Structure of Curriculum for Bachelor of Technology (B.Tech.) in Information Technology Programme

Syllabus Aligned with the National Education Policy (NEP) 2020
Effective from Academic Year 2026–2027

(For Affiliated Colleges)

Department of Information Technology

Dr. Babasaheb Ambedkar Technological University, Lonere

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Abbreviations

Abbreviation	Definition
BSC	Basic Science Course
PCC	Programme Core Course
PEC	Programme Elective Course
MDM	Multidisciplinary Minor
OE	Open Electives
HSSM	Humanities, Social Science, and Management Course
VEC	Value Education Courses
VSEC	Vocational and Skill Enhancement Courses
CEP	Community Engagement Project
FP	Field Project
OJT	On Job Training
HON	Honor Course
DM	Double Minor
RM	Research Methodology
HR	Honor with Research
L	Lecture
P	Practical
T	Tutorial
CA	Continuous Assessment
MSE	Mid Semester Exam
ESE	End Semester Exam
CR	Credits

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B.Tech. in Information Technology with Multidisciplinary Minor

Vision

To be a center of excellence in Information Technology education, research, and innovation, nurturing globally competent professionals with ethical values and social responsibility.

Mission

M1:	To impart strong theoretical and practical knowledge in emerging areas of Information Technology.
M2:	To promote interdisciplinary learning, innovation, and research culture.
M3:	To inculcate ethical values, leadership skills, and societal responsibility.
M4:	To develop industry-ready professionals with lifelong learning capabilities.

Programme Educational Objectives (PEOs)

PEO1:	Apply engineering principles, computing knowledge, and modern tools to solve real-world problems in industry, academia, and entrepreneurship.
PEO2:	Engage in innovation, research, or higher studies to advance in their professional careers.
PEO3:	Demonstrate ethical behavior, leadership, teamwork, and communication skills in multidisciplinary environments.
PEO4:	Contribute to society by developing sustainable, inclusive, and technology-driven solutions.
PEO5:	Pursue continuous learning and adapt to technological advancements throughout their professional journey.

Programme Outcomes (POs)

PO1:	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and Information Technology specialization to solve complex problems.
PO2:	**Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems to reach substantiated conclusions.
PO3:	**Design/Development of Solutions:** Design IT solutions and systems to meet desired needs with consideration for public health, safety, culture, society, and environment.
PO4:	**Conduct Investigations of Complex Problems:** Use research-based knowledge and methods to analyze and interpret data and provide valid conclusions.
PO5:	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern IT tools for complex engineering activities.
PO6:	**The Engineer and Society:** Apply contextual knowledge to assess societal, legal, and cultural issues relevant to professional practice.
PO7:	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities.
PO8:	**Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings.
PO9:	**Communication:** Communicate effectively with engineering communities and society at large, and write effective reports and documentation.
PO10:	**Project Management and Finance:** Demonstrate knowledge of project management and financial principles to manage projects in a multidisciplinary environment.
PO11:	**Lifelong Learning:** Recognize the need for lifelong learning in the context of technological change.

Programme Specific Outcomes (PSOs)

PSO1:	Apply the principles and practices of computing and software engineering to develop real-world IT solutions in domains like Web, Data Analytics, Networks, and Cybersecurity.
PSO2:	Demonstrate proficiency in using modern tools, programming languages, and platforms for effective problem-solving and project implementation.
PSO3:	Exhibit leadership, innovation, and ethical responsibility in IT practices, with effective teamwork and communication.

PEO–PO–PSO Correlation Matrix

PEOs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PSO 3
PEO1	3	3	3	2	3	1	1	1	1	2	2	3	3	2
PEO2	2	2	2	3	3	1	1	1	2	2	3	3	3	2
PEO3	1	1	2	1	2	2	3	3	3	3	2	1	2	3
PEO4	2	2	3	2	2	3	3	2	2	1	2	3	2	3
PEO5	2	2	2	2	3	1	1	2	2	2	3	2	3	2

Note: Values in the matrix represent the level of correlation between PEOs and POs/ PSOs:**1**– Low, **2**– Medium, **3**–High.

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Curriculum Structure for Third Year B. Tech (Information Technology)

Semester – V

Sr. No.	Course Type	Course code	Course Name	Hours		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total Mark	Total
1	PCC	**26AF1246PC501**	Operating Systems	3	-	20	20	60	100	3
2	PCC Lab	**26AF1246PCL502**	Operating Systems Lab	-	2	60	-	40*	100	1
3	PCC	**26AF1246PC503**	Database Management Systems	3	-	20	20	60	100	3
4	PCC Lab	**26AF1246PCL504**	Database Management Systems Lab	-	2	60	-	40*	100	1
5	PCC	**26AF1246PC505**	Compiler Design	3	-	20	20	60	100	3
6	MDM	**26AF1246MD506**	Multidisciplinary Minor-3	3	-	20	20	60	100	3
7	OE	**25AF1MACOEMO5(X)**	Open Elective-3	3	-	20	20	60	100	3
8	PEC	**26AF1246PE508A** **26AF1246PE508B** **26AF1246PE508C**	A. Data science and visualization B. Internet of Things C. Blockchain Technology	3	-	20	20	60	100	3
9	PEC Lab	**26AF1246PEL509A** **26AF1246PEL509B** **26AF1246PEL509C**	A. Data science and visualization with Python Programming Lab B. Internet of Things Lab C. Blockchain Technology Lab	-	2	60	-	40*	100	1
10	ELC	**26AF1246ELC510**	Mini project-1	-	2	60	-	40*	100	1
			Total	**18**	**8**	**360**	**120**	**520**	**1000**	**22**

***Practical/Oral evaluation of 40 marks at the end of the semester.**
†Presentation/Oral evaluation of 40 marks at the end of the semester.

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Semester – VI										
Sr. No.	**Course Type**	**Course code**	**Course Name**	**Hours**		**Examination Scheme**				**Credits**
				L	**P**	**CA**	**MSE**	**E S E**	**Total Marks**	**Total**
1	PCC	**26AF1246PC601**	Software Design and Testing	3	-	20	20	60	100	3
2	PCC Lab	**26AF1246PCL602**	Software Design and Testing Lab	-	2	60	-	40 *	100	1
3	PCC	**26AF1246PC603**	Computer Networks and Internet Protocol	3	-	20	20	60	100	3
4	PCC Lab	**26AF1246PCL604**	Computer Networks and Internet Protocol Lab	-	2	60	-	40 *	100	1
5	PCC	**26AF1246PC605**	Soft computing	3	-	20	20	60	100	3
6	MDM	**26AF1246MD606**	Multidisciplinary Minor-4	3	-	20	20	60	100	3
7	PEC	**26AF1246PE607A** **26AF1246PE607B** **26AF1246PE607C**	A. Cloud Computing B. Enterprise Resource Planning C. Management information System	3	-	20	20	60	100	3
8	PEC	**26AF1246PE608A** **26AF1246PE608B** **26AF1246PE608C**	A. Machine Learning B. Generative AI & prompt engineering C. Augmented Reality and Virtual Reality	3	-	20	20	60	100	3
9	PEC Lab	**26AF1246PEL609A** **26AF1246PEL609B** **26AF1246PEL609C**	A. Machine Learning Lab B. Generative AI & prompt Engineering Lab C. Augmented Reality and Virtual Reality Lab	-	2	60	-	40 *	100	1
10	ELC	**26AF1246 ELC 610**	Mini project-2	-	2	60	-	40 *	100	1
Total				**18**	**08**	**360**	**120**	**520**	**1000**	**22**

***Practical/Oral evaluation of 40 marks at the end of the semester.**
†Presentation/Oral evaluation of 40 marks at the end of the semester.

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List of Multidisciplinary Minor (MDM) Courses offered by Department of Information Technology

Multidisciplinary Minor (MDM) Courses

Sr. No.	Course Type	Semester	Course code	Course Name	Hours		Examination Scheme				Credits
					L	P	CA	MSE	ESE	Total Marks	Total
1	MDM	Sem-III	**25AF1246MD306**	Data Structures	2	-	20	20	60	100	2
2	MDM	Sem-IV	**25AF1246MD406**	Computer Organization and Architecture	3	-	20	20	60	100	3
3	MDM	Sem-V	**25AF1246MD506**	Machine learning	3	-	20	20	60	100	3
4	MDM	Sem-VI	**25AF1246MD606**	Cloud Computing	3	-	20	20	60	100	3
5	MDM	Sem-VII	**25AF1246MD706**	Internet Of Things	3	-	20	20	60	100	3
				Total	**14**	**0**	**100**	**100**	**300**	**500**	**14**

Note: ***Information Technology department Students*** *will choose a* ***Multidisciplinary Minor (MDM) Bucket*** *(a Set of Courses to be learnt from 2nd Year to Third/Final Year) offered by the* ***other departments.***

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List of Open Elective (OE) Courses offered by University

Faculty-wise baskets of OE are prepared by University which are chosen from faculty **other than** that of the Major Faculty i.e. in this case **Major Faculty is Faculty of Engineering**. Other Faculties considered are as follows:

1. Faculty of Management and Commerce
2. Faculty of Law
3. Faculty of Humanities and Arts
4. Faculty of Architecture and Planning
5. Faculty of Health Sciences
6. Faculty of Science

Students need to take up **three or four courses of 08 credits** over semesters **III** to **V**

Open Elective (OE) Courses

Sr. No.	Course Type	Semester	University OE Courses link	Hours		Examination Scheme				Credits
				L	P	CA	MSE	E SE	Total Mark	Total
1	OE	Sem-III	https://dbatu.ac.in/wp-content/uploads/2024/08/Open-Electives-Buckets-for-University-Campus-2024-25.pdf	3	-	20	20	60	100	3
2	OE	Sem-IV		2	-	20	20	60	100	2
3	OE	Sem-V		3	-	20	20	60	100	3
Total				**8**	**0**	**60**	**60**	**180**	**300**	**8**

Note: *It is essential for students to choose these courses from disciplines* ***other than their major programme (i.e. engineering)*** *for which they initially* ***enrolled in during their first year (ex.B. Tech. IT).***

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List of Honor Courses offered by Department of Information Technology

Honor (HON) Courses

Sr. No.	Course Type	Semester	Course code	Course Name	Hours		Examination Scheme				Credits
					L	P	CA	MSE	ESE	Total Marks	Total
1	HON	Sem-III	**25AF1246HON301**	Optimization Techniques	3	-	20	20	60	100	3
2	HON	Sem-IV	**25AF1246HON402**	Advanced Algorithms and Data Structures	3	-	20	20	60	100	3
3	HON	Sem-V	**25AF1246HON503**	Advanced Computer Architecture	3	-	20	20	60	100	3
4	HON	Sem-VI	**25AF1246HON604**	Mobile Computing	3	-	20	20	60	100	3
5	HON	Sem-VII	**25AF1246HON705**	Robotics and Embedded Systems	3	-	20	20	60	100	3
6	HON	Sem-VIII	**25AF1246HON806**	Artificial Neural Networks	3	-	20	20	60	100	3
				Total	**18**	**0**	**120**	**120**	**360**	**600**	**18**

Note: *Students with a* ***CGPA ≥ 7.5*** *after the first year are* ***eligible*** *to opt for 6 additional courses (18–20 credits) from their* ***parent (major) department.***

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List of Double Minor (DM) Courses offered by Department of Information Technology

Double Minor (DM) Courses

Sr. No.	Course Type	Semester	Course code	Course Name	Hours		Examination Scheme				Credits
					L	P	CA	MSE	ESE	Total Marks	Total
1	DM	Sem-III	**25AF1246DM301**	Computer Networks Fundamentals	3	-	20	20	60	100	3
2	DM	Sem-IV	**25AF1246DM402**	Data science and visualization	3	-	20	20	60	100	3
3	DM	Sem-V	**25AF1246DM503**	IT Service Management (ITSM)	3	-	20	20	60	100	3
4	DM	Sem-VI	**25AF1246DM604**	DevOps (Development and operations)	3	-	20	20	60	100	3
5	DM	Sem-VII	**25AF1246DM705**	UI/UX Design	3	-	20	20	60	100	3
6	DM	Sem-VIII	**25AF1246DM806**	Data Security	3	-	20	20	60	100	3
				Total	**18**	**0**	**120**	**120**	**360**	**600**	**18**

Note: *Student are required to select a double minor program from a department* ***other than their major programme*** *(Students who enrolled in their first year of engineering is the major programme* ***B. Tech. IT****) and it* ***must different*** *from the* ***Multidisciplinary Minor programme****.*

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List of Honor with Research Courses in Semester –VII and Semester -VIII offered by Department of Information Technology

Honor with Research (HR) Courses

Sr. No.	Course Type	Semester	Course code	Course Name	Hours		Examination Scheme				Credits
					L	P	CA	MSE	ESE	Total Mark	Total
1	HR	Sem-VII	**25AF1246HRL701**	**Research Orientation, Literature Review & Proposal Approval** *(Includes: problem identification, research gap analysis, and proposal defense)*	-	6	60	-	40	100	**3**
2	HR	Sem-VII	**25AF1246HRL702**	**Project Implementation – Phase I & IPR Awareness** *(Initial design, development, and Intellectual Property Rights & Research Ethics training)*	-	6	60	-	40	100	**3**
3	HR	Sem-VIII	**25AF1246HRL803**	**Project Implementation – Phase II & Documentation** *(Final implementation, validation, and thesis preparation)*	-	6	60	-	40	100	**3**
4	HR	Sem-VIII	**25AF1246HRL804**	**Research Paper Writing & Publication** *(Target: Scopus/Web of Science/IEEE/UGC-CARE journals or reputed conferences)*	-	6	60	-	40	100	**3**
5	HR	Sem-VIII	**25AF1246HRL805**	**Final Viva / Project Defense** *(Internal & External evaluation, defense of research work)*	-	12	100		100	200	**6**
				Total	**-**	**36**	**340**	**-**	**260**	**600**	**18**

Note: *Students with a* ***CGPA ≥ 7.5 or 75%*** *after the* ***6th semester*** *are eligible for the* ***UG Research degree*** *and must complete an* ***additional 18-credit*** *research project/dissertation in the 4th year within their major discipline.*

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Credit Distribution:

1. B.Tech. degree with a multidisciplinary minor:

SEM- I	SEM -II	SEM -III	SEM -IV	SEM -V	SEM -VI	SEM -VII	SE M – VIII	TOTA L
21	23	22	23	22	22	22	12	**167** (160-176)

2. B.Tech. honour with multidisciplinary minor:

SEM- I	SEM -II	SEM -III	SEM -IV	SEM -V	SEM -VI	SEM -VII	SE M – VIII	TOTA L
21	23	22+3	23+3	22+3	22+3	22+3	12+3	**167+18 =185** (180-194)

3. B.Tech. honour with Research and multidisciplinary minor:

SEM- I	SEM -II	SEM -III	SEM -IV	SEM -V	SEM -VI	SEM -VII	SE M – VIII	TOTA L
21	23	22	23	22	22	22+6	12+12	**167+18 =185** (180-194)

4. B.Tech. degree with Double Minors (Multidisciplinary and Specialization Minors) :

SEM- I	SEM -II	SEM -III	SEM -IV	SEM -V	SEM -VI	SEM -VII	SEM - VIII	TOTA L
21	23	22+3	23+3	21+3	22+3	22+3	18+3	**167+18 =185** (180-194)

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List of Exit Options after Third Year B.Tech to Qualify for B. Voc. in Information Technology

Sr. No.	Course Code	Semester	Name of the course	Credits		
				Theory	Practical	Total
1	**25AF1246EX401**	Sem-IV	IT Hardware and Networking https://klic.mkcl.org/klic-courses/it-hardware-and-networking	120Hr		8
			Total	**120**		**8**

OR

Sr. No.	Course Code	Semester	Name of the course	Credits		
				Theory	Practical	Total
1	**25AF1246EX402**	Sem-IV	Java Programming Essentials and Mobile App Development https://klic.mkcl.org/klic-courses/java-programming-essentials-and-mobile-app-development	120Hr		8
			Total	**120**		**8**

Important criteria for the Exit Option after Second Year	
Total Additional Credits Required	**08**
Certificate Awarded	**B. Voc.** in IT
Requirement	Completion of any one Skill-Based Course listed in the Exit Option Structure
Duration	Summer Vacation
Important Guidelines	
1. **Option Registration**	Must be registered with the Parent Department & Exam Section
2. **Prerequisite**	Clearing of all course work till the End of Third Year as a Regular Student.
3. **Minimum Credits Earned**	**120**
4. **Evaluation**	Conducted by the Department for the award of the said certification.
5. **Document Submission**	Original Course/Internship Certificates required at the time of evaluation

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Criteria for Re-entry or Lateral Entry under NEP 2020

Sr.No.	Re-entry or Lateral Entry (NEP 2020)
1.	**Re-entry Option**: Students exiting at any level can **rejoin** the same or another institution **within 4 years** to complete their degree.
2.	**Maximum Duration**: The entire degree must be completed **within 8 years** from the date of first admission.
3.	**Based on Credits**: Re-entry or lateral entry is allowed based on **valid earned credits** stored in the **Academic Bank of Credits (ABC)**.
4.	**Multiple Entry Paths**: Students can re-enter into **UG Diploma, B.Voc, UG Degree (Single/Double Minor), Honours, or Research** programs.
5.	**Subject to Availability**: Admission depends on **intake capacity** and **validation of prior learning outcomes**.

