter-domain- Path Vector Routing. Congestion Control Algorithms- Leaky Bucket and Token Bucket Algorithms. Congestion Control Polices- Open-loop Congestion Control, Closed-loop Congestion Control.

Unit-5 Transport Layer **6(L) hrs**

Services- Process to Process Communication, Addressing, Connectionless and Connection Oriented Services, Multiplexing and De-Multiplexing, Flow Control, Error Control. User Datagram Protocol (UDP)- Header Format and its Applications. Transmission Control Protocol (TCP)- Header Format and its Applications. Elements of Transport Protocols- Three way handshaking Connection Establishment and Release.

Unit-6 Session, Presentation and Application Layer **4(L) hrs**

Data Compression Techniques- Lossless and Lossy Compression Techniques. Domain Name Space (DNS)- Purpose, Namespace, DNS in the Internet, Resolution. TELNET- Local versus Remote Logging, EMAIL- Architecture, FTP (File Transfer Protocol)- Control Connection, Data Connection, FTPS, WWW (World Wide Web)- Architecture HTTP (Hyper Text Transfer Protocol), HTTPS.

Laboratory Work: Students will simulate the scenario related to above topics with any open source simulation tools and implement programs with any open source C++ tools.

Following is only the suggested list of Practical's. Instructor may frame additional Practical's relevant to the course contents

Experiment No.	Experiment Title
1	Familiarization with various network simulation tools: Wireshark, CISCO packet tracer, NS2/NS3, GNS3 etc.
2	Simulation of message transmission for single point and multi point devices.
3	Study and implementation of various LAN topologies any simulation tools.
4	Configuration of TCP/IP Protocols in Windows.
5	Familiarization with various transmission media and its specifications.
6	Preparing straight and cross cables using crimping tool.
7	Familiarization with networking components LAN Adapters, Hubs, Switches, Routers etc.
8	Develop a program to compute the Hamming Distance between any two code words (Decimal to binary conversion first)
9	To implement and check the error detection/error correction techniques in networks using a C++ program using Single bit parity.
10	To implement and check the error detection/error correction techniques in networks using a C++ program using even odd parity.
11	To implement and check the error detection/error correction techniques in networks using a C++ program using CRC.
12	Designing and implementing class A, B and C networks
13	To study and use of the basic networking commands.: arp –a, hostname, ipconfig, ipconfig /all, Ipconfig /renew, Ipconifg /release, ipconfig /flushdns, nbtstat –a, netdiag, netstat, nslookup, pathping, ping, route and tracert in Windows.
14	Configuration of WWW protocols using any simulation tool.

Text Books

1. Behrouz A. Forouzan, “Data Communication & Networking”, Tata McGraw Hill, 5th edition, 2017
2. Andrew S. Tanenbaum, “Computer Networks”, Pearson Education, 6th edition, 2022
3. Douglas E. Comer, “Internetworking with TCP/IP”, Volume-I, Prentice Hall, India. 6th edition, 2015

Reference Books

1. James F. Kurose and Keith W. Ross, “Computer Networking”, Pearson Education. 7th edition,2016
2. Behrouz A. Forouzan, “Data Communication & Networking”, Tata McGraw Hill, 3rd edition, 2004
3. Behrouz A. Forouzan, “Data Communication & Networking”, Tata McGraw Hill, 4th edition, 2007
4. W. Stallings, “Data and Computer Communication”, Prentice Hall of India. 10th edition, 2017

Online Learning Materials

1. https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/resources/lecture1/