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Syllabus of SEMESTER-V Courses

Teaching Scheme		OPERATING SYSTEMS Course code: **26AF1246PC501**	Examination Scheme	
TH	**3**	**Prerequisite** - Computer organization and Architecture	**CA**	**20**
PR	**2**	**Course Objectives:** 1. To understand the fundamental concepts, structures, and services of operating systems. 2. To study process management, CPU scheduling, threads, and inter-process communication mechanisms. 3. To analyse process synchronization techniques and deadlock handling methods. 4. To understand memory management techniques, virtual memory, and page replacement algorithms. 5. To learn file system organization, directory structures, and secondary storage management.	**MSE**	**20**
CR	**1**		**ESE**	**60**
			TOTAL	**100**

Course Outcomes (COs):

At the end of Course Students will be able.

CO1: Explain the structure, components, services, and design principles of operating systems.

CO2: Apply process scheduling algorithms, thread concepts, and inter-process communication techniques to solve process management problems.

CO3: Analyse synchronization issues and implement appropriate synchronization mechanisms and deadlock handling strategies.

CO4: Evaluate memory management techniques including paging, segmentation, virtual memory, and page replacement algorithms.

CO5: Describe file system organization, directory structures, and the role of secondary storage devices in operating systems.

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	1	–	1	–	–	–	–	–	2	3	1	–
CO2	3	3	2	1	2	–	–	1	–	–	2	3	2	1
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–
CO5	3	2	1	1	2	–	–	–	–	–	2	3	2	–

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONENT

Unit No.	Topic	Hours
1	Introduction: System Booting, Operating System Structures: Definition, Types of operating system, System components, System services, Systems calls, shell with commands, System programs, System structure, Virtual machines, System design and implementation.	06 Hrs
2	**Process Scheduling:** Processes and CPU scheduling: Process concept, Process scheduling, Operation on a process, Cooperating processes, Threads, Multithreading Models, Inter process communication, Scheduling criteria, Scheduling algorithms, Process Synchronization: The critical-section problem, Critical regions, Synchronization hardware, Semaphores, Monitors.	08 Hrs.
3	**Deadlocks:** Systems model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock, combined approach to Deadlock handling.	08 Hrs
4	**Memory Management and Virtual Memory:** Logical versus physical address space, MMU, Memory Management requirements, Memory partitioning: Fixed & Dynamic partitioning, Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit),Swapping, Contiguous allocation, Paging, Segmentation, Demand paging, Page replacement algorithms, Thrashing.	08 Hrs
5	**I/O and File Management:** I/O Management and Disk Scheduling: I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches. **File Management:** Overview, File Organization and access, File Directories, File Sharing, Security issues, Record Blocking, Secondary Storage Management. Comparative study of Windows and UNIX file systems.	05 Hrs
	Text Books: 1. A. Silberschatz, P. B. Galvin, and G. Gagne, ***Operating System Concepts Essentials***, 10th ed., Wiley Asia, Student Edition, 2021. **Reference Books:** 1. W. Stallings, ***Operating Systems: Internals and Design Principles***, 5th ed., Prentice Hall of India. 2. C. Crowley, ***Operating System: A Design-Oriented Approach***, 1st ed., Irwin Publishing. 3. G. J. Nutt, ***Operating Systems: A Modern Perspective***, 2nd ed., Addison-Wesley. 4. D. M. Dhamdhere, ***Systems Programming and Operating Systems***, 2nd ed., Tata McGraw-Hill, 2001.	

5. G. Nutt, ***Operating Systems Concepts***, 3rd ed., Addison-Wesley.
6. H. M. Deitel, ***An Introduction to Operating Systems***, 3rd ed., Pearson Education, 2007.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Operating System Fundamentals	Prof. Santanu Chattopadhyay	IIT Kharagpur	https://nptel.ac.in/courses/106105214
02	Introduction to Operating Systems	Prof. Chester Rebeiro	IIT Madras	https://nptel.ac.in/courses/106106144

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Teaching Scheme	Operating system Lab Course code**: 26AF1246PCL502**	Examination Scheme	
2 Hrs / Week = Credit 1	**Course Outcomes (COs):** *Upon successful completion of this course, students will be able to:* **CO1:** Demonstrate proficiency in Linux/UNIX environment, shell commands, and process management using system calls. **CO2:** Analyze and implement CPU scheduling algorithms and evaluate their performance. **CO3:** Apply deadlock prevention, avoidance, and detection techniques in operating systems. **CO4:** Implement memory management techniques including partition allocation and virtual memory management. **CO5:** Perform file system operations and manage directories, permissions, and storage resources in Linux.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	–	1	–	–	2	3	3	1	3
CO2	3	3	2	2	2	–	1	–	–	2	3	2	1	3
CO3	3	3	2	2	2	1	1	–	–	2	3	2	1	3
CO4	3	3	2	2	2	–	–	–	–	2	3	2	–	3
CO5	3	2	1	1	3	1	1	–	–	2	3	3	1	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

List of Experiments:

1. Study and execution of basic Linux/UNIX shell commands.
2. Program to create and terminate processes using system calls.
3. Implementation of CPU Scheduling algorithm (FCFS).
4. Implementation of CPU Scheduling algorithm (SJF).
5. Implementation of CPU Scheduling Algorithms: Round Robin Scheduling.
6. Implementation of Banker's Algorithm for Deadlock Avoidance.
7. Simulation of Deadlock Detection Algorithm
8. Implementation of Fixed Partition Memory Allocation (First Fit, Best Fit, Worst Fit)
9. Implementation of Page Replacement Algorithms.
10. File System Operations: Create, Read, Write, Delete, and Rename Files
12. Directory Management and File Permissions in Linux.
13. Mini Project: Simulation of an Operating System Module (Scheduling, Memory Management, or File System)

Note:

1. The above list is for illustration purposes only. The course coordinator may update or change the list as needed,
2. At least **8** to**10** experiments should be performed.
3. Students should be encouraged to design and perform new experiments, subject to prior approval from the respective subject authority.

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Teaching Scheme		Database Management System Course code: **26AF1246PC503**	Examination Scheme	
TH	**3**	**Course Objectives:** **1.** Understand the fundamental concepts of database systems, data models, database architecture, and the advantages of DBMS over file processing systems. **2.** Learn data modeling techniques and design databases using Entity-Relationship (ER) diagrams and relational models. **3.** Develop the ability to formulate and execute database queries using relational algebra and SQL. **4.** Understand database design principles, normalization techniques, and integrity constraints for efficient database implementation. **5.** Study transaction processing, concurrency control, recovery mechanisms, and database security concepts. **Course Outcomes (COs):** *At the end of Course Students will be able.* **CO1:** Explain fundamental concepts of database systems, data models, ER modeling, and database architecture. **CO2:** Design conceptual and logical database schemas using Entity-Relationship (ER) diagrams and relational models. **CO3:** Apply relational algebra, relational calculus, and SQL queries for data retrieval and manipulation. **CO4:** Understand database design concepts and able to create E-R Model. **CO5:** Understand Big data and learning about its analytics also able to understands storage system.	**CA**	**20**
PR	**-**		**MSE**	**20**
CR	**3**		**ESE**	**60**
			TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	-	-	-	1	-	1	2	2	-
CO2	3	3	3	2	2	-	-	1	1	-	1	3	2	-
CO3	3	3	2	2	3	-	-	-	1	-	1	3	3	-
CO4	3	3	3	2	2	-	-	1	1	-	1	3	2	-
CO5	2	3	2	3	3	1	-	-	1	-	2	3	3	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**– Medium, **3**–High.

COURSE CONTENTS

Unit No.	Unit Details	Hours
1	Introduction: Basic concepts, Advantages of DBMS over file-processing systems, Data abstraction, Data models and data independence, Components of DBMS and overall structure of DBMS, Data modeling, Entity, Attributes, Relationships, Constraints, Keys E-R diagrams, Components of E-R Model.	8 Hrs
2	Relational Model: Basic concepts, Attributes and domains, Concept of integrity and referential constraints, Schema diagram, Relational query languages, Relational Algebra and Relational Calculus: Tuple relational and domain relational calculus. Structured Query Language-I: Introduction, Characteristics and advantages, Data types and literals, DDL, Tables: creating, modifying, deleting.	8 Hrs
3	Views: Creating, Dropping, Updation using views, DML, Operators, SQL DML queries, SELECT query and clauses. Structured Query Language- II: Set operations, Predicates and joins, Set membership, Tuple variables, Set comparison, Ordering of tuples, Aggregate functions, Nested queries, Database modification using SQL Insert, Update and Delete queries, Dynamic and SQL and concept of stored procedures, Query by-example.	8 Hrs
4	Database Design Using the E-R Model: 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, Features of Good Relational Designs, Normal Forms(1NF,2NF,3NF)	8 Hrs
5	BIG DATA ANALYTICS: **Big Data**: Big Data Storage System, The MapReduce Paradigm, Beyond MapReduce: Algebraic Operations, Streaming Data, Graph Databases, **Data Analytics**: Overview of Analytics, Data Warehousing, Data Mining, Physical Storage Systems: Overview of Physical Storage Media, Storage Interface, Magnetic Disks, Flash Memory, RAID	8 Hrs
	Textbooks: 1. A. Silberschatz, H. F. Korth, and S. Sudarshan, ***Database System Concepts***, 7th ed., McGraw Hill Education, 2019. 2. R. Elmasri and S. B. Navathe, ***Fundamentals of Database Systems***, 7th ed., Pearson Education, 2015. 3. R. Ramakrishnan and J. Gehrke, ***Database Management Systems***, 3rd ed., McGraw Hill Education, 2007.	

Reference Books:

1. C. Coronel and S. Morris, ***Database Systems: Design, Implementation, and Management***, 11th ed., Cengage Learning, 2014.
2. J. Murach, ***Murach's MySQL***, 2nd ed., Shroff Publishers, 2016.
3. J. Murach, ***Murach's Oracle SQL and PL/SQL: Works with All Versions Through 11g***, Shroff Publishers, 2008.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Data Base Management System	Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay	IIT Kharagpur	https://nptel.ac.in/courses/106105175

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Teaching Scheme	**Database Management System Lab** Course code**: 26AF1246PCL504**	**Examination Scheme**	
2 Hrs / Week = Credit 1	**Course Outcomes (COs):** *Upon successful completion of this course, students will be able to:* **CO1:** Explain the fundamentals of DBMS, data models, E-R modeling, and relational databases. **CO2:** Apply SQL, relational algebra, and relational calculus to create, retrieve, update, and manage databases. **CO3:** Design normalized databases and implement advanced SQL features such as joins, views, triggers, stored procedures, cursors, and exception handling. **CO4:** Develop database applications using database design principles and GUI-based interfaces for real-world problems. **CO5:** Explain Big Data concepts, data warehousing, data mining, MapReduce, and modern database storage systems.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	-	1	3	2	1
CO2	3	3	2	1	3	-	-	-	-	-	1	3	3	1
CO3	3	3	3	2	3	-	1	1	1	-	2	3	3	2
CO4	2	3	3	2	3	1	1	2	2	2	2	3	3	3
CO5	2	2	1	2	3	1	-	-	-	-	3	2	3	2

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

List of Experiments:

1. Creation of databases and use of SQL commands (DDL, DML and DCL).
2. Suitable exercises to practice SQL commands may be given for Insert, Update and Delete.
3. Write SQL procedure for an application which uses exception handling.
4. Write SQL procedure for an application with cursors.
5. Write SQL for implementing Nested Queries.
6. Write SQL for implementing Join Queries.
7. Write a DBMS program to prepare reports for an application using functions.
8. Write SQL block containing triggers.
9. Write SQL block containing stored procedures.
10. Develop a menu driven, GUI-based database application in any one of the domains such as Banking, Billing, Library management, Payroll, Insurance, Inventory, Healthcare etc. integrating all the features covered in the above exercises.

Note:

1. The above list is for illustration purposes only. The course coordinator may update or change the list as needed,
2. At least **8** to**10** experiments should be performed.
3. Students should be encouraged to design and perform new experiments, subject to prior approval from the respective subject authority.

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Teaching Scheme		Compiler Design Course code: **26AF1246PC505**	Examination Scheme	
TH	**3**	**Prerequisite Courses:**	**CA**	**20**
CR	**3**	1. Data Structures	**MSE**	**20**
		2. Complexity Theory	**ESE**	**60**
		Course Objectives: 1. To understand the concepts of Finite Automata. 2. Students should be able to design and analyze finite state machine. 3. To understand, design and implement various phases of compiler. 4. To extend the knowledge of parser by parsing LL parser and LR parser. 5. To understand optimization of codes and runtime environment	**TOTAL**	**100**
		Course Outcomes (COs): *Course Outcomes: Upon successful completion of this course, students will be able to:* **CO1:** Understand the concepts of automata, formal grammars and languages. **CO2:** Identify the capabilities and limitations of computing machine. **CO3:** To acquire the knowledge of modern compiler & its features. **CO4:** To learn & use the new tools and technologies used for designing a compiler. **CO5:** To use the knowledge of patterns, tokens & regular expressions for solving a problem in the field of data mining.		