Accessed on May 15, 2025

2. https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/resources/lecture2/ Accessed on May 15, 2025
3. https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/pages/lecture-notes/ Accessed on May 15, 2025
4. https://youtu.be/lnU-Zw3NEEQ?si=r5ZRdgUkFtN9Vo2V Accessed on May 15, 2025
5. https://youtu.be/29Qdz0FmvmQ?si=dtsXLXJfDpGOfHFY Accessed on May 15, 2025
6. https://youtu.be/8BK70UDgyrc?si=vJGSwp74De124bNc Accessed on May 15, 2025
7. https://www.youtube.com/watch?v=9ycQolopz6g Accessed on May 15, 2025
8. https://youtu.be/5AHp0f0489E?si=ZBrq84ewy3aVy-Qy Accessed on May 15, 2025
9. https://youtu.be/8-3CSAkscYU?si=mcLKFV2fZu_MKQdQ Accessed on May 15, 2025
10. https://youtu.be/5ex1s4lURto?si=28ULjxNjzz7uHJUD Accessed on May 15, 2025
11. https://youtu.be/JsUzPkOxZfA?si=Tx50yS7Hab86iu2p Accessed on May 15, 2025
12. https://youtu.be/qZlMS4yJM-E?si=WOHubr2UDL7htzO9 Accessed on May 15, 2025
13. https://youtu.be/VUdfS70puWI?si=qjvKdGrDblRJADNk Accessed on May 15, 2025
14. https://youtu.be/f1y25BfOH9I?si=jePNPqn665KMpBgm Accessed on May 15, 2025
15. https://youtu.be/5vbPS-KnhvI?si=Fgn7eb1r7Cip7Riv Accessed on May 15, 2025
16. https://youtu.be/rGWPOm3ectk?si=grDN6_KyOxuyNjrW Accessed on May 15, 2025
17. https://youtu.be/i6wlR8dmw1k?si=vvGG8bl5H_yFASYW Accessed on May 15, 2025
18. https://youtu.be/JkqgkN_j6Lo?si=T9CHaEeGAl99Gv6J Accessed on May 15, 2025
19. https://youtu.be/8LeqAH_ppsA?si=e4nmBiddE_EEk1cu Accessed on May 15, 2025
20. https://www.youtube.com/watch?v=Lo_pIjzej1A&list=PLfmqK5mMBWj_J-O4jMyYSz4WMZjUQX0Iq Accessed on May 15, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Emergence of Networks & Reference Models (English)	Prof. Sujoy Ghosh	IIT Kharagpur	https://nptel.ac.in/courses/106105081
2	Computer Networks and Internet Protocols (English)	Prof. Soumya Kanti Ghosh and Prof Sandip Chakraborty	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_cs15/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. (CSE) Scheme - 2024

Course Code: CCS107
Course Title: Discrete Mathematics

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 15(T) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 90%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to

CO#	Course Outcomes
1	Apply the principles of sets, relations, and functions to solve mathematical problems.
2	Construct formal proofs to validate logical arguments using mathematical reasoning.
3	Evaluate combinatorial problems using appropriate mathematical methods and techniques.
4	Apply number theory concepts to solve computational problems in computer science.
5	Prove elementary properties of algebraic structures and apply them in the analysis and interpretation of data to draw valid conclusions.
6	Make use of appropriate mathematical models to assess real-world problems.

Contents

Part-A

Unit-1 Fundamentals of Sets, Relations and Functions 9 (L) hrs

Sets – Operations on sets, Subsets, Types of sets, ordered pairs, Proofs of general identities of sets, Classes of sets and partitions, Countable and uncountable sets. Relations –Representations of relations, Types of relations, Composition of relations, Closure properties of relations, Equivalence relations, Compatibility relations, Partial order relations. Functions – Introduction and types of functions, Sum and product of functions, Hashing functions, recursively defined functions.

Unit-2 Prepositional and Predicate Logic 4(L) hrs

Prepositions and compound prepositions, Logical connectives, Truth tables, Logical implication and logical equivalence, Normal forms– Conjunctive and Disjunctive, Validity of well-formed formula, Propositional inference rules–Modus ponens and modus tollens. Predicate logic, Universal and existential quantification, Limitations of propositional and predicate logic.