CO-PO Mapping:

COs \ POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PS O1	PS O2	PSO 3
CO1	3	2	1	-	1	-	-	-	-	-	2	2	1	-
CO2	3	3	1	2	1	-	-	-	-	-	2	2	1	-
CO3	3	2	2	1	3	-	-	-	-	-	2	3	3	-
CO4	2	2	3	1	3	-	-	1	1		2	2	3	1
CO5	3	3	2	2	3	-	-	-	-	-	2	3	3	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Automata Theory and Finite State Machine** Symbols, Alphabet, String, Language, Difference between natural and formal language. Deterministic and Non-deterministic FA, Regular Expression, Algebraic laws of RE, Pumping lemma for regular languages.	07 Hrs
2	**Context Free Grammar and Pushdown Automata** CFG: Context Free Grammar, Parse Tree, Application of CFG: YACC, Ambiguity in Grammar and Language. Chomsky hierarchy.PDA: Definition, Graphical Notations, Examples, Language of a PDA.	07 Hrs
3	**Introduction to Lexical Analysis** Introduction to Compiling and Lexical Analysis: Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler-Construction tools, Role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.	07 Hrs
4	**Syntax Analysis and Syntax-Directed Translation** **Syntax Analysis:** The role of the Parser, Top-Down Parsing: FIRST, FOLLOW, LL (1) parser, Bottom- Up Parsing: LR-Parsers, Operator-precedence Parser. **Syntax-Directed Translation:** Definitions, Construction of Syntax Trees, Dependency graph, Types of attribute: Synthesized, Inherited, S-Attributed grammar, L-Attributed grammar.	07 Hrs
5	**Intermediate Code Generation and Optimization** Intermediate Code Generation: Variants of syntax trees, Three address code, Types and declarations, Type checking, Control Flow and Backpatching, procedure calls. Issues in the design of code generation, Need of code optimization, Principal sources of optimization, Basic blocks and flow graphs, Optimization of basic blocks, Peephole optimization.	08 Hrs
	Text Books: 1. J. E. Hopcroft, R. Motwani, and J. D. Ullman, ***Introduction to Automata Theory, Languages, and Computation***, 2nd ed., Addison-Wesley. 2. M. Sipser, ***Introduction to the Theory of Computation***, 2nd ed., Cengage Learning. 3. A. V. Aho, M. S. Lam, R. Sethi, and J. D. Ullman, ***Compilers: Principles, Techniques, and Tools***, 2nd ed., Pearson. **Reference Books:** 1 J. C. Martin, ***Introduction to Languages and the Theory of Computation***, 3rd ed., Tata McGraw-Hill, 2003.	

	2 K. C. Louden, ***Compiler Construction: Principles and Practice***, PWS Publishing Company, 1997.	

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Compiler Design	Prof. Santanu Chattopadhyay	IIT Kharagpur	https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs07

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Teaching Scheme		Data science and visualization Course code: **26AF1246PE508A**	Examination Scheme	
TH	3	**Prerequisite Courses:** **1**.Programming fundamentals	CA	20
PR	-	**Course Objectives:**	MSE	20
CR	3		ESE	60
			TOTAL	100

Course Objectives:

1. To understand the fundamentals of Data Science and the data analytics lifecycle.
2. To learn data preprocessing, cleaning, and transformation techniques
3. To apply statistical and machine learning methods for data analysis.
4. To develop skills in data visualization and interpretation.
5. To use Data Science tools for solving real-world problems.

Course Outcomes (COs):

At the end of Course Students will be able.

1. **To understand** the concepts, lifecycle, and applications of Data Science.
2. To **develop** data preprocessing, transformation, and exploratory data analysis
3. To **apply** statistical methods and basic machine learning techniques for data analysis.
4. **To create** effective visualizations and dashboards for data interpretation
5. **To analyze** real-world datasets and apply advanced analytics techniques to solve practical problems.

CO-PO Mapping:

COs \ POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PS O1	PS O2	PSO 3
CO1	3	2	–	–	1	–	–	–	–	–	2	2	1	–
CO2	2	3	1	3	2	–	–	–	–	–	1	3	2	–
CO3	3	3	2	3	2	–	–	–	–	–	1	3	2	–
CO4	1	2	2	2	3	–	–	–	2	–	1	2	3	1
CO5	3	3	3	3	2	1	–	1	1	–	2	3	2	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Data Science** :Introduction to Data Science and its applications, Data Science lifecycle, Types of data and data sources, Big Data concepts and ecosystem ,Data acquisition and data collection techniques, Introduction to Python for Data Science, Data Science tools and platforms	08 Hrs
2	**Data Preprocessing and Data Wrangling:** Data cleaning and integration ,Handling missing values and outliers ,Data transformation and normalization, Data reduction techniques, Feature engineering ,Data preparation using Pandas and NumPy ,Exploratory Data Analysis (EDA)	08 Hrs
3	**Statistical Analysis and Machine Learning Fundamentals:** Descriptive statistics ,Probability distributions ,Correlation and covariance ,Hypothesis testing ,Introduction to Machine Learning ,Supervised and Unsupervised Learning ,Classification and Regression basics.	08 Hrs
4	**Data Visualization Techniques:** Principles of data visualization,Visual perception and design,Charts: Bar, Pie, Line, Scatter, Histogram,Interactive visualization,Data storytelling,Visualization using Matplotlib and Seaborn ,Dashboard concepts.	08 Hrs
5	**Advanced Data Analytics and Applications:** Clustering techniques (K-Means),Association Rule Mining, Introduction to Predictive Analytics ,Case studies in Healthcare, Finance, and Marketing ,Ethical issues in Data Science ,Data privacy and security ,Emerging trends in Data Science and AI .	08 Hrs
	Text Book: 1. F. Provost and T. Fawcett, ***Data Science for Business***, O'Reilly Media. 2. W. McKinney, ***Python for Data Analysis***, O'Reilly Media. 3. P. Bruce, A. Bruce, and P. Gedeck, ***Practical Statistics for Data***	

Scientists, 2nd ed., O'Reilly Media.

Reference Books:

1. J. Han, M. Kamber, and J. Pei, ***Data Mining: Concepts and Techniques***, 3rd ed., Morgan Kaufmann.
2. A. C. Müller and S. Guido, ***Introduction to Machine Learning with Python: A Guide for Data Scientists***, O'Reilly Media, 2016.
3. C. N. Knaflic, ***Storytelling with Data: A Data Visualization Guide for Business Professionals***, Wiley, 2015.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Data Science for Engineers	Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan	IIT Madras	https://nptel.ac.in/courses/106106179
02	Data Visualization with Python	IBM	Coursera	https://www.coursera.org/learn/python-for-data-visualization?action=enroll#modules

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Teaching Scheme	Data science and visualization with Python Programming Lab Course code: **26AF1246PEL509A**	Examination Scheme	
2 Hrs / Week = Credit 1	**Course Objectives:** 1. To provide hands-on experience with Python libraries used in Data Science. 2. To develop skills in data collection, preprocessing, and analysis. 3. To apply statistical and machine learning techniques on datasets. 4. To create meaningful visualizations and dashboards. 5. To solve real-world problems using Data Science tools and techniques. **Course Outcomes (COs):** *At the end of Course Students will be able.* **CO1:** Use Python and Data Science libraries for data handling and analysis. **CO2:** Perform data cleaning, preprocessing, and transformation on datasets. **CO3:** Apply exploratory and statistical analysis techniques to extract meaningful insights from data. **CO4:** Design and develop effective data visualizations for interpretation and communication. **CO5:** Implement machine learning models and analyze real-world datasets to support data-driven decision-making.	**CA**	**60**
		MSE	**-**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PS O1	PS O2	PSO 3
CO1	3	2	-	2	3	-	-	-	-	-	1	2	3	-
CO2	2	3	-	3	2	-	-	-	-	-	1	3	2	-
CO3	2	3	-	3	2	-	-	-	1	-	1	3	2	-
CO4	2	2	2	3	3	-	-	1	2	-	1	2	3	1
CO5	3	3	2	3	3	-	1	1	1	1	2	3	3	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

List of Experiments:

1. Installation and familiarization with Python, Jupyter Notebook, NumPy, Pandas, Matplotlib, and Seaborn.
2. Data acquisition and loading datasets from CSV, Excel, and online sources using Pandas.
3. Data preprocessing: Handling missing values, duplicates, and outliers in datasets.
4. Data transformation and feature engineering using Pandas.
5. Exploratory Data Analysis (EDA) using descriptive statistics and correlation analysis.
6. Data visualization using Bar Charts, Pie Charts, Histograms, and Line Graphs.
7. Advanced visualization using Scatter Plots, Heat Maps, Pair Plots, and Box Plots.
8. Implementation of Classification algorithms (Decision Tree or K-Nearest Neighbors) using Scikit-Learn.
9. Implementation of Clustering (K-Means) and interpretation of results.
10. Mini Project: Data analysis, visualization, and presentation of insights using a real-world dataset.

Suggested Mini Project Domains

- Healthcare Data Analysis
- Student Performance Prediction
- Sales and Marketing Analytics
- Financial Data Analysis
- Social Media Data Analytics
- Weather Data Visualization

Note

1. The above list is for illustration purposes only. The course coordinator may update or modify the list as required.
2. At least 8 to 10 experiments should be performed.
3. Students should be encouraged to design and perform new experiments, subject to prior approval from the respective course instructor.

Software Requirements

1. Python 3.x
2. Jupyter Notebook / Google Colab
3. NumPy
4. Pandas
5. Matplotlib
6. Seaborn
7. Scikit-Learn

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Teaching Scheme		Internet Of Things Course code: **26AF1246PE508B**	Examination Scheme	
TH	**3**	**Course Objectives**:	**CA**	**20**
PR	**2**	1. To understand fundamentals of IoT system.	**MSE**	**20**
CR	**1**	2. To study various IoT protocols.	**ESE**	**60**
		3. To learn various elements of IoT security	**TOTAL**	**100**
		4. To use python programming in IoT		

Course Outcomes:
On completion of the course, students will be able to

CO1: Explain the characteristics and methodology to design IoT system

CO2: Identify various devices required for different IoT applications.

CO3: Describe various IoT protocols for communication between different endpoints to develop client server application.

CO4: Explain various elements of IoT Securities

CO5: Make use of various cloud offering available for IoT Platform

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PSO 3
CO1	3	2	1	–	1	–	–	–	–	–	2	3	1	–
CO2	3	3	2	1	2	–	–	1	–	–	2	3	2	1
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–
CO5	3	2	1	1	2	–	–	–	–	–	2	3	2	–

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to IoT and its Platforms Design :** Definition and characteristics of IoT, Applications, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges. **IoT Platform Design Methodology:** Purpose and requirement specification, Process specification, Domain model specification, Information model specification, Service specifications level specification, Functional view specification, Operational view specification, Device and component integration, Application development.	09 Hrs
2	**IoT Physical Devices and Programming Raspberry Pi with Python:** Basic building blocks of IoT device, Sensors and actuators, Connectivity technologies, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Beagle board and Other IoT Devices. **Programming Raspberry Pi with Python:** Working with digital and analog input output, Retrieving data from the real world with sensors, Working with accelerators, Temperature sensor, Displaying information and performing action using LCD and Servo motors, Working with cloud publishing data to the cloud-Python pub nub.	08 Hrs
3	**IoT Protocols: Four pillars of IoT**: M2M, WSN , SCADA and RFID. **Protocol Standardization for IoT**: Issues with IoT Standardization, Unified Data Standards**IoT Protocols**: IEEE 802.15.4, BACNet, Modbus, KNX, Zigbee, 6LoWPAN,LoRa	09 Hrs
4	**IoT Security:** Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT.	08 Hrs
5	**IoT Physical servers and Cloud offering**: Introduction to Cloud Storage Models, Communication API, WAMP: AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework: Djanjo, Amzon Web Services for IoT, SkyNet IoT Messaging Platform**.**	06 Hrs
	Text Books: 1. A. Bahga and V. Madisetti, ***Internet of Things: A Hands-On Approach***, Universities Press. 2. H. Zhou, ***The Internet of Things in the Cloud: A Middleware Perspective***, CRC Press, 2012. 3. G. C. Hillar, ***Internet of Things with Python: Interact with the World***	

and Rapidly Prototype IoT Applications Using Python, Packt Publishing, 2016.

4. D. Uckelmann, M. Harrison, and F. Michahelles (Eds.), ***Architecting the Internet of Things***, Springer, 2011.

Reference Books

1. D. Easley and J. Kleinberg, ***Networks, Crowds, and Markets: Reasoning About a Highly Connected World***, Cambridge University Press, 2010.
2. O. Hersent, O. Elloumi, and D. Boswarthick, ***The Internet of Things: Applications to the Smart Grid and Building Automation***, Wiley, 2012.
3. O. Hersent, D. Boswarthick, and O. Elloumi, ***The Internet of Things: Key Applications and Protocols***, Wiley, 2012.
4. B. Sosinsky, ***Cloud Computing Bible***, Wiley India, 2010.
5. A. McEwen and H. Cassimally, ***Designing the Internet of Things***, Wiley, 2014.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Introduction to Internet of Things	Prof. Sudip Misra	IIT Madras	https://nptel.ac.in/courses/106105166

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Teaching Scheme	Internet Of Things LAB Course code: **26AF1246PEL509B**	Examination Scheme	
2 Hrs / Week = Credit 1	**Course Objectives :** 1. To test the functionality of various sensors and actuators 2. To use python for GPIO programming in IOT 3. To develop client server application in IoT using various protocols **Course Outcomes:** **CO1:** Make use of various actuators and sensors available for sensing the real world. **CO2:** Design and construct IoT application for specified requirement **CO3:** Apply various IoT protocols for communication between different endpoints to develop client server applications. **CO4:** Construct an application for remote sensing, monitoring and controlling appliances.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	3	2	1	1	3	–	–	1	–	–	2	3	3	1	3
CO2	3	3	2	2	2	–	–	1	–	–	2	3	2	1	3
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1	3
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–	3
CO5	3	2	1	1	3	–	1	1	–	–	2	3	3	1	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

	Laboratory Experiments / Assignments	
	1. Interface the I/O devices like LED, Switch, Buzzer to Raspberry Pi and write GPIO programming in python to test its functionality	CO1
	2. Write an application to detect obstacles using Proximity sensor and notify the user using LED or Buzzer.	CO1 CO2
	3. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicates the user using LED or Buzzer.	CO1,CO2
	4. Using the light sensor, monitor the surrounding light intensity and automatically turn on/off the high intensity LED by taking some predefined threshold light intensity value.	CO1, CO2
	5. Display any RSS news feed headline on a LCD display connected to a device. Extract data from any website and flash it on an LCD	CO1, CO3
	6. Interface the USB webcam with the device and capture the image	CO1, CO3
	7. Create an account on Thing speak cloud and write an application to publish the temperature information and interested applications can subscribe	CO1, CO3
	8. Create a simple web interface for Raspberry-Pi to control the connected LEDs remotely through the interface	CO1, CO3
	9. Interface an Android smartphone with an Arduino /Raspberry pi via Bluetooth to control an LED from your phone	CO1, CO3,CO4
	10. Project using Raspberry pi to identify and solve any real world problem.	. CO1, CO3,CO4
	Note: 1. The above list is for illustration purposes only. The course coordinator may update or modify the list as required. 2. At least 8 to 10 experiments should be performed. **3.** Students should be encouraged to design and perform new experiments, subject to prior approval from the respective course instructor.	