Unit-3 Combinatorial Mathematics 9 (L) hrs

Basic counting principles, Permutations and combinations, Pigeonhole principle, Inclusion and exclusion principle, Recurrence relations – Solving homogeneous and non- homogeneous recurrence relations, Sequences, Generating function

Part- B

Unit-4 Number Theory **7 (L) hrs**

The division algorithm, modular arithmetic, Primes and greatest common divisors: The fundamental theorem of arithmetic, Euclidean algorithm. Congruences: Congruence relation, Linear congruence equation, The Chinese remainder theorem, Applications of Congruences.

Unit-5 Algebraic Structures and Morphism **8 (L) hrs**

Algebraic structures with one binary operation, Properties of an operation, Congruence relation, Semi groups, Monoids, Groups, Substructures, Cyclic groups, Cosets, Normal subgroups, Dihedral groups, Permutation Groups. Homomorphism and isomorphism of groups, Applications of groups. Algebraic structures with two binary operations, Rings – Introduction, Abelian ring, Ring with unity, Multiplicative inverse, Subrings, Homomorphism of rings. Integral Domain, Ideals.

Unit-6 Graph Theory **8 (L) hrs**

Graphs – Definition, degree, Connectivity, path, cycle, Directed and undirected, Sub Graph, Bi-connected component and Articulation points. Eulerian chains and cycles, Hamiltonian chains and cycles, shortest paths algorithms – Dijkstra's algorithm, Warshall's algorithm. Rooted trees, Spanning tree algorithms – Kruskal's algorithm, Prim's algorithm. Graph coloring, Map Coloring, Chromatic number, Planar graphs, Euler's formula, Isomorphism and homomorphism of graphs, Applications of graph theory.

Text Books

1. K.H. Rosen, "Discrete Mathematics and its applications", 8th edition, Tata McGraw Hill, 2021.
2. S. Lipschutz and M.Lipson, "Schaum's Outline of Discrete Mathematics", 4th edition, Tata McGraw Hill, 2022.
3. A. Doerr and K. Levarseur, "Applied Discrete Structures for Computer Science", 3rd edition, Pearson Education, Inc. 2018.
4. Tremblay, J.P. and Manohar R., "Discrete Mathematical Structures with Applications to Computer Science", 1st edition, Tata McGraw Hill, 2008.

Reference Books

1. C.L. Liu and D. Mohapatra "Elements of Discrete Mathematics: A Computer Oriented Approach", 4th edition, Tata McGraw Hill, 2014.
2. Susanna S. Epp, Discrete Mathematics with Applications, 5th edition, Wadsworth Publishing Co. Inc. 2020.
3. Haggard G., Schlipf J. and Whitesides, Sue, Discrete Mathematics for Computer Science, 2nd edition, Cengage Learning, 2008.
4. Johnsonbaugh R., Discrete Mathematics, 7th edition, Pearson Education, 2007.

Online Learning Materials

1. Discrete Mathematics and its applications by Kenneth H. Rosen https://mrce.in/ebooks/Maths-Discrete Mathematics & its Applications 8th Ed.pdf
   Accessed on April 30, 2025
2. Discrete Mathematics: An Open Introduction by Oscar Levin
   https://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
   https://teachmint.storage.googleapis.com/public/224619601/StudyMaterial/35957954-ed0c-4c03-9772-f1b2a3dfc756.pdf
   Accessed on April 30, 2025
3. Applied Discrete Structures by Al Doerr & Ken Levasseur
   https://math.libretexts.org/Bookshelves/Combinatorics_and_Discrete_Mathematics/Applied_Discrete_Structures_(Doerr_and_Levasseur)
   Accessed on April 30, 2025