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Teaching Scheme		Blockchain Technology Course code: **26AF1246PE508C**	Examination Scheme	
TH	3	**Prerequisite Courses:**	CA	20
PR	1	1. Programming and Problem Solving	MSE	20
CR	4	2. Fundamentals of C Programming Languages	ESE	60
		Course Objectives: **1.** Understanding Block chain Fundamentals and creating basic blocks. **2.** Able to Develop Block chain Applications in a structured manner **3.** Ability to create own crypto currency and get familiarity with future currencies. **4.** Able to Evaluate and AnalyzeBlock chain Systems **Course Outcomes (COs):** **CO1:** Knowledge of Blockchain Concepts and creating basic blocks. **CO2:** Proficiency in Blockchain Development. **CO3:** Ability to Design and Implement Blockchain Applications. **CO4:** Evaluation and Analysis of Blockchain Systems. **CO5:** Knowledge of crypto currency and creating a basic form of it.	TOTAL	100

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	3	3	2	-	3	1	-	-	1	1	-	3	2	3	2
CO2	3	3	3	2	3	2	-	-	1	2	-	3	2	3	2
CO3	3	3	3	1	3	2	-	1	2	2	1	3	2	3	-
CO4	3	3	3	1	3	2	-	1	2	2	1	3	2	3	2
CO5	3	3	3	-	3	2	-	1`	2	2	1	3	2	3	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Blockchain:** Fundamentals of Blockchains Technology, The Structure of Blockchains, Blockchain Applications, The Blockchain Life Cycle,Distributed Ledger vs Centralized System, Merkel Root, Nonce Value, Hash Algorithm, and its applications.	**5 Hrs**
2	**Blockchain Types and Consensus mechanism**: Introduction, Decentralization and Distributed system, Types of Blockchain: Public Blockchain,Private Blockchain and Consortium Blockchain, Consensus Protocol: POW, POS, POC, POB, BFT and PBFT.	**6 Hrs**
3	**Encountering the Ethereum Blockchain**: History of Ethereum, Ethereum: The Open-Source Worldwide Computer, Decentralized Applications, Decentralized Autonomous Organizations, hacking a Blockchain, The cryptocurrency Ether Getting Up and Running on Ethereum Mining for Ether, Setting up your Ethereum Wallet, Building Your First (DAO) Decentralized Autonomous Organization, Test net and Congress, Governance and Voting, Uncovering the Future of DAOs.	**9 Hrs**
4	**Cryptocurrency – Bitcoin, Altcoin and Token**: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage. **Smart Contracts**:Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry	**9 Hrs**
5	**Security and applications of Blockchain:** Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance.Application of Blockchain: Banking and Finance,Education,Energy,Healthcare,Supply Chain,The Blockchain and IoT	**6 Hrs**
	Text Books: 1. A. Caro, ***Blockchain: The Beginner's Guide to Understanding the Technology Behind Bitcoin and Cryptocurrency***. 2. S. Marks, ***Blockchain for Beginners: Guide to Understanding the Foundation and Basics of the Revolutionary Blockchain Technology***, CreateSpace Independent Publishing Platform. **Reference Books:** 1. C. Subramanian, A. George, A. K. A., and M. Karthikeyan, ***Blockchain Technology***, Universities Press. 2. M. Swan, ***Blockchain: Blueprint for a New Economy***, O'Reilly Media.	

3. T. Laurence, ***Blockchain For Dummies***, Wiley.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Blockchain and Its Application	Prof.sandip Chakraborty, Prof.Shamik Sural	IIT Kharagpur	https://nptel.ac.in/courses/106105235 https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs34

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Teaching Scheme	Blockchain Technology Lab Course code: **26AF1246PEL509C**	Examination Scheme	
2 Hrs / Week = Credit 1	**Prerequisite Courses:** 1. Programming and Problem Solving 2. Fundamentals of C Programming Languages **Course Objectives:** **1.** Understanding Block chain Fundamentals and creating basic blocks. **2.** Able to Develop Block chain Applications in a structured manner **3.** Ability to create own crypto currency and get familiarity with future currencies. **4.** Able to Evaluate and Analyze Block chain Systems **Course Outcomes (COs):** **CO1:** Knowledge of Blockchain Concepts and creating basic blocks. **CO2:** Proficiency in Blockchain Development. **CO3:** Ability to Design and Implement Blockchain Applications. **CO4:** Evaluation and Analysis of Blockchain Systems. **CO5:** Knowledge of crypto currency and creating a basic form of it.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	**3**	**3**	**2**	**-**	**3**	**1**	**-**	**-**	**1**	**1**	**-**	**3**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**1**	**2**	**-**	**3**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**1**	**3**	**2**	**-**	**1**	**2**	**2**	**1**	**3**	**2**	**3**	**-**
CO4	**3**	**3**	**3**	**1**	**3**	**2**	**-**	**1**	**2**	**2**	**1**	**3**	**2**	**3**	**2**
CO5	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**1`**	**2**	**2**	**1**	**3**	**2**	**3**	**1**

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

	List of Experiments: 1. Study and perform practical on Cryptography algorithm for securing data. 2. Study and implement about Bitcoin Structure and Design. 3. Study and design your own Cryptocurrency. 4. Study and Install Bitcoin Wallet. 5. Study and understand the basics of Solidity language. 6. Implement Smart contact and run it using application tool. 7. Study about Hyperledger Composer. 8. Study about Hyperledger Fabric. 9. Building a Private Ethereum Network and Deploying Smart Contract & Security. 10. Study and apply real life application of Blockchain. 11. Case study OR Mini Project on blockchain technology. **Note:** 1. The above list is for illustration purposes only. The course coordinator may update or change the list as needed, 2. At least **8** to**10** experiments should be performed. 3. Students should be encouraged to design and perform new experiments, subject to prior approval from the respective subject authority.	

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Teaching Scheme	Mini Project-I Course code: **26AF1246ELC510**	Examination Scheme	
2 Hrs / Week = Credit 1	**Course Objectives:** 1. The course aims to enable students to: 2. Identify and analyze a real-world problem suitable for an IT-based solution. 3. Apply knowledge acquired from core subjects to design an innovative solution. 4. Develop teamwork, communication, project planning, and documentation skills. 5. Design and implement a prototype using appropriate software tools and technologies. 6. Prepare technical documentation and effectively present the project work. **Course Outcomes (COs):** After successful completion of the course, students will be able to: **CO1:** Identify, analyze, and define a real-world problem through literature survey and requirement analysis. **CO2:** Design an appropriate software architecture, database, algorithms, and user interface for the proposed solution. **CO3:** Develop and test a working prototype using suitable programming languages, frameworks, and tools. **CO4:** Demonstrate teamwork, project management, technical documentation, and presentation skills while considering professional ethics.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**3**	**2**	**-**
CO2	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**1**	**1**	**3**	**3**	**3**	**1**
CO3	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**2**	**1**	**3**	**3**	**3**	**2**
CO4	**1**	**1**	**1**	**-**	**2**	**1**	**-**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

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Syllabus of SEMESTER-VI Courses

Teaching Scheme		Software Design and Testing Course code: **26AF1246PC601**	Examination Scheme	
TH	**3**	**Course Objectives**: 1. To understand software life cycle development models. 2. To understand and apply Software Requirements Engineering Techniques, Software design principles, modeling and Software testing techniques. 3. To understand the use of metrics in Software Engineering. 4. To understand Software Project Testing Techniques.	**CA**	**20**
PR	**2**		**MSE**	**20**
CR	**1**		**ESE**	**60**
			TOTAL	**100**
		Course Outcomes: *On completion of the course, students will be able to* **CO1:** Explain the fundamental concepts and various types of software testing. **CO1:** Identify, formulate, and solve engineering problems using appropriate software testing techniques. **CO2:** Apply different software testing methods to validate software quality. **CO3:** Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. **CO4:** Use appropriate techniques, skills, and modern engineering tools necessary for engineering practice.		

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	1	–	1	–	–	–	–	–	2	3	1	–
CO2	3	3	2	1	2	–	–	1	–	–	2	3	2	1
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–
CO5	3	2	1	1	2	–	–	–	–	–	2	3	2	–

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**UNIT -I** Software Development Process: Software crisis and myths, Software process and development: Generic view of process, Software life cycle and models, Analysis and comparison of varies models, an agile view of process, Requirement Engineering: Requirements engineering tasks, initiating requirement engineering process, Eliciting requirement, developing use-cases.	09 Hrs
2	**UNIT -II Building** the analysis model, Negotiating and validating requirement, System Design Overview: Design process and design quality, Design concepts, Design model, Pattern based software design, Architectural design, User interface design.	07 Hrs
3	**UNIT-III** Management of Project: Risk management, Importance of software quality and measurements, software engineering techniques for quality assurance, and Change management	07 Hrs
4	**UNIT-IV:**. Validation and Testing: Strategic approach to Software testing, Strategic issues, Test strategies for conventional software, Validation testing, System testing, Debugging, White box testing	08 Hrs
5	**UNIT V:** Black box testing : Integration Testing ,System and acceptance testing ,System and acceptance testing, performance testing, regression testing	06 Hrs
	Text Books 1. R. S. Pressman, ***Software Engineering***, 7th ed., Tata McGraw-Hill, 2018. 2. G. Booch, J. Rumbaugh, and I. Jacobson, ***The Unified Modeling Language User Guide***, 2nd ed., Addison-Wesley, 2005. 3. S. Desikan and G. Ramesh, ***Software Testing: Principles and Practices***, Pearson Education. **Reference Books** 1. S. L. Pfleeger, ***Software Engineering: Theory and Practice***, 4th ed., Pearson Education, 2012. 2. I. Sommerville, ***Software Engineering***, 10th ed., Pearson Higher Education, 2017. 3. P. Jalote, ***An Integrated Approach to Software Engineering***, 2nd ed., Springer, 2012.	

Alternative NPTEL/SWAYAM Digital Reference				
Sr.No.	**NPTEL/SWAYAM Courses Name**	**Instructor**	**Host Institute**	**Links**
01	Software Testing	Prof. Meenakshi D'Souza	IIIT Bangalore	https://nptel.ac.in/courses/106101163
02	Software Testing	Prof. Rajib Mall	IIT Kharagpur	https://nptel.ac.in/courses/106105150

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Teaching Scheme	Software Design and Testing Lab Course code: **26AF1246PCL602**	Examination Scheme	
2 Hrs / Week = Credit 1	**Course Objectives:** 1. To Write and test the functionality of source code. 2. To use White box and black box testing techniques. 3. To learn configuration of automation tool. **Course Outcomes:** *On completion of the course, students will be able to* **CO1:** Write and make use of test cases. **CO2:** Perform white-box and black-box testing. **CO3:** Install and configure automation testing tools . **CO4:** Test websites and web components using appropriate testing techniques.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	3	2	1	1	3	–	–	1	–	–	2	3	3	1	3
CO2	3	3	2	2	2	–	–	1	–	–	2	3	2	1	3
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1	3
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–	3
CO5	3	2	1	1	3	–	1	1	–	–	2	3	3	1	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

Laboratory Experiments / Assignments:

1. Design, develop, code and run the program in any suitable language to solve the commission problem, Analyze it from the perspective of data flow testing, derive at least 10 different test cases, execute these test cases and discuss the test results.
2. Design, develop, code and run the program in any suitable language to solve the Next Date problem, Analyze it from the perspective of decision table-based testing, derive at least 10 different test cases, execute these test cases and discuss the test results.
3. Design, develop, code and run the program in any suitable object-oriented language to solve the calendar problem. Analyze it from the perspective of OO testing, derive test cases to test the method that increment the date and the method that increments the month, execute these test cases and discuss the test results.
4. Design, develop, code and run the program in any suitable object-oriented language to solve the currency converter problem. Analyze it from the perspective of use case-based system testing, derive appropriate system test cases, execute these test cases and discuss the test results.
5. Design, develop, code and run the program in any suitable language to implement an absolute letter grading procedure, making suitable assumptions. Determine the basis paths and using them to derive different test cases, execute these test cases and discuss the test results.
6. Design, develop, code and run the program in any suitable language to implement the binary search algorithm. Determine the basis paths and using them to derive different test cases, execute these test cases and discuss the test results.
7. Introduce at least one automation testing tool like selenium and configure it for testing
8. Website testing using automation tool selenium

Note:

1. The above list is for illustration purposes only. The course coordinator may update or change the list as needed,
2. At least **8** to**10** experiments should be performed.
3. Students should be encouraged to design and perform new experiments, subject to prior approval from the respective subject authority.

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Teaching Scheme		Computer Networks and Internet Protocol Course code: **26AF1246PC603**	Examination Scheme	
TH	**3**	**Course Objectives** 1. To understand the fundamentals of computer networks and Internet protocols. 2. To learn IP addressing, subnetting, and routing concepts. 3. To study IPv4, ICMP, and ARP protocols. 4. To understand TCP and UDP communication. 5. To explore DNS, HTTP, and routing protocols (RIP, OSPF, and BGP). **Course Outcomes (COs):** *At the end of Course Students will be able.* **CO1:** Explain network fundamentals, protocols, and OSI/TCP-IP models. **CO2:** Apply IP addressing, subnetting, and routing techniques. **CO3:** Describe IPv4, ICMP, ARP, and packet handling mechanisms. **CO4:** Analyze UDP and TCP operations for reliable communication. **CO5:** Explain DNS, HTTP, RIP, OSPF, and BGP routing protocols.	**CA**	**20**
PR	**2**		**MSE**	**20**
CR	**4**		**ESE**	**60**
			TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	–	–	2	–	–	–	–	–	1	3	2	–
CO2	3	3	1	2	2	–	–	–	–	–	1	3	2	–
CO3	3	2	–	2	2	–	–	–	–	–	1	3	2	–
CO4	3	3	1	2	2	–	–	–	–	–	1	3	2	–
CO5	3	3	2	2	3	1	–	–	1	–	2	3	2	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	Introduction to computer networks and Internet: Introduction to History,Protocols and Standards. Addressing, Standards organization, Internet standards, Internet Organizations, The OSI Model and the TCP/IP Protocol Suite vs OSI Model, Layers in the OSI Model, TCP/IP Protocol suite, TCP/IP Versions.	06 Hrs
2	Introduction to Network Layer, Introduction Classful addressing, other issues, subnetting, supernetting, classless addressing, Delivery and Forwarding of IP Packets, Direct vs indirect delivery, routing methods, static vs dynamic routing, routing table and routing module.	08 Hrs.
3	CIDR Internet Protocol Version 4 (Ipv4) Datagram, Fragmentation, Internet Control Message Protocol Version 4 (ICMPv4) message format, Error reporting, Query, Checksum. Options, Checksum, IP Package, Address Resolution Protocol (ARP) ARP, ARP Package, RARP	08 Hrs
4	Transport Layer: User Datagram Protocol (UDP) process to process communication, user datagram, checksum, udp operation, use of udp. Transmission Control Protocol (TCP) tcp services, tcp features, segment, a tcp connection, state transition diagram, flow control, error control, congestion control, tcp timers, options.	08 Hrs
5	Domain Name System (DNS) , HTTP, Unicast Routing Protocols (RIP, OSPF, and BGP) ,Intra and inter domainrouting, OSPF, path vector routing, BGP, Distance vector routing, RIP, Linkstate routing.	05 Hrs
	Text Books 1. J. F. Kurose and K. W. Ross, ***Computer Networking: A Top-Down Approach***, 8th ed., Pearson, 2024. 2. B. A. Forouzan and F. Mosharraf, ***TCP/IP Protocol Suite***, 4th ed., Tata McGraw-Hill, 2012. 3. D. E. Comer, ***Internetworking with TCP/IP, Volume I: Principles, Protocols, and Architecture***, 6th ed., Pearson, 2013.	