Online Courses and Video Lectures

1. https://www.youtube.com/watch?v=pMzcLG6s3z0 Accessed on April 30, 2025
2. https://youtube.com/playlist?list=PLU6SqdYcYsfLV24T0XVb3z3mjl8QG0EBN&si=cbnY62VBzqqGUsP3 Accessed on April 12, 2025
3. https://www.youtube.com/watch?v=NW-naslChdo Accessed on April 12, 2025
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics- for- computer-science-fall-2010/video-lectures
   Accessed on April 12, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Discrete Mathematics	Prof. Sudarshan Iyengar, Prof. Anil Shukla	IIT Ropar	https://onlinecourses.nptel.ac.in/noc24_cs92/preview
2	Discrete Mathematics	Prof. Sudarshan Iyengar, Prof. Prabuchandran K.J	IIT Ropar, IIT Dharwad	https://onlinecourses.nptel.ac.in/noc22_cs33/preview
3	Discrete Mathematical Structures	Prof. Kamala Krithivasan	IIT Madras	https://nptel.ac.in/courses/106106094
4	Discrete Mathematics	Dr. Sugata Gangopadhyay, Dr. Aditi Gangopadhyay	IIT Roorkee	https://nptel.ac.in/courses/111107058

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B.Tech. (CSE) Scheme - 2024

Course Code: CCS108

Course Title: Artificial Intelligence

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45 (L)+30 (P)= 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 60%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): ESC105

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the foundational principles and scope of Artificial Intelligence and its role in building intelligent systems.
2	Examine problems that can be solved using AI techniques such as search, logic, learning, and decision-making.
3	Apply AI methods and models, including classical algorithms, machine learning, and neural networks to solve real-world problems.
4	Demonstrate the ability to use modern AI tools and platforms to develop intelligent systems and evaluate their performance.
5	Analyze the capabilities and limitations of AI technologies, including deep learning, generative models, and large language models.
6	Exhibit awareness of ethical, societal, and practical considerations in the design and deployment of AI systems.

Contents

Part-A

Unit-1 Introduction **3 (L) hrs**

Intelligence, Foundations of Artificial Intelligence (AI), History of AI; Agents and Environments - The concept of rationality, Nature of environments, Structure of Agents, Application and Impact of AI in real world.

Unit-2 Problem Formulation and Solution **10 (L) hrs**

Problem-Solving agents, Search Algorithms-Uninformed Search Strategies – Breadth first search, Depth first search, Iterative Deepening, Informed Search Strategies; Heuristic Search – Designing a heuristic

function, Branch and Bound, Hill Climbing, Best-first Search, A* algorithm, Iterative deepening A*(IDA), Small memory A*(SMA).

Unit-3 Game Playing **5 (L) hrs**

Representation of games as search problems, Understanding game trees, Perfect Information game, Imperfect Information game, Evaluation function, Minimax algorithm, Alpha-beta pruning.

Unit-4 Logical Reasoning **5 (L) hrs**

Propositions, Inference in Propositional logic and First order Predicate logic, Resolution, Forward chaining, Backward chaining, Knowledge representation techniques - Semantic networks, Frames.

Part-B

Unit-5 Planning **7 (L) hrs**

Basic representation of plans, Partial order planning, Planning in the blocks world, Hierarchical planning, Conditional planning, Representation of time, schedule and resource constraints, Measures, temporal constraints.

Unit-6 Uncertainty **5 (L) hrs**

Basic probability, Bayes rule and its use, Belief networks, Default reasoning, Fuzzy sets and fuzzy logic; Decision making– Utility theory, Utility functions, Decision theoretic expert systems.

Unit-7 Introduction to Machine Learning and Deep Learning **5 (L) hrs**

Introduction to machine learning, Types of learning - Supervised, Unsupervised, Reinforcement Learning, Introduction to neural networks and deep learning.

Unit-8 Advancements in AI **5 (L) hrs**

Explainable AI (XAI), Edge AI, Generative AI, AI for Social Good - Applications of AI in healthcare, education, climate change, and sustainability, AI Security - Protecting AI systems from attacks and ensuring secure AI development), Case studies of AI-driven innovations - Smart Speakers, Self-Driven cars, Smart Agriculture, etc.