Reference Books

1. J. F. Kurose and K. W. Ross, ***Computer Networking: A Top-Down Approach***, 5th ed., Pearson Education India, 2012.
2. J. Doyle, ***Routing TCP/IP, Volume 2***, Cisco Press.
3. G. A. Donahue, ***Network Warrior***, O'Reilly Media.
4. J. Edelman, S. S. Lowe, and M. Oswalt, ***Network Programmability and Automation***, O'Reilly Media.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Computer Networks And Internet Protocol	Prof. Soumya Kanti Ghosh Prof. Sandip Chakraborty	IIT Kharagpur	https://nptel.ac.in/courses/106105183

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Teaching Scheme	Computer Networks and Internet Protocol Lab Course code: **26AF1246PCL604**	Examination Scheme	
2 Hrs / Week = Credit 1	**Course Outcomes (COs):** *Upon successful completion of this course, students will be able to:* **CO1:** Configure and analyze computer networks using IP addressing, subnetting, and network devices. **CO2:** Design, simulate, and troubleshoot network topologies and routing mechanisms using networking tools. **CO3:** Analyze the operation of network layer protocols such as IPv4, ARP, and ICMP using packet analysis tools. **CO4:** Develop client-server applications using TCP and UDP socket programming for network communication. **CO5:** Configure and evaluate network services and routing protocols such as DNS, HTTP, RIP, and OSPF in a simulated environment.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	2	1		3							3	3	
CO2	3	3	2	2	3			1				3	3	
CO3	2	3	-	3	3							3	3	1
CO4	2	2	2	1	3			1	1			3	3	2
CO5	3	2	2	2	3			1	1			3	3	2

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

List of Experiments:

1. Study of Network Devices and Basic Network Configuration.
2. Perform IPv4 Addressing and Subnetting for a given network.
3. Design and simulate Bus, Star, Ring, and Mesh topologies using Cisco Packet Tracer.
4. Configure a Local Area Network (LAN) and verify connectivity using Ping commands.
5. Study and analyze IPv4 Datagram structure using Wireshark.
6. Analyze ARP and ICMP protocols using network utilities and packet capture tools.
7. Develop a Client-Server application using UDP Socket Programming.
8. Develop a Client-Server application using TCP Socket Programming.
9. Configure and analyze HTTP/Web Server communication.
10. Configure and verify OSPF routing protocol in a multi-router network.
11. Study and analyze routing tables and packet forwarding mechanisms.

Note:

1. The above list is for illustration purposes only. The course coordinator may update or change the list as needed,
2. At least **8** to**10** experiments should be performed.
3. Students should be encouraged to design and perform new experiments, subject to prior approval from the respective subject authority.

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Teaching Scheme		Soft Computing Course code: 26AF1246PC605	Examination Scheme	
TH	3	**Course Objectives**:	CA	20
PR	2	**1.** To introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.	MSE	20
CR	1	**2.** To gain insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems.	ESE	60
		3. To create awareness of the application areas of soft computing technique.	TOTAL	100
		4. To learn alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system.		

Course Outcomes:

On completion of the course, students will be able to

CO1: Explain the basics of biological and artificial neurons.

CO2: Understand alternative, adaptable, resilient, and optimal solutions using soft computing techniques.

CO3: Apply soft computing tools to solve real-world problems.

CO4: Explain the methods of fuzzification and defuzzification.

CO5: Apply soft computing techniques to analyze and solve real-world engineering problems.

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	1	–	1	–	–	–	–	–	2	3	1	–
CO2	3	3	2	1	2	–	–	1	–	–	2	3	2	1
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–
CO5	3	2	1	1	2	–	–	–	–	–	2	3	2	–

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Artificial Neural Network**:Artificial Neural Network, Biological neuron , Artificial neuron model , Concept of bias and threshold , McCulloch Pits Neuron Model , Implementation of logical AND, OR, XOR functions , Learning paradigms: Supervised, Unsupervised, Reinforcement , Linear neuron model , Gradient descent algorithm, Activation functions:Binary, Bipolar (linear, signup, log sigmoid, tan sigmoid) , Learning mechanisms: Hebbian, Delta Rule of Perceptron and its limitations.	09 Hrs
2	**Artificial Neural Network**:Multilayer perceptron (MLP) and backpropagation algorithm, Application of MLP, Selforganizing Feature Maps, Clustering of Learning vector quantization, Radial Basis Function networks, Hopfield network,auto associative and hetero - associative memory, A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.	07 Hrs
3	**Fuzzy Logic -I** (Introduction): Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.	07 Hrs
4	**Fuzzy Logic-II** (Fuzzy Membership, Rules): Membership functions, Interference in fuzzy logic, Fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications & Defuzzification , Fuzzy Controller , Industrial applications.	08 Hrs
5	**Evolutionary computation**: Genetic Algorithms, Survival of the Fittest, Fitness Computations, Crossover, Mutation, Reproduction, Rank method, Rank space method, Simulated annealing, Evolutionary computation, Ant colony optimization algorithms, Particle swarm optimization	06 Hrs
	Text Books 1. L. Fausett, ***Fundamentals of Neural Networks: Architectures, Algorithms, and Applications***, Pearson Education, 2008. 2. T. J. Ross, ***Fuzzy Logic with Engineering Applications***, 3rd ed., John Wiley & Sons, 2010. 3. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, ***Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence***, PHI Learning. 4. S. N. Sivanandam and S. N. Deepa, ***Principles of Soft Computing***, John Wiley & Sons, 2007.	

Reference Books

1. J. Hertz, A. Krogh, and R. G. Palmer, ***Introduction to the Theory of Neural Computation***, Addison-Wesley, 1991.
2. S. Haykin, ***Neural Networks: A Comprehensive Foundation***, 2nd ed., Prentice Hall, 1999.
3. J. C. Principe, N. R. Euliano, and W. C. Lefebvre, ***Neural and Adaptive Systems: Fundamentals through Simulations***, John Wiley & Sons, 2000.
4. R. O. Duda, P. E. Hart, and D. G. Stork, ***Pattern Classification***, 2nd ed., Wiley, 2000.
5. S. Theodoridis and K. Koutroumbas, ***Pattern Recognition***, 4th ed., Academic Press, 2008.
6. H. T. Nguyen and E. A. Walker, ***A First Course in Fuzzy Logic***, 3rd ed., Taylor & Francis Group, 2008.
7. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, ***Introduction to Fuzzy Logic Using MATLAB***, Springer, 2007.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Introduction to Soft Computing	Prof. Debasis Samanta	IIT Kharagpur	https://nptel.ac.in/courses/106105173

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Teaching Scheme		Cloud Computing Course code: **26AF1246PE607A**	Examination Scheme	
TH	**3**	**Prerequisite Courses:**	**CA**	**20**
CR	**3**	1. Database Management System	**MSE**	**20**
		Course Objectives: 1. To learn the concept of cloud computing. 2. To understand the trade-off between deploying applications in the cloud over local infrastructure. 3. To identify different storage virtualization technologies and their benefits. 4. To understand and articulate business continuity solutions including backup and recovery technologies, local and remote replication solutions.	**ESE**	**60**
			TOTAL	**100**
		Course Outcomes (COs): *Upon successful completion of this course, students will be able to:* **CO1:** To understand the key dimensions of the challenge of Cloud Computing. **CO2:** To assess the economics, financial and technological implications for selecting cloud computing for organization. **CO3:** To describe and apply storage technologies. **CO4:** To identify leading storage technologies that provide cost-effective IT solutions for medium to large scale businesses and data centers. **CO5:** To describe important storage technology features such as availability, replication, scalability and performance		

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	2	1	–	1	–	–	–	–		2	2	1	–
CO2	2	3	2	2	1	2	–	–	–	3	2	2	1	–
CO3	3	2	2	1	3	–	–	–	–		1	3	3	–
CO4	3	3	3	2	3	1	–	–	–	1	1	3	3	–
CO5	3	2	3	2	3	–	–	–	–		2	3	3	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Cloud Applications, Deployment models and service models.	07 Hrs
2	**Virtualization:** Issues with virtualization, Virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, Virtualization of data centers and Issues with Multi-tenancy, Storage virtualization, Challenges, Types of storage virtualization.	07 Hrs
3	**Implementation:** Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, Deployment of Web Services from inside and outside a Cloud Architecture, MapReduce and its extensions to Cloud Computing, Hadoop.	07 Hrs
4	**Cloud Storage & Data Management** Cloud storage types: Object storage, Block storage, File storage, Distributed file systems, Data replication and consistency, Big Data in cloud, Introduction to NoSQL databases, Storage services.	07 Hrs
5	**The Enterprise Cloud Computing Paradigm and Cloud Security** Introduction, Adoption and Consumption Strategies, Issues for Enterprise Applications on the Cloud, Transition Challenges, The Cloud Supply Chain. **Cloud Security**: Securing the Cloud, Securing Data, Establishing Identity and Presence.	07 Hrs
	Text Books 1. T. Erl, R. Puttini, and Z. Mahmood, ***Cloud Computing: Concepts, Technology & Architecture***, Pearson. 2. R. Buyya, J. Broberg, and A. Goscinski (Eds.), ***Cloud Computing: Principles and Paradigms***, Wiley. 3. B. Sosinsky, ***Cloud Computing Bible***, Wiley. **Reference Books** 1. T. Velte, A. Velte, and R. Elsenpeter, ***Cloud Computing: A Practical Approach***, Tata McGraw-Hill.	

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Cloud Computing	Prof. Soumya K. Ghosh	https://nptel.ac.in/courses/106105167	https://nptel.ac.in/courses/106105167

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Teaching Scheme		Enterprise Resource Planning Programme Elective Course (PEC) Course code: **26AF1246PE607B**	Examination Scheme	
TH	**3**	**Course Objectives:** 1. To introduce to enterprise systems and show how organizations use enterprise systems to run their operations more efficiently and effectively. 2. To learn about the critical success factors and implementation strategies that lead to enterprise system success. 3. To learn about the informational, knowledge, and decision-making opportunities afforded by enterprise systems. 4. To examine typical Enterprise Systems modules: Materials Management (MM), Supply Chain Management (SCM), Customer Relationship Management (CRM), Human Resource Management (HRM). **Course Outcomes (COs):** *At the end of Course Students will be able.* **CO1:** To demonstrate a good understanding of basic issues in Enterprise Systems. **CO2:** To explain the scope of common Enterprise Systems (e.g., MM, SCM, CRM, HRM, procurement). **CO3:** To explain the challenges associated with implementing enterprise systems and their impacts on organizations. **CO4:** To describe the selection, acquisition and implementation of enterprise systems. **CO5:** To use one of the popular ERP packages to support business operations and decision-making.	**CA**	**20**
PR	**-**		**MSE**	**20**
CR	**3**		**ESE**	**60**
			TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	-	-	-	1	-	1	2	2	-
CO2	3	3	3	2	2	-	-	1	1	-	1	3	2	-
CO3	3	3	2	2	3	-	-	-	1	-	1	3	3	-
CO4	3	3	3	2	2	-	-	1	1	-	1	3	2	-
CO5	2	3	2	3	3	1	-	-	1	-	2	3	3	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**– Medium, **3**–High.

COURSE CONTENTS

Unit No.	Topic	Hours
1	Enterprise Resource Planning: Introduction, Disadvantages of non-ERP systems, What Is ERP? Need of ERP, Advantage of ERP, Risks of ERP, Growth of ERP. ERP Modules: Finance, Production Planning, Control and Management, Sales and Distribution, Human Resource Management, Inventory Control System, Quality Management, Plant Maintenance.	8 Hrs
2	ERP Implementation: ERP Implementation (Transition) strategies, ERP Implementation Life Cycle, Implementation Methodologies, Evaluation and selection of ERP package, ERP Project Team: Vendors, Employees, Consultants, Training & Education, Project management & Monitoring, Post Implementation Activities, Operation & maintenance of ERP system, Measuring the Performance of ERP System, Success & failure factors of an ERP, Implementation.	8 Hrs
3	ERP Market and Vendors: ERP Marketplace and Marketplace Dynamics, Comparison of Current ERP Packages and Vendors, like; SAP, Oracle, PeopleSoft, BAAN etc.	8 Hrs
4	ERP and Related Technologies: Business Process Re-Engineering (BPR), Information Systems - Management Information System (MIS), Decision Support System (DSS), Executive Support System (ESS), Data Warehousing, Data Mining, Online Analytical Processing (OLAP), Supply Chain Management, Customer Relationship Management.	8 Hrs
5	ERP Case Studies: ERP systems implemented in: TISCO, SKF Automotive Bearings Co. Ltd, Qualcomm CDMA, California, Post Implementation review of ERP packages in Manufacturing, Services and Others Organizations, Customization of ERP for different types of Industries.	8 Hrs
	Text Books 1. A. Leon, ***ERP Demystified***, 3rd ed., Tata McGraw-Hill, New Delhi. 2. V. K. Garg and N. K. Venkita Krishnan, ***ERP Ware: ERP Implementation Framework***, PHI Learning. **Reference Books** 1. V. K. Garg and N. K. Venkita Krishnan, ***ERP Concepts and Planning***, 2nd ed., PHI Learning.	

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Teaching Scheme		Management Information System Course code: 26AF1246PE607C	Examination Scheme	
TH	3	**Course Objectives**: 1. To understand concepts of Management Information System and Business intelligence for MIS. 2. To recognize the need of an information system in today's global business with tools and technologies. 3. To identify IT infrastructure components and to study security in the Information System. 4. To understand the importance of project management and the international information system. 5. To understand the concepts of decision support systems for business applications. **Course Outcomes**: *On completion of the course, students will be able to* **CO1:** Explain the fundamentals of Management Information Systems and business intelligence. **CO2:** Illustrate the role of information systems, e-business, and ethical issues in organizations. **CO3:** Describe IT infrastructure, databases, networking, and information security. **CO4:** Demonstrate the use of enterprise applications, project management, and global information systems. **CO5:** Apply ERP, CRM, SCM, e-commerce, and Decision Support Systems for business applications.	CA	20
PR	-		MSE	20
CR	1		ESE	60
			TOTAL	100

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	1	2	1	1	-	-	-	-	-	-	-	1	2	3
CO2	1	1	1	-	-	-	-	1	1	-	-	1	2	3
CO3	2	1	1	-	-	-	-	-	-	-	-	2	1	2
CO4	2	1	1	1	-	-	-	-	-	1	-	2	1	2
CO5	2	2	2	1	1	-	-	-	-	-	-	2	1	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**An Overview of Management Information System:** Management information system: Concept, Definition, Role of MIS, Impact of MIS, Management as a Control System: The functions of Management, Managerial Roles, The Levels of Management, Support to the Management, Management effectiveness and MIS, Organization as a System. Decision Making, Business intelligence for MIS.	08 Hrs
2	**Organization, Management and Network Enterprise :** Perspectives on Information System. Global E-business and collaboration: Business Processes, Types of Information Systems, Tools and technologies for collaboration and teamwork, E-mail and Instant Messaging, Social Networking, Virtual worlds, Internet based Collaboration Environments. Information system organization and strategy, Ethical and social issues in information system.	08 Hrs
3	**Information Technology Infrastructure:** IT infrastructure and Emerging Technologies: IT infrastructure and its components, Hardware and software platform trends, Management issues. **Foundation of Business intelligence**: Databases and information management. Telecommunication, The Internet and Wireless technology, Securing information systems: system vulnerability, Business value of security and control.	08 Hrs
4	**Key System Applications for Digital Age:** Enterprise Applications, E-Commerce: Digital Markets and Digital Goods, Managing knowledge, Enhancing Decision Making, Building information Systems, Managing project: The importance of project Management, the business value of information systems, Managing project risk, Managing Global Systems: The growth of international information systems, organizing international information systems, Technology issues and opportunities for global value chain.	08 Hrs
5	**Business Applications:** Introduction to e-business systems: Functional Business systems, cross functional Enterprise systems. Customer Relationship Management: The Business focus, Enterprise Resource Planning: The business backbone, Supply chain Management: Business Network. Electronic Commerce Systems: Fundamentals, e-commerce applications and issues. Decision support systems: Decision support in Business, DSS Components, Data Mining for Decision Support, benefits and challenges in enterprise system.	08 Hrs
	Text Books 1. W. S. Jawadekar, ***Management Information System: A Global Digital Enterprise Perspective***, 5th ed., McGraw Hill Education Pvt. Ltd. 2. J. A. O'Brien and G. M. Marakas, ***Management Information Systems***, 7th ed., McGraw-Hill. **Reference Books** 1. K. C. Laudon and J. P. Laudon, ***Management Information Systems: Managing the Digital Firm***, 12th ed., Pearson.	

2. J. A. O'Brien, ***Management Information Systems: Managing Information Technology in the Business Enterprise***, 6th ed., Tata McGraw-Hill.

3. R. Schultheis and M. Sumner, ***Management Information Systems: The Manager's View***, 4th ed., Tata McGraw-Hill.

4. G. B. Davis and M. H. Olson, ***Management Information Systems: Conceptual Foundations, Structure, and Development***, 2nd ed., Tata McGraw-Hill.

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Teaching Scheme		Machine learning Course code: **26AF1246PE608A**	Examination Scheme	
TH	**3**	**Prerequisite** - Engineering Mathematics- II and Data analysis and visualization	**CA**	**20**
PR	**-**		**MSE**	**20**
CR	**3**	**Course Objectives:** 1. Understand fundamental concepts of Machine Learning, AI, and Data Science. 2. Apply supervised, unsupervised, and reinforcement learning techniques. 3. Evaluate and improve ML models using feature engineering and model selection methods. 4. Understand neural networks, deep learning, and optimization algorithms. 5. Explore advanced deep learning architectures and their real-world applications **Course Outcomes (COs):** *At the end of Course Students will be able.* **CO1:** Explain core Machine Learning concepts and learning paradigms. **CO2:** Implement classification, regression, and clustering algorithms. **CO3:** Apply feature engineering, dimensionality reduction, and model evaluation techniques. **CO4:** Design and train neural network and deep learning models. **CO5:** Analyze and apply CNNs, RNNs, LSTMs, and other deep learning architectures to solve real-world problems.	**ESE**	**60**
			TOTAL	**100**

CO-PO Mapping:

COs \ POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	1	-	2	2	1	-
CO2	3	3	2	2	3	-	-	-	-	-	1	3	3	-
CO3	2	3	2	3	3	-	-	-	-	-	1	3	3	-
CO4	3	2	3	2	3	-	-	1	-	-	2	3	3	1
CO5	3	3	3	3	3	1	1	1	1	-	2	3	3	2

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**– Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Machine Learning:** Overview of ML, types of learning (supervised, unsupervised, and reinforcement), and applications. AI vs ML vs Data Science, traditional programming vs ML paradigm, and real-world engineering applications. Concept Learning, Evaluating Hypothesis: Estimating Hypothesis accuracy, types of hypotheses, Hypothesis testing, Find S algorithm, CEA algorithm, Probability Theory.	08 Hrs
2	**Supervised and Unsupervised Learning-**Classification: Binary and Multiclass, Bayes theorem, Decision trees, Naïve Bayes classifier, SVM, k-Nearest Neighbors (k-NN), Regression- logistic and linear regression algorithm, Introduction to clustering, need for clustering, types of clustering, K-Means clustering, Hierarchical Clustering, Reinforcement Learning	09 Hrs
3	**Model Evaluation and Selection:** Introduction to Feature Engineering. Feature Transformation: Dimensionality reduction techniques- Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA). Practical Machine Learning: Bias-Variance; Training/Testing; Overfitting; Occam's razor; Regularization and Model Selection. Autoencoders, Regularization: L2 regularization, Early stopping, Dataset augmentation, Dropout	09 Hrs
4	**Deep Learning-** McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.	08 Hrs
5	**Deep Learning Architectures-** LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks, Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs.	06 Hrs
	Text Books 1. T. M. Mitchell, ***Machine Learning***, McGraw-Hill Education, 2013. 2. M. Kubat, ***An Introduction to Machine Learning***, Springer. 3. I. Goodfellow, Y. Bengio, and A. Courville, ***Deep Learning***, MIT Press, 2016.	

Reference Books

1. C. M. Bishop, ***Pattern Recognition and Machine Learning***, Springer, 2006.
2. I. Goodfellow, Y. Bengio, and A. Courville, ***Deep Learning***, MIT Press, 2016.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Introduction to Machine Learning	Prof. Sudeshna Sarkar	IITKGP, IIT Kharagpur	https://nptel.ac.in/courses/106105152

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Teaching Scheme	**Machine Learning Lab** Course code: 26AF1246PEL609A	**Examination Scheme**	
2 Hrs / Week = Credit 1	**Course Outcomes (COs):** *Upon successful completion of this course, students will be able to:* **CO1:** Implement concept learning algorithms (Find-S, CEA) to generate and evaluate hypotheses. **CO2:** Apply classification, regression, and clustering algorithms to solve ML problems. **CO3:** Implement PCA for dimensionality reduction and Study overfitting and regularization techniques. **CO4:** Apply feature engineering, PCA/LDA, model evaluation, and regularization techniques to improve and select ML models. **CO5:** Build and evaluate ANN and CNN , RNN models for prediction and pattern recognition.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs/PSOs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	-	-	1	-	-	-	1	-	2	2	1	-
CO2:	3	3	2	2	3	-	-	-	-	-	1	3	3	-
CO3	2	3	2	3	3	-	-	-	-	-	1	3	3	-
CO4:	3	2	3	2	3	-	-	1	-	-	2	3	3	1
CO5:	3	3	3	3	3	1	1	1	1	-	2	3	3	2

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

List of Experiments:

1. Implementation of Find-S Algorithm for concept learning and hypothesis generation.
2. Implementation of Candidate Elimination Algorithm (CEA) for version space learning.
3. Implementation of Classification Algorithms for supervised learning tasks.
4. Implementation of Regression Algorithms for predictive modeling.
5. Implementation of Unsupervised Learning Algorithms for clustering and pattern discovery.
6. Implementation of Principal Component Analysis (PCA)
7. Training and Testing of Machine Learning Models
8. Case Study on Model Selection
9. Implementation of Artificial Neural Networks (ANNs) for classification and prediction problems.
10. Implementation of Convolutional Neural Networks (CNNs) for image-based learning applications.
11. Case Study on Machine Learning Applications – I using real-world datasets.
12. Case Study on Machine Learning Applications – II involving analysis, model development, and performance evaluation
13. **Mini Project:** Design and implementation of a Machine Learning/Deep Learning solution for a real-world problem.

Note:

1. The above list is for illustration purposes only. The course coordinator may update or change the list as needed,
2. At least **8** to**10** experiments should be performed.
3. Students should be encouraged to design and perform new experiments, subject to prior approval from the respective subject authority.

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Teaching Scheme		Generative AI & Prompt Engineering Course code: **26AF1246PE608B**	Examination Scheme	
TH	3	**Prerequisite Courses:** Programming fundamentals	CA	20
PR	-	**Course Objectives:**	MSE	20
CR	3	**1.** To understand the fundamentals of Artificial Intelligence, Machine Learning, Deep Learning, and Generative AI. **2.** To learn the architecture and working principles of Large Language Models (LLMs) and foundation models. **3.** To develop effective prompt engineering skills for various Generative AI applications. **4.** To explore text, image, audio, video, and code generation using modern Generative AI tools. **5.** To understand ethical, legal, security, and societal aspects of Generative AI deployment.	ESE	60
			TOTAL	100
		Course Outcomes (COs): *At the end of Course Students will be able.* **CO1:** Explain the concepts, architecture, and applications of Generative AI and Large Language Models. **CO2:** Analyze the working principles of foundation models, embeddings, tokenization, and transformer-based architectures. **CO3:** Design and optimize prompts using advanced prompt engineering techniques for different AI tasks. **CO4:** Apply Generative AI tools for text, image, audio, video, and code generation in real-world applications. **CO5:** Evaluate ethical, security, legal, and societal implications associated with Generative AI technologies.		

CO-PO Mapping:

COs \ POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	2	-	1	2	-	-	-	-	-	1	2	2	-
CO2	3	3	-	3	2	-	-	-	-	-	1	2	2	-
CO3	2	2	3	2	3	-	-	1	1	-	1	3	3	1
CO4	2	2	3	2	3	1	-	1	2	1	1	3	3	1
CO5	1	2	1	2	1	3	3	1	2	-	2	1	1	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Generative AI** Evolution of AI, Machine Learning, Deep Learning, and Generative AI , Overview of Generative AI ecosystem , Foundation Models and Large Language Models (LLMs) , Transformer Architecture Basics , Applications of Generative AI in education, healthcare, business, and research , Introduction to ChatGPT, Gemini, Claude, and other AI assistants	07 Hrs
2	**Large Language Models and Generative AI Technologies:** Natural Language Processing Fundamentals,Working of LLMs ,Training, Fine-tuning, and Inference ,Tokenization and Embeddings ,Retrieval-Augmented Generation (RAG) ,Open-source vs Proprietary AI Models ,Overview of GPT, LLaMA, Mistral, Gemini, and Claude models.	07 Hrs
3	**Prompt Engineering Fundamentals:** Introduction to Prompt Engineering ,Prompt Design Principles ,Zero-shot, One-shot, and Few-shot Prompting , Chain-of-Thought Prompting ,Role-based Prompting ,Context Engineering, Prompt Optimization Techniques ,Evaluation of Prompt Quality	07 Hrs
4	**Multimodal Generative AI Applications:** Text-to-Text Generation ,Text-to-Image Generation ,Text-to-Audio and Speech Synthesis ,Text-to-Video Generation ,AI-assisted Coding and Programming ,AI Agents and Autonomous Systems ,Use Cases in Research, Education, Healthcare, and Industry	07 Hrs
5	**Ethics, Security, and Future Trends in Generative AI:** Responsible AI and AI Governance ,Bias, Fairness, and Explainability ,Hallucinations in LLMs ,Data Privacy and Security Concerns ,Copyright and Intellectual Property Issues ,AI Regulations and Compliance ,Emerging Trends in Generative AI ,Future Scope and Career Opportunities.	07 Hrs
	Text Books 1. A. Ng, ***Generative AI for Everyone***, DeepLearning.AI, 2024. 2. J. Tunstall, L. von Werra, and T. Wolf, ***Hands-On Large Language Models***, O'Reilly Media, 2024. 3. V. Rajan, ***Building LLM Powered Applications***, O'Reilly Media, 2024. **Reference Books** 1. L. Tunstall, L. von Werra, and T. Wolf, ***Natural Language Processing with Transformers***, O'Reilly Media, 2022. 2. I. Goodfellow, Y. Bengio, and A. Courville, ***Deep Learning***, MIT Press, 2016. 3. S. Russell and P. Norvig, ***Artificial Intelligence: A Modern Approach***, 4th ed., Pearson, 2021.	

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Prompt Engineering	Dr. Sagar Gulati	JAIN (Deemed to be University), Bangalore	https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg131
02	Generative AI for Everyone	Andrew Ng	DeepLearning.AI	https://www.deeplearning.ai/courses/generative-ai-for-everyone

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Teaching Scheme	Generative AI & Prompt Engineering Lab Course code: 26AF1246PEL609B	Examination Scheme	
2 Hrs / Week = Credit 1	**Prerequisite Courses:** **1**.Programming fundamentals **Course Objectives:** **1.** To understand the fundamentals of Artificial Intelligence, Machine Learning, Deep Learning, and Generative AI. **2.** To learn the architecture and working principles of Large Language Models (LLMs) and foundation models. **3.** To develop effective prompt engineering skills for various Generative AI applications. **4.** To explore text, image, audio, video, and code generation using modern Generative AI tools. **5.** To understand ethical, legal, security, and societal aspects of Generative AI deployment. **Course Outcomes (COs):** *After successful completion of the laboratory, students will be able to:* **CO1:** Explain the concepts, architecture, and applications of Generative AI and Large Language Models. **CO2:** Analyze the working principles of foundation models, embeddings, tokenization, and transformer-based architectures. **CO3:** Design and optimize prompts using advanced prompt engineering techniques for different AI tasks. **CO4:** Apply Generative AI tools for text, image, audio, video, and code generation in real-world applications. **CO5:** Evaluate ethical, security, legal, and societal implications associated with Generative AI technologies.	**CA**	**60**
		MSE	**-**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	1	2	-	-	-	-	-	1	2	2	-
CO2	3	3	-	3	2	-	-	-	-	-	1	2	2	-
CO3	2	2	3	2	3	-	-	1	1	-	1	3	3	1
CO4	2	2	3	2	3	1	-	1	2	1	1	3	3	1
CO5	1	2	1	2	1	3	3	1	2	-	2	1	1	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Exp. No.	List of Experiments:	CO
1	**Introduction to Generative AI Tools** **Objective** • Familiarize students with popular Generative AI platforms. **Activities** • Create accounts • Explore interfaces • Compare responses	**CO1**
2	**Prompt Engineering Basics** **Objective** • Learn Zero-shot prompting. **Activities** • Create prompts • Compare outputs • Analyze quality Eg. Pick one of the quotes below and translate it into another language that you're familiar with. • A rose by any other name would smell as sweet. By William Shakespeare • That's one small step for a man, a giant leap for mankind. By Neil Armstrong • Speak softly and carry a big stick. By Theodore Roosevelt • Life is like riding a bicycle. To keep your balance, you must keep moving. By Albert Einstein	**CO1**
3	**Few-shot and One-shot Prompting** **Objective** • Design few-shot prompts. **Activities** • Text classification • Sentiment analysis • Question answering	**CO2**