Laboratory Work
Students will implement above topics in python or similar programming language and will also implement mini project based on course contents.

Following is only the suggested list of Practical's. Instructor may frame additional Practical's relevant to the course contents

Experiment No.	Experiment Title
1	Implement a simple reflex agent for the vacuum-cleaner world.
2	Implement Breadth First and Depth First search for water jug problem.
3	Implement Hill Climbing search algorithm.
4	Implement A* algorithm for eight puzzle problem.
5	Develop a Tic Tac Toe game using the Minimax algorithm with alpha-beta pruning.
6	Represent a small real-world domain using frames and semantic networks.
7	Implement the Goal Stack Planning method for the Blocks World.
8	Implement Bayes Rule to classify emails as spam or not spam.
9	Build a small neural network from scratch without using any deep learning libraries.
10	Generate images from text using a pre-trained diffusion or GAN model.

Mini Project: Student will develop a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2022.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, Second Edition, 2022.

Reference Books

1. David L. Poole, Alan K. Mackworth, "Artificial Intelligence", Cambridge University Press, Second edition, 2017.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill, 3rd edition, 2019.
3. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi.
4. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd edition, Sebastopol, CA: O'Reilly Media, 2022.

Online Learning Materials

1. https://www.youtube.com/watch?v=V0flteSbu8M Accessed on August 4, 2025
2. Search - Lecture 0 - CS50's Introduction to Artificial Intelligence with Python 2020 Accessed on August 4, 2025
3. An Introduction to Artificial Intelligence | Prof. Mausam Accessed on August 4, 2025
4. OpenAI, HuggingFace documentation
5. https://platform.openai.com Accessed on August 4, 2025
6. https://teachablemachine.withgoogle.com Accessed on August 4, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Artificial Intelligence: Search Methods for Problem Solving	Prof. Deepak Khemani	IIT Madras	https://onlinecourses.nptel.ac.in/noc25_cs88/preview
2	Artificial Intelligence: Concepts and Techniques	Prof. V. Susheela Devi	IISc Bangalore	https://onlinecourses.nptel.ac.in/noc25_cs159/preview

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B.Tech. (CSE) Scheme - 2024

Course Code: LCCS109
Course Title: Data Analytics Tools

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2	**Credits:** 1
Semester: 4	**Theory/Practical:** Practical	**Teaching Hours:** 30(P) = 30 hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** Nil
Duration of End Semester Examination (ESE): NA		
Course Type: Core Course		

Prerequisites (if any): NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply data preparation techniques in Excel and Python to clean, filter, and merge structured datasets for analysis.
2	Create charts and dashboards using Matplotlib and Power BI/Tableau to display the changes and relationships within datasets.
3	Perform statistical inference methods to validate hypotheses using real-world data samples.
4	Design interactive dashboards in Power BI/Tableau to present key performance indicators and filtering options for data exploration.
5	Integrate Excel, Python, and data visualization tools in a project to analyze a given dataset by preparing data, calculating performance metrics, and presenting insights for decision-making.

Contents

Practical No.	Practical Title
1	Introduction to Data Analytics Tools: Overview of data analytics and its lifecycle, Comparison of tools- Excel, Python (Pandas, NumPy), Power BI, Tableau, Setting up the environment- Jupyter Notebook, Google Colab, VS Code 1.1 Install Python and set up Jupyter Notebook. Load a CSV dataset containing student records using Pandas. Display the structure, summary statistics, and identify null values.
2	Data Handling with Excel: Working with structured data in Excel, Basic functions- sort, filter, pivot tables, lookup functions. 2.1 Using a dataset of student scores, create pivot tables showing average scores per subject. Add slicers to filter by class/section and generate bar charts for top 10 performers. 2.2 Use Excel functions (VLOOKUP, IF, AVERAGEIF) to identify students with less than 75% attendance and flag them for academic warning