		
4	**Chain of Thought Prompting** **Objective** • Generate reasoning-based solutions. **Activities** • Mathematical reasoning • Logical problems • Stepwise explanations To practice and understand advanced prompt engineering techniques, including prompts for programmers, marketing, customer care, chain-of-thought reasoning, and perspective-based prompts.	**CO2**
5	**Role-based Prompting** **Objective** • Use AI as an expert. **Activities** • Teacher • Software Engineer • Researcher • Doctor	**CO3**

6	**Text Summarization and Translation** **Objective** • Perform NLP tasks. **Activities** • Summarization • Translation • Grammar correction	**CO3**
7	**Text-to-Image Generation** **Objective** • Generate images using AI. **Tools** • DALL·E • Gemini • Microsoft Designer	**CO4**
8	**Research Paper Assistance** **Objective** • Use AI in academic writing. **Activities** • Literature review • Abstract generation • Citation assistance	**CO4**
9	**Resume and Cover Letter Generation** **Objective** • Create professional documents.	**CO5**

10	**AI for Data Analysis** **Objective** • Generate Python code. **Activities** • Data visualization • Statistics • CSV analysis	**CO5**
	Text Book: 1. Generative AI For Everyone – Andrew Ng, DeepLearning.AI, 2024. 2. Hands-On Large Language Models, O'Reilly Media, 2024. 3. Building LLM Powered Applications, O'Reilly Media, 2024. **Reference Books:** 1. Natural Language Processing with Transformers, O'Reilly Media. **2.** Deep Learning, MIT Press. **3.** Artificial Intelligence: A Modern Approach, Pearson	

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Teaching Scheme		Augmented Reality & Virtual Reality Course code: 26AF1246PEL608C	Examination Scheme	
TH	3	Course Objectives: 1. To study concepts of Augmented Reality 2. To gain knowledge of various input and output devices required for interacting in virtual world 3. To explain AR techniques 4. To know Virtual Reality and its applications **Course Outcomes:** *At the end of Course Students will be able.* **CO1:** Explain the concepts of the Augmented Reality (AR). **CO2:** Describe architecture of AR **CO3:** Interpret different AR techniques **CO4:** Describe fundamental principles of Virtual Reality (VR) **CO5:** Outline Human Factors in VR Evaluations.	CA	20
PR	2		MSE	20
CR	1		ESE	60
			TOTAL	100

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	1	–	1	–	–	–	–	–	2	3	1	–
CO2	3	3	2	1	2	–	–	1	–	–	2	3	2	1
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–
CO5	3	2	1	1	2	–	–	–	–	–	2	3	2	–

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Augmented Reality:** Introduction to Augmented Reality, History of Augmented Reality, Taxonomy, Technology and Features of Augmented Reality, Difference Between AR and VR, Challenges With AR, AR Systems and Functionality, Augmented Reality Methods, Visualization Techniques For Augmented Reality, Mobile Projection Interfaces.	06 Hrs
2	**AR & VR Architecture**: Audio Displays, Haptic Displays, Visual Displays, Visual Perception, Spatial Display Model. Tracking, Sensors Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.	08 Hrs
3	**AR Techniques:** Introduction to Marker Based Approach, Marker-Based Tracking, Types of Markers, Marker Camera Pose and Identification, Visual Tracking, Marker Types, Template Markers, 2D Barcode Markers, Imperceptible Markers. Marker Less Approach, Localization Based Augmentation, Real World Examples, Tracking Methods Visual Tracking, Feature Based Tracking, Hybrid Tracking, Initialization and Recovery	08 Hrs
4	**Introduction to Virtual Reality**: Introduction to Virtual Reality, The three I's of virtual reality, Commercial VR technology, five classic components of a VR system. Input Devices, Trackers, Navigation, Gesture Interfaces, Three-dimensional position trackers, Manipulation Interfaces, Output Devices, Graphics displays, Sound displays, Haptic feedback	08 Hrs
5	**VR Applications**: Testbed Evaluation of Universal VR Tasks, VR Health and Safety Issues, Direct Effects of VR Simulations on User, VR in social aspects. VR applications in industry, Medical applications, Military applications, Robotics applications.	06 Hrs
	Text Books 1. S. Aukstakalnis, ***Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR***, Addison-Wesley. 2. R. Chopra, ***Virtual and Augmented Reality***, Khanna Book Publishing, 2021.	

Reference Books

1. G. C. Burdea and P. Coiffet, ***Virtual Reality Technology***, 2nd ed., Wiley-IEEE Press, 2006.
2. S. M. LaValle, ***Virtual Reality***, Cambridge University Press, 2016.
3. G. J. Kim, ***Designing Virtual Systems: The Structured Approach***, Springer, 2005.
4. W. R. Sherman and A. B. Craig, ***Understanding Virtual Reality: Interface, Application, and Design***, Morgan Kaufmann, 2002.

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Foundation for Virtual and Augmented Reality Systems	Prof Samit Bhattacharya	IIT Guwahati	https://nptel.ac.in/courses/106103842

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Teaching Scheme	**Augmented Reality & Virtual Reality Lab** Course code: 26AF1246PEL609C	**Examination Scheme**	
2 Hrs / Week = Credit 1	**Course Outcomes:** *After successful completion of the laboratory, students will be able to:* **CO1:** Make use of AR and VR development tools. **CO2:** Demonstrate the use of AR, VR, and MR devices. **CO3:** Design and develop AR/VR game scenes. **CO4:** Build AR and/or VR applications.	**CA** **ESE** **TOTAL**	**20** **40** **100**

CO-PO Mapping:

COs \ POs / PSOs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PSO 3**
CO1	3	2	1	1	3	–	–	1	–	–	2	3	3	1	3
CO2	3	3	2	2	2	–	–	1	–	–	2	3	2	1	3
CO3	3	3	2	2	2	–	1	1	–	–	2	3	2	1	3
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	–	3
CO5	3	2	1	1	3	–	1	1	–	–	2	3	3	1	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

	Laboratory Experiments / Assignments	CO1
	1. Study of various AR & VR Development tools such as UNITY 3D IDE and its documentation.	
	2. Create a C# script that plays a video when an image is scanned using AR App (AR Core & Unity).	CO3
	3. Develop & Deploy a simple marker-based AR app in which you have to write a C# program to play video on tracking a particular marker.	CO3,CO4
	4. Design and Develop the following using Vuforia Engine developer	

	portal: I. Plane detection II. Marker based Tracking (Create database of objects to be tracked in Vuforia) III. Object Tracking and deploy it on AR devices	CO3,CO4
	5. Demonstration of the working of HTC Vive, Oculus Quest 2, Microsoft Hololens2	CO2
	6. Develop a scene in Unity that includes: I. A cube, plane and sphere, apply transformations on the 3 game. objects. II. Add a video and audio source.	CO4
	7. Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the color and Material/texture of the game objects dynamically on button click	CO4
	8. Develop and deploy a VR app, Add interactive elements to the environment, such as objects that can be picked up, manipulated, or triggered by the user's actions	CO4
	9. A. Create a multiplayer VR game (battlefield game). The game should keep track of score, no. of chances/lives, levels (created using different scenes), involve interaction, animation and immersive environment. OR B. Create a treasure hunt AR application which should have the following features: • A help button for instruction box to appear • A series of markers which would give hints on being scanned • Involve interaction, sound, and good UI OR C. Evaluate an existing VR application or a VR game.	CO1 to CO4

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Teaching Scheme	Mini Project-2 Course code: **26AF1246ELC610**	Examination Scheme	
2 Hrs / Week = Credit 1	**Course Objectives:** *The course aims to enable students to:* 1. Extend the proposed solution into a complete software product with advanced features. 2. Apply software engineering practices for implementation, testing, validation, and deployment. 3. Integrate modern tools and emerging technologies to solve complex engineering problems. 4. Develop project management, entrepreneurship, innovation, and research skills. 5. Present and demonstrate the completed project professionally. **Course Outcomes (COs):** *After successful completion of the course, students will be able to:* **CO1:** Implement and integrate all modules of the proposed system using appropriate technologies. **CO2:** Evaluate system performance through testing, validation, optimization, and quality assurance techniques. **CO3:** Demonstrate the completed project with proper documentation, deployment, and user manual while considering security, ethics, and sustainability. **CO4:** Exhibit professional competence through teamwork, project management, communication, lifelong learning, and innovation.	**CA**	**60**
		ESE	**40**
		TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	3	3	2	3	-	-	-	2	2	1	3	3	2
CO2	3	2	2	3	3	1	1	-	2	2	2	3	3	2
CO3	2	2	2	2	3	2	2	3	2	3	2	2	3	3
CO4	1	1	1	-	2	2	1	3	3	3	3	2	2	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

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Syllabus of Minor (MDM) in IT Courses offered by Department of Information Technology at Third Year B.Tech Level

Teaching Scheme		Multidisciplinary Minor-3 Machine learning Course code: **25AF1246MD506**	Examination Scheme	
TH	3	**Prerequisite - Engineering Mathematics -II**	CA	20
PR	-	**Course Objectives:** 1. Understand data pre-processing, wrangling, and visualization techniques. 2. Learn machine learning concepts and learning paradigms. 3. Apply supervised learning algorithms for prediction and classification. 4. Apply clustering techniques for pattern discovery. 5. Evaluate and improve machine learning models.	MSE	20
CR	3		ESE	60
			TOTAL	100
		Course Outcomes (COs): *At the end of Course Students will be able.* **CO1:** Apply data pre-processing and visualization techniques. **CO2:** Explain machine learning concepts and learning types. **CO3:** Implement supervised learning algorithms for classification and regression. **CO4:** Apply clustering algorithms to analyse unlabelled data. **CO5:** Evaluate machine learning models using validation and performance measures.		

CO-PO Mapping:

COs \ POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	2	2	-	3	3	-	-	-	-	-	1	2	3	-
CO2	3	2	-	1	1	-	-	-	-	-	2	2	1	-
CO3:	3	3	2	2	3	-	-	-	-	-	2	3	3	-
CO4:	3	3	1	3	3	-	-	-	-	-	2	3	3	-
CO5:	2	3	1	3	2	-	-	-	-	-	2	3	2	-

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Data and visualization:** Types of Digital Data: Classification of Digital Data, Structured versus Unstructured Data. Dataset Sources- kaggle, google dataset, **Data** pre-processing and wrangling. Data visualization with Pie Chart, Tree Map, Heat Map, Scatter Plot, Histogram, Word Cloud, Box Plot.	06 Hrs
2	**Introduction-** Overview of ML, types of learning (supervised, unsupervised, and reinforcement), and applications. AI vs ML vs Data Science, traditional programming vs ML paradigm, and real-world engineering applications. Concept Learning, Evaluating Hypothesis.	06 Hrs
3	**Supervised machine Learning:** Decision trees, Naïve Bayes classifier, SVM**,** k-Nearest Neighbors (k-NN), Regression- logistic and linear regression algorithm.	09 Hrs
4	**Unsupervised machine Learning: Introduction** to clustering, need for clustering**,** types of clustering, K-Means clustering, Hierarchical Clustering.	06 Hrs
5	**Model Evaluation and Selection:** Feature engineering, Train-test split, K-fold cross validation, Performance measure, and Feature importance, Bias-variance trade off, Regularization.	08 Hrs
	Text Books 1. T. M. Mitchell, ***Machine Learning***, McGraw-Hill Education, 2013. 2. M. Kubat, ***An Introduction to Machine Learning***, Springer. 3. I. Goodfellow, Y. Bengio, and A. Courville, ***Deep Learning***, MIT Press, 2016. **Reference Books** 1. C. M. Bishop, ***Pattern Recognition and Machine Learning***, Springer, 2006. 2. I. Goodfellow, Y. Bengio, and A. Courville, ***Deep Learning***, MIT Press, 2016.	

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	**Introduction to Machine Learning**	Prof. Sudeshna Sarkar	**IITKGP, IIT Kharagpur**	https://nptel.ac.in/courses/106105152

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Teaching Scheme		Multidisciplinary Minor-4 Cloud Computing Course code: **26AF1246MD506**	Examination Scheme	
TH	**3**	**Prerequisite Courses:** 1. Database Management System	**CA**	**20**
PR	**-**		**MSE**	**20**
CR	**3**	**Course Objectives:** 1. To learn the concept of cloud computing. 2. To understand the trade-off between deploying applications in the cloud over local infrastructure. 3. To identify different storage virtualization technologies and their benefits. 4. To understand and articulate business continuity solutions including backup and recovery technologies, local and remote replication solutions.	**ESE**	**60**
			TOTAL	**100**
		Course Outcomes (COs): *Upon successful completion of this course, students will be able to:* **CO1:** To understand the key dimensions of the challenge of Cloud Computing. **CO2:** To assess the economics, financial and technological implications for selecting cloud computing for organization. **CO3:** To describe and apply storage technologies. **CO4:** To identify leading storage technologies that provide cost-effective IT solutions for medium to large scale businesses and data centers. **CO5:** To describe important storage technology features such as availability, replication, scalability and performance		

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	1	–	1	–	–	–	–	–	2	2	1	–
CO2	2	3	2	2	1	2	–	–	–	3	2	2	1	–
CO3	3	2	2	1	3	–	–	–	–	–	1	3	3	–
CO4	3	3	3	2	3	1	–	–	–	1	1	3	3	–
CO5	3	2	3	2	3	–	–	–	–	–	2	3	3	1

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Basics of Cloud Computing :** What is Cloud Computing, Traditional vs Cloud computing, Roots Of Cloud Computing Features of cloud (on-demand, scalable, pay-per-use) , Advantages and disadvantages , Real-life examples.	08 Hrs
2	**Types of Cloud and Services :** Public Cloud, Private Cloud, Hybrid Cloud\, Simple comparison, IaaS (Infrastructure as a Service) , PaaS (Platform as a Service) , SaaS (Software as a Service) , Simple examples of each.	07 Hrs
3	**Virtualization:** What is virtualization, Need of virtualization, Virtual machines (VM) , Hypervisor (basic idea), Types of Hypervisor and Issues with Multi-tenancy, Storage virtualization, Challenges, Types of storage virtualization.	07 Hrs
4	**Cloud storage types** Object storage, Block storage, File storage, Distributed file systems, Data replication and consistency, Big Data in cloud, Introduction to NoSQL databases , Storage services.	08 Hrs
5	**Cloud Applications and Case studies** Applications: E-learning , E-commerce, Healthcare, Agriculture. Case studies: Netflix on AWS ,Google services , Cloud in IoT.	05 Hrs
	Text Books **1.** T. Erl, R. Puttini, and Z. Mahmood, ***Cloud Computing: Concepts, Technology & Architecture***, Pearson. **2.** R. Buyya, J. Broberg, and A. Goscinski (Eds.), ***Cloud Computing: Principles and Paradigms***, Wiley. **3.** B. Sosinsky, ***Cloud Computing Bible***, Wiley. **Reference Books** **1.** T. Velte, A. Velte, and R. Elsenpeter, ***Cloud Computing: A Practical Approach***, Tata McGraw-Hill.	