3	Data Manipulation using Python (NumPy & Pandas): Introduction to Pandas DataFrames and NumPy arrays, Data cleaning: missing values, duplicates, outliers, Data transformation: filtering, grouping, merging, reshaping. 3.1 Clean a merged dataset containing student marks and attendance. Handle missing values, drop duplicates, and create a new column final_score = 0.7 * theory + 0.3 * practical 3.2 Perform data transformations: • Group by subject and compute average scores. • Use pivot_table to view subject-wise performance. • Merge two data sources (scores and demographics)
4	Data Visualization Technique: Importance of visualization in analytics, Plotting libraries- Matplotlib, Choosing appropriate charts for different data types. 4.1 Create the following using Matplotlib: • Histogram of student scores • Box plot comparing marks across subjects • Line plot of attendance trends over time
5	Power BI / Tableau Basics: Data import and model creation, Visualization creation and dashboard design, Basic DAX formulas (for Power BI). 5.1 Import student data into Power BI. Create relationships between student, attendance, and marks tables. Use DAX to calculate: • Average score • Attendance ratio • Count of students scoring above 85% 5.2 Design a dashboard in Power BI/Tableau with: • KPI tiles (avg score, attendance %) • Charts for marks by class • Filters/slicers for gender, section, subject
6	Statistical Inference & Hypothesis Testing: Hypothesis formulation, Level of significance, critical region, critical value, Small-sample tests- Student's t-test (single mean, difference of means), F-test (variance comparison), Chi-square test, Large-sample tests- Z-test for single proportion, Z-test for single mean 6.1 Perform a t-test to determine if the average performance of Class A differs significantly from the expected pass threshold (e.g., 50%). 6.2 Conduct an F-test to compare score variability between two sections and determine if one section is more consistent. 6.3 Apply a Chi-square goodness-of-fit test to see if the grade distribution (A, B, C, D, F) matches the expected distribution. 6.4 Use a Z-test to assess whether the proportion of students attending more than 80% of classes is significantly greater than 60%

Mini-Project: Academic Performance Analytics for Student Success

You are hired as a **data analyst** for a school group that wants to evaluate the performance of students across multiple departments. The aim is to identify:

- Factors affecting student performance
- Analysis of attendance behavior and subject-wise performance variation
- Whether performance is improving year over year
- If there are statistically significant differences between student groups

Dataset Requirements:
You can use a real or simulated dataset that contains: Student_ID, Name, Department, Class, Gender, Marks_Subject1, Marks_Subject2, Attendance, Grade, Academic_Year

Reference Books

1. Martin C. Brown, "Python The complete Reference", 4th edition, McGraw Hill Education, 2018.
2. Allen B. Downey, "Think Python", 1st edition, Green Tea Press, 2012.
3. Allen B. Downey, "Think Stats", 2nd edition, Green Tea Press, 2014.

Online Learning Materials

1. Wes McKinney, "Python for Data Analysis", 1st Edition, O'Reilly Media, GitHub Repository https://github.com/wesm/pydata-book Accessed on May 12, 2025
2. Microsoft, "Power BI Guided Learning", Microsoft Learn, Free Access. https://learn.microsoft.com/en-us/training/powerplatform/power-bi Accessed on May 12, 2025
3. Tableau Software, "Tableau Free eLearning Videos", Tableau Public, Free Access. https://www.tableau.com/learn/training Accessed on May 12, 2025
4. Excel Easy, "Excel Tutorial for Beginners", Excel-Easy.com, Free Access https://www.excel-easy.com/ Accessed on May 12, 2025

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B.Tech. (CSE) Scheme - 2024

Course Code: MCCS101
Course Title: Environmental Sciences and Sustainability

Programme: B.Tech.	**L:** 2 **T:0 P:** 0	**Credits:** 0
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 30(L) = 30 hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** 0
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 0%		
Duration of End Semester Examination (ESE): Nil		
Course Type: Core Course		

Prerequisites (if any): NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	To understand problems of environmental pollution, its impact on human and ecosystem.
2	Gain knowledge on natural processes and resources that sustain life and govern economy.
3	Analyze the role of conservation of biodiversity and its importance
4	To make use of green computing fundamentals for sustainable solutions.
5	To analyze the e-waste management for sustainable development.
6	Adopt sustainability as a practice in life and society.

Contents

Part-A

Unit-1 Introduction to Environment Sciences 5(L) hrs

Multidisciplinary nature of environmental studies- definition, scope and importance, need for public awareness. Natural Resources- renewable and non-renewable resources, natural resources and associated problems, forest resources, water resources, mineral resources, food resources, energy resources, land resources, role of an individual in conservation of natural resources, equitable use of resources for sustainable life style.

Unit-2 Eco system 5(L) hrs

Ecosystems- concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids, introduction, types, characteristic features, structure and function of the following ecosystems- forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

Unit-3 Biodiversity and its conservation 5(L) hrs

Biodiversity and its conservation- introduction, genetic, species and ecosystem diversity, biogeographical classification of India, Value of biodiversity, biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity- in-situ and ex-situ conservation of biodiversity.

Part-B

Unit-4 Electronic Waste Management **5(L) hrs**

What is e-waste, raw materials present in e-waste, environmental aspects of e-waste, social aspects of e-waste. An overview of treatment technologies of E-waste- Introduction, types of contaminants in E-waste, treatment strategies of E-waste, recycling, landfill disposal, biological treatment, advanced methods, Case study- E-waste Streams.

Unit-5 Sustainability and Sustainable Computing **6(L) hrs**

Concept of sustainability, Sustainability Indicators, environmental indicators (e.g., air/water quality), needs and challenges- economic, social and aspects of sustainability, energy efficient computing, sustainable software design, green data centers, cloud sustainability. Case study- Green IT.

Unit-6 Green Computing **4(L) hrs**

Understanding Green Computing, environmental challenges in software development, practices for green computing in software development, strategies for promoting environmental sustainability in software development, impacts of green technology, green awareness, green initiatives in information technology, green technology certifications, issues & challenges ahead.

Text Books

1. D.D. Mishra, “Fundamental concepts in Environmental Studies”, S Chand and Co Ltd. 2nd Edition, 2022.
2. Anubha Kaushik and C. P. Kaushik’s “Perspectives in Environmental Studies”, 6th Edition, New Age International Publishers ,2018.
3. Vishal Jain, Murali Raman, “Convergence Strategies for Green Computing and Sustainable Development”, Publisher-IGI Global, 2023.

Reference Books

1. Erach Barucha, “Textbook of Environmental studies”, UGC, 3rd edition, 2021.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2nd edition, 2016.
3. Dharmendra S. Sengar, “Environmental law”, Prentice Hall of India Pvt. Ltd, New Delhi,2nd edition, 2007.
4. P. Jayarama Reddy, “Urban Mining and Sustainable Waste Management”, CRC Press, 2016.

Online Learning Materials

1. https://wjaets.com/sites/default/files/WJAETS-2024-0052.pdf Accessed: May 12, 2025
2. https://wasteaid.org/wp-content/uploads/2022/06/Handbook-of-E-waste-management.pdf Accessed: May 12, 2025
3. https://onlinecourses.nptel.ac.in/noc24_hs160/preview Accessed: May 12, 2025
4. https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf Accessed: May 12, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Certificate course in Environmental Sustainability	Dr. M. Rajesh, Dr. Sindhu P Nair, Dr. Jalajakumari VT, Dr. P Unnikrishnan	IGNOU Regional Centre, Vatakara	https://onlinecourses.swayam2.ac.in/nou20_ag12/preview