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/SWAYAM Courses Name	Instructor	Host Institute	Links
01	Cloud Computing	Prof. Soumya K. Ghosh	https://nptel.ac.in/courses/106105167	https://nptel.ac.in/courses/106105167

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Syllabus of Honor Courses (HON) offered by Information Technology at Third Year B.Tech Level

Teaching Scheme		Honor (HON) Courses-3 **Advanced Computer Architecture** Course code: **25AF1246HON503**	Examination Scheme	
TH	**3**	**Course Objectives:** 1. Understand modern processor architectures and execution techniques. 2. Analyze computer system performance using standard metrics. 3. Learn parallel processing concepts and multicore architectures. 4. Understand memory hierarchy and cache optimization techniques. 5. Explore multiprocessor systems and interconnection networks. **Course Outcomes (COs):** *After completing the course, students will be able to:* **CO1:** Explain the concepts and models of advanced computer architecture. **CO2:** Analyze and compare the performance of computer architectures. **CO3:** Design and evaluate pipelined architectures and hazard solutions. **CO4:** Apply memory hierarchy concepts to improve system performance. **CO5:** Demonstrate knowledge of parallel and distributed computing architectures.	**CA**	**20**
PR	**-**		**MSE**	**20**
CR	**3**		**ESE**	**60**
			TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	-	3	-	1	1	2	3	2	2
CO2	-	-	2	-	-	-	-	-	-	1	2	-	3	-
CO3	2	-	3	-	-	-	3	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	1	2	2	3	-	2
CO5	3	-	-	3	3	1	3	-	2	-	3	3	3	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**UNIT I: Processor Design Concepts :**Review of Basic Computer Organization, Performance Evaluation Methods, Introduction to RISC, Instruction Pipeline, Instruction Pipeline and Performance.	05 Hrs
2	**UNIT II: Instruction Pipeline Principles and Scheduling Techniques :** Pipeline Hazards and Analysis, Branch Prediction, MIPS Pipeline for Multi-Cycle Operations, Compiler Techniques to Explore Instruction Level Parallelism, Dynamic Scheduling with Tomasulo's Algorithm, Speculative Execution.	07 Hrs
3	**UNIT III: Superscalar Processing :**Advanced Pipelining and Superscalar Processors, Exploiting Data Level Parallelism, Vector and GPU Architectures, Architectural Simulation using gem5.	05 Hrs
4	**UNIT IV: Cache Memory Principles and Cache Memory Optimizations:** Introduction to Cache Memory, Block Replacement Techniques and Write Strategy, Design Concepts in Cache Memory, Basic and Advanced Optimization Techniques in Cache Memory, Cache Optimization using gem5.	08 Hrs
5	**UNIT V: Primary and Secondary Storage Systems, Tiled Chip Multicore Processors :**Introduction to DRAM System, DRAM Controllers and Address Mapping, Secondary Storage Systems, Design Concepts in DRAM and Hard Disk, Tiled Chip Multicore Processors (TCMP), Routing Techniques in Network on Chip (NoC), NoC Router Microarchitecture, TCMP and NoC: Design and Analysis, Future Trends in Computer Architecture Research.	
	Text Books 1. J. L. Hennessy and D. A. Patterson, ***Computer Architecture: A Quantitative Approach***, Morgan Kaufmann. 2. K. Hwang, ***Advanced Computer Architecture: Parallelism, Scalability, Programmability***, McGraw-Hill Education. 3. D. A. Patterson and J. L. Hennessy, ***Computer Organization and Design: The Hardware/Software Interface***, Morgan Kaufmann. **Reference Books** 1. D. E. Culler and J. P. Singh, ***Parallel Computer Architecture: A Hardware/Software Approach***, Morgan Kaufmann. 2. J. P. Shen and M. H. Lipasti, ***Modern Processor Design: Fundamentals of Superscalar Processors***, Waveland Press.	

Alternative NPTEL/SWAYAM Digital Reference

Sr.No.	NPTEL/ SWAYAM Courses Name	Instructor	Host Institute	Links
1.	Advanced Computer Architecture	PROF.JOHN JOSE /	IIT Guwahati	https://nptel.ac.in/courses/106102229

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Teaching Scheme		Honor (HON) Courses-4 Mobile Computing Course code: **25AF1246HON604**	Examination Scheme	
TH	**3**	**Course Objectives:**	**CA**	**20**
PR	**-**	**1.** Understand the fundamentals of wireless communication and mobile computing.	**MSE**	**20**
CR	**3**	**2.** Explain mobile communication architectures and technologies.	**ESE**	**60**
		3. Analyze GSM, CDMA, and 4G mobile networks.	**TOTAL**	**100**
		4. Apply Mobile IP, MANET, and transport layer protocols.		
		5. Understand data dissemination and synchronization in mobile computing**.**		
		Course Outcomes (COs): *At the end of Course Students will be able.* **CO1:** Explain wireless communication and mobile computing concepts. **CO2:** Describe mobile computing architecture and mobile communication technologies. **CO3:** Analyze GSM, CDMA, WCDMA, and 4G network architectures. **CO4:** Apply Mobile IP, transport protocols, and MANET routing techniques. **CO5:** Explain data dissemination, synchronization, and security mechanisms in mobile computing.		

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	2	-	-	1	-	-	-	-	-	1	3	2	-
CO2	3	2	1	-	2	-	-	-	-	-	1	3	3	-
CO3	3	3	1	1	2	-	-	-	-	-	1	3	3	1
CO4	2	3	2	2	3	-	-	-	-	-	1	3	3	2
CO5	2	3	2	2	3	-	-	-	2	-	2	3	3	2

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	Fundamentals of Wireless and basics of wireless network: Digital communication, Wireless communication system and limitations, Wireless media, Frequency spectrum, Technologies in digital wireless communication, Wireless communication channel specification, Wireless network, Wireless switching technology, Wireless communication.	07 Hrs
2	Mobile Communications and Computing: An Overview Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Data Dissemination, Mobility Management, Security, Hand-held Pocket Computers, Hand-held Devices: Operating Systems, Smart Systems, Limitations of Mobile Devices, Automotive Systems.	07 Hrs
3	GSM and other architectures: GSM-Services and System Architectures, Radio Interfaces, Protocols Localization, Calling, Handover, Security, New Data Services, modulation, Multiplexing, Controlling the medium access, Spread spectrum, Coding methods, CDMA, IMT 2000, WCDMA and CDMA 2000, 4G Networks.	07 Hrs
4	Mobile Network and Transport Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route optimization, Dynamic Host Configuration Protocol, Mobile Transport Layer, Conventional TCP/IP Transport Layer Protocol, Indirect TCP, Snooping TCP, Mobile TCP, Mobile Ad-hoc Networks (MANET), Routing and Routing Algorithms in MANET, Security in ad-hoc networks.	07 Hrs
5	Data Dissemination and Data Synchronization in Mobile Computing: Communication Asymmetry, classification of data delivery mechanism, data dissemination broadcast models, selective tuning and indexing techniques, synchronization, synchronization software for mobile devices, synchronization protocols.	07 Hrs.
	Text Books 1. R. Kamal, ***Mobile Computing***, 2nd ed., Oxford University Press, New Delhi. 2. S. K. S. Manvi and M. S. Kakkasageri, ***Wireless and Mobile Networks: Concepts and Protocols***, Wiley India. **Reference Books** 1. M. Ciampa, ***Guide to Designing and Implementing Wireless LANs***, Thomson Learning, Vikas Publishing House, 2001. 2. R. Rischpater, ***Wireless Web Development***, Springer. 3. S. Singhal, ***The Wireless Application Protocol***, Pearson. 4. P. Stavroulakis, ***Third Generation Mobile Telecommunication Systems***, Springer.	

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Syllabus of Double Minor Courses (DM) offered by Information Technology in at Third Year B.Tech Level

Teaching Scheme		Double Minor (DM) Courses -3 IT Service Management (ITSM) Course code: **25AF1246DM503**	Examination Scheme	
TH	**3**	**Course Objectives:** 1. Uderstand IT Infrastructure and IT Service Management concepts. 2. Learn ITIL service delivery and support processes. 3. Understand storage, security, and disaster recovery management. 4. Apply ITSM practices to improve IT service quality and efficiency. **Course Outcomes (COs):** *At the end of Course Students will be able.* **CO1:** Explain IT infrastructure and ITSM concepts ***CO2:*** Apply ITIL service delivery and support processes. **CO3:** Analyze storage, backup, and disaster recovery management. **CO4:** Evaluate IT security and access control mechanisms. **CO5:** Recommend ITSM solutions to improve service quality and organizational efficiency.	**CA**	**20**
PR	**-**		**MSE**	**20**
CR	**3**		**ESE**	**60**
			TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	–	–	1	–	–	–	–	–	–	3	2	–
CO2	2	3	2	–	3	–	–	–	1	1	–	3	3	–
CO3	2	3	–	2	3	–	–	–	–	–	–	3	3	2
CO4	2	3	–	2	3	1	–	2	–	–	–	3	3	2
CO5	2	3	3	2	3	1	–	1	2	2	1	3	3	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	IT Infrastructure: Introduction, Challenges in IT Infrastructure Management, Design Issues of IT Organizations and IT Infrastructure, IT System Management Process, IT Service Management Process, Information System Design Process.	07 Hrs
2	Service Delivery Process: Service Level Management, Financial Management, IT Service Continuity Management, Capacity Management & Availability Management. Service Support Process: Configuration Management, Incident Management, Problem Management, Change Management & Release Management.	08 Hrs
3	Storage Management: Storage, Backup, Archive and Retrieve, Disaster Recovery, Space Management, Database and Application Protection and Data Retention.	07 Hrs
4	Security Management: Computer Security, Internet Security, Physical Security, Identity Management, Access Control System and Intrusion Detection.	07 Hrs
5	Case Studies on how IT Service Management and ITIL processes make IT efficient and save cost for organizations.	06 Hrs.
	Text Books 1. P. Gupta, S. Prakash, and U. Jayaraman, ***IT Infrastructure and Its Management***, Tata McGraw-Hill Education, 2009. **Reference Books** 1. W. R. Hudson, R. C. G. Haas, and W. Uddin, ***Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation***, McGraw-Hill, 1997. 2. A. Sengar, ***IT Infrastructure Management***, 2nd ed., S. K. Kataria & Sons, 2009.	

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Teaching Scheme		Double Minor (DM) Courses-4 DevOps (Development and operations) Course code: **25AF1246DM604**	Examination Scheme	
TH	**3**	**Course Objectives:** 1. Understand DevOps principles, culture, and lifecycle. 2. Learn version control, CI/CD, and automation techniques. 3. Apply containerization, orchestration, and cloud technologies. 4. Use Infrastructure as Code (IaC), configuration management, and monitoring tools. 5. Develop automated software development, testing, and deployment pipelines. **Course Outcomes (COs):** *At the end of Course Students will be able.* **CO1:** Explain DevOps concepts, lifecycle, and version control. **CO2:** Apply CI/CD, build automation, and testing tools. **CO3:** Implement containers, orchestration, cloud, and IaC solutions. **CO4:** Apply monitoring, logging, security, and DevSecOps practices. **CO5:** Develop an end-to-end automated DevOps pipeline using industry tools.	**CA**	**20**
PR	**-**		**MSE**	**20**
CR	**3**		**ESE**	**60**
			TOTAL	**100**

CO-PO Mapping:

COs \ POs / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 7	PS O1	PS O2	PSO 3
CO1	3	2	-	-	2	-	-	-	2	2	1	2	3	2	-
CO2	3	3	2	2	3	-	-	-	2	2	2	2	3	3	2
CO3	3	3	3	2	3	-	-	-	2	2	2	2	3	3	3
CO4	2	3	2	3	3	2	1	2	2	2	2	2	3	3	3
CO5	3	3	3	3	3	2	1	2	3	3	3	3	3	3	3

Note: Values in the matrix represent the level of correlation between COs and POs/ PSOs:**1**–Low, **2**–Medium, **3**–High.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to DevOps and Version Control:** Introduction to DevOps, Evolution of DevOps, DevOps Principles, Benefits and Challenges, DevOps Culture, Agile and Lean Concepts, Software Development Life Cycle (SDLC), Continuous Feedback, DevOps Lifecycle, Collaboration between Development and Operations Teams, Version Control Systems, Git Architecture, Git Commands, GitHub, Branching and Merging Strategies, Pull Requests, Repository Management.	07 Hrs
2	**Continuous Integration and Continuous Delivery (CI/CD):**Introduction to Continuous Integration, Continuous Delivery, Continuous Deployment, CI/CD Pipeline, Build Automation, Automated Testing, Build Management Tools, Jenkins Architecture and Pipeline, Maven, Gradle, Test Automation Frameworks, Unit Testing, Code Quality Analysis using SonarQube, Artifact Repository Management (Nexus), Release Management.	07 Hrs
3	**Containerization, Orchestration and Cloud :** Virtualization vs Containerization, Docker Architecture, Docker Images, Containers, Dockerfile, Docker Compose, Container Registry, Kubernetes Architecture, Pods, ReplicaSets, Deployments, Services, ConfigMaps, Secrets, Scaling and Load Balancing, Introduction to Cloud Computing, DevOps on AWS, Azure and Google Cloud Platform, Serverless Computing.	07 Hrs
4	**Infrastructure Automation and Configuration Management:** Infrastructure as Code (IaC), Terraform Fundamentals, Configuration Management Concepts, Ansible Architecture, Playbooks, Roles, Inventory Management, Puppet and Chef Overview, Automated Provisioning, Shell Scripting for Automation, Environment Management, Secret Management, DevOps Automation Workflows.	08 Hrs
5	**Monitoring, Logging, Security and DevSecOps :**Monitoring Concepts, Application Performance Monitoring, Logging and Log Management, Prometheus, Grafana, ELK Stack (Elasticsearch, Logstash, Kibana), DevSecOps Concepts, Security in CI/CD Pipeline, Vulnerability Assessment, Container Security, Static and Dynamic Application Security Testing (SAST & DAST), Compliance, Incident Management, Site Reliability Engineering (SRE), Case Studies and End-to-End DevOps Pipeline.	07 Hrs.
	Text Books 1. M. Krief, ***Learning DevOps: A Comprehensive Guide to Accelerating DevOps Culture Adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins***, 2nd ed., Packt Publishing, 2022.	

2. G. Kim, J. Humble, P. Debois, and J. Willis, ***The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations***, 2nd ed., IT Revolution Press, 2021.

3. J. Verona, ***Practical DevOps***, Packt Publishing.

Reference Books

1. J. Humble and D. Farley, ***Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation***, Addison-Wesley.

2. B. Burns, J. Beda, and K. Hightower, ***Kubernetes: Up & Running***, O'Reilly Media.

3. K. Morris, ***Infrastructure as Code: Dynamic Systems for the Cloud Age***, 2nd ed., O'Reilly Media.

4. J. Geerling, ***Ansible for DevOps***, Lean Publishing.

5. K. Matthias and S. P. Kane, ***Docker: Up & Running***, 3rd ed., O'Reilly Media.

